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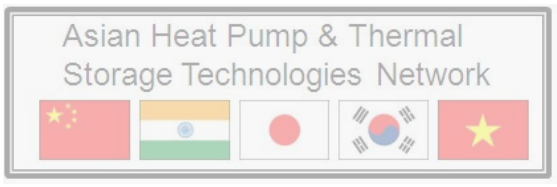
ASIAN HEAT PUMP & THERMAL STORAGE TECHNOLOGIES NETWORK

NEWSLETTER

APPROACH TOWARD ENERGY EFFICIENT BUILDING

～Special focus on Zero Energy Building～

CONTENT



ABSTRACTS

POLICY FOR NET ZERO ENERGY BUILDINGS IN KOREA

The policy fulfillment of countries for reduction of global greenhouse gases is speeding rapidly. Their response on the reduction of greenhouse gases in the past were mainly progressed up for defensive side, whereas recently countries are announcing their long-term goals and reinforcing on specific fulfillment plans competitively. The most important thing for actual fulfillment of greenhouse gases is to set the goal, construct policy which can fulfill the goal and provide ways for these policies to be fulfilled. These ways can move markets properly only when connected with definite economic indicators. This article introduces the existing policies on zero energy buildings in Korea, and the ultimate goal of greenhouse gases reduction of buildings, and through this, finds implications of Korea's furtherance direction.

APPROACH TOWARD ZEB IN JAPAN

ZEB (Net Zero Energy Building) is a building that emits zero CO2 on annual net basis by reducing the energy consumption through enhancement of the energy efficiency performance of the building envelop and facilities, networking on neighboring buildings, on-site utilization of renewable energy and so on. In Japan in order to examine the roadmap to realization and the dissemination of the ZEB a "Committee on Realization and Dissemination of ZEB" has been held and a report has been published in 2009. Focusing on the trends of final energy consumption, business & residential sector accounts for more than 30% and compare to transportation and industrial sector it has been increasing rapidly so the energy saving in this sector is most important. By introducing energy saving measure system for the buildings they proposed to realize ZEB as the standard for the new buildings by 2030.

TOWARDS NET ZERO ENERGY BUILDINGS IN CHINA

A common view of the building energy efficiency work is that the net zero energy building is an effective solution. China government at present has a series of policy in the building energy efficiency and reduces the GHG emission. Retrofitting the heating system, promote the compliance of the building energy efficiency standards, the huge public building energy usage metering, renewable energy application, all these measures toward to achieving a higher goal of building energy efficiency of China. This article introduces the contribution of China's building energy efficiency work up to now, then give the short term national plan of the next five-year period. The policy and technical road map to reach the goal are also introduced.

ABSTRACTS

APPROACH TOWARD ZEB IN INDIA

In India, Buildings in Residential and commercial sectors account for approximately one-third (33%) of total electricity consumption and this percentage will increase to 37% by 2021 due to rapid urbanization. Considering the amount of electricity consumed and its growth in building sector, it becomes quite evident that energy efficiency across the building sector is of utmost concern and is of prime importance. Net zero energy building is one of the solutions to combat this increase in electricity consumption. Currently in India, Government has many policies (like energy codes, star labeling of equipment, star rating of existing buildings and rating system for new buildings) which promote energy efficiency in buildings. However so far there has not been any specific policy or a well-defined government program to integrate these initiatives and promote a common NZEB strategy for the country.

PROMOTING ENERGY EFFICIENCY AND CONSERVATION FOR BUILDINGS IN VIETNAM

During the past ten years, electricity consumption in the residential and public commercial buildings in Vietnam has been in the order of 38-43% of the total final electricity use in the country. Within the framework of Vietnam National Energy Efficiency Program (VNEEP) for the period of 2006-2015, a number of policies and measures are recognized that aim at minimizing waste of energy in the industry, agriculture, transportation and construction sectors. However there has not been yet any specific strategies or policies to promote a so-called Zero Emission Building (ZEB) in the country. Instead, the Government and Ministries concerned has attempted to promote energy efficiency and conservation (EE&C) for the building sector.

POLICY FOR NET ZERO ENERGY BUILDINGS IN KOREA

Jun-Young CHOI, Republic of KOREA

Abstract: The policy fulfillment of countries for reduction of global greenhouse gases is speeding rapidly. Their response on the reduction of greenhouse gases in the past were mainly progressed up for defensive side, whereas recently countries are announcing their long-term goals and reinforcing on specific fulfillment plans competitively. The most important thing for actual fulfillment of greenhouse gases is to set the goal, construct policy which can fulfill the goal and provide ways for these policies to be fulfilled. These ways can move markets properly only when connected with definite economic indicators. This article introduces the existing policies on zero energy buildings in Korea, and the ultimate goal of greenhouse gases reduction of buildings, and through this, finds implications of Korea's furtherance direction.

Introduction

The policy fulfillment of countries for reduction of global greenhouse gases is speeding rapidly. Their response on the reduction of greenhouse gases in the past were mainly progressed up for defensive side, whereas recently countries are announcing their long-term goals and reinforcing on specific fulfillment plans competitively.

Kyoto Protocol ('08-'12) on global convention on climate change were lead by developed countries centering on OECD countries, but Post Kyoto Protocol from 2013 onwards, participation from almost all countries including China is expected. Although still the differences of their opinions between developed countries and developing countries for the settings and allocations of reduction goals is acute, important thing is regardless of international commitments, almost every countries choose greenhouse gases reduction as their first priority policy and are expanding on their specific plans. Greenhouse gases reduction from 2013 onwards is expected to work out new agreement on international reduction goals (For instance, in the range below 2℃ for global temperature rise, 450ppm for concentration of greenhouse gases) and countries to fulfill their duty on emission reduction from national dimension. Also the trend for carbon emission trade is switching its plan to activate carbon emission credit trade, not only a traditional trade between countries, but subdivided into industrial and local trade unit within countries. This means carbon emission will become essential factor in everyday industry acts.

The most important thing for actual fulfillment of greenhouse gases is to set the goal, construct policy which can fulfill the goal and provide ways for these policies to be fulfilled. These ways can move markets properly only when connected with definite economic indicators. This article introduces the existing policies on zero energy buildings in Korea, and the ultimate goal of greenhouse gases reduction of buildings, and through this, finds implications of Korea's furtherance direction.

Fundamental law on Low Carbon Green Growth and buildings

For greenhouse gases reduction, Korea turned national policy direction from passive response to active response, Low Carbon Green Growth, and the real promotion is expected to begin from taking effect of 2010 fundamental law on low carbon green growth. The past concept on greenhouse gases reduction focused on 'Low Carbon', but by adding another goal 'Green Growth', now carbon emission is becoming the most prior national goal, controlling the whole society including corporations and lives of nations.

'Fundamental law on Low Carbon Green Growth' which has been confirmed to be performed from April 2010, is the most significant law taking the charge of taking steps for Korea's greenhouse gases reduction. The followings are its main content.

- Policy for green industry support and promotion (Article 23)
- Establish technology and system for acceleration on recycling of resource (Article 24)
- Standardization of green technology and green industry (Article 32)
- Introduction to sectored energy goal management such as household and business (Article 42 Section 4, and Section 5)
- Introduction to carbon statistics, statistics management, and emission in response to climate change (Article 49)
- Responding to basic principles of green land, constructing energy and resource self-standing type carbon-neutral city (Article 51)
- Management on green building design criteria relevant to green building expansion, rating system, and emission (Article 54)

Fundamental law on Low Carbon Green Growth contains previous political points, and from those what should be focused is introduction to goal management. Goal management has two meanings; one is that it is individual goal management on corporations using lots of energy, and the other is managing thoroughly on the goal the country allocated industrially. For buildings, in order to manage effectively on allocated goals, monitoring on carbon emission on building's field or individual building is needed, and this is point connected with construction of energy statistics and management system organization.

The economic meaning of reduced carbon emission from emission introduction system means it is given by the nation or markets. Later on the markets will be formed in such a way to add on financial burdens, and this will be the most powerful cause on the effect on energy efficiency of buildings, directly but indirectly.

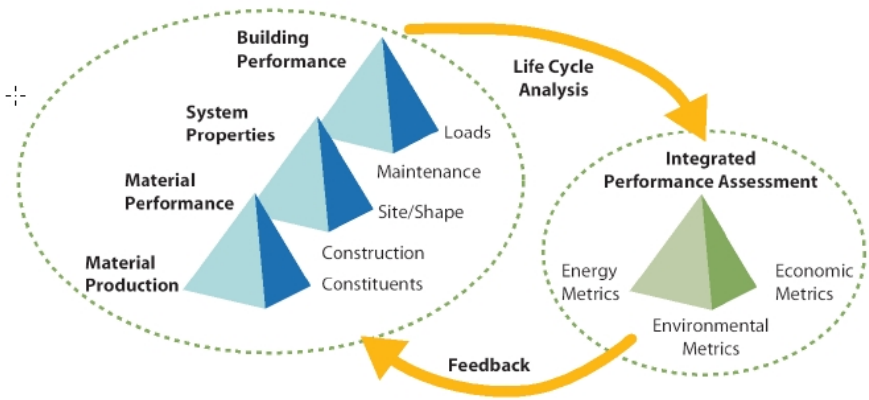


Figure 1.Strategy of Net Zero Energy House

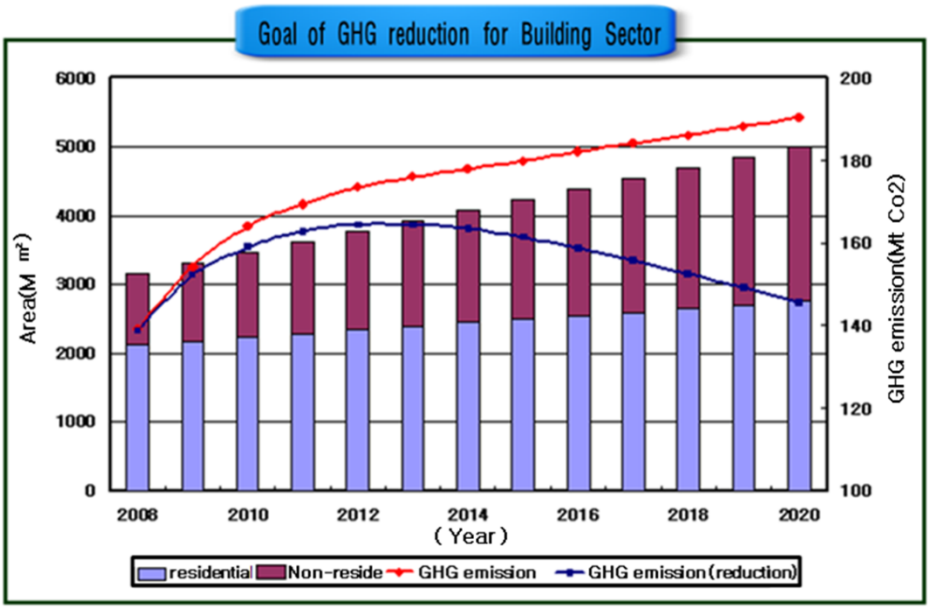


Figure 2.Goal of GHG reduction for Building Sector

Ways for Zero Energy Implementation and Roadmap

The ultimate goal of carbon emission reduction is zero energy building, but at this time countries are reporting similar conclusions on their report that it is still not cost-efficient. Also, as low-carbon emissions of existing buildings are more difficult, the importance of developing cost-effective ways is being emphasized. The view that it is more advantageous for carbon emission reduction in the dimension of power or local heat production, not only seeking for solutions to reduce carbon emission within buildings, is also being suggested. Nevertheless energy economic specialists are expecting carbon emission reduction in buildings will be much advantageous than other industries or transportations. The United Kingdom announced their goal to reduce 80% on greenhouse gases from every house until 2050, and this goal is being considered for other industries or transportations cannot achieve. Although their goal can be seen unrealistic, by looking at mid-term challenging goals the United Kingdom is suggesting, we feel the need to focus on the possibility of realistic promotions for innovative changes of houses and building industries. Previously, the increase of energy efficiency has been made progressively and there were no clear and visible goals. The policy suggestion from British government that they will construct zero carbon home to all new housings in 2016, with different speed from the past, it is leading building industry conversion. In most countries, low energy buildings are being implemented as a short-term goal previous of zero energy, but some countries aim for positive energy buildings or surplus buildings which produce additional energy more to how much buildings use annually. France is announcing that they will try their new constructions in 2020 to be energy positive buildings.

The full meaning of zero carbon buildings should aim that the building itself other than energy usage like heating and cooling, lighting, and hot-water supplies to not have a negative impact on the environment. Zero energy buildings being suggested by countries nowadays do not always include ‘green’ section which includes waste reduction and using recycled materials. The three forms of national program for carbon emission reduction of buildings can be divided into low energy buildings, zero energy buildings, and green buildings. When considering the current technology and the market costs, several cases other than domestic are being reported that zero energy buildings are not cost efficient, but from long-term dimension, counties are suggesting various scenario analysis for its realization and technology and policy road map.

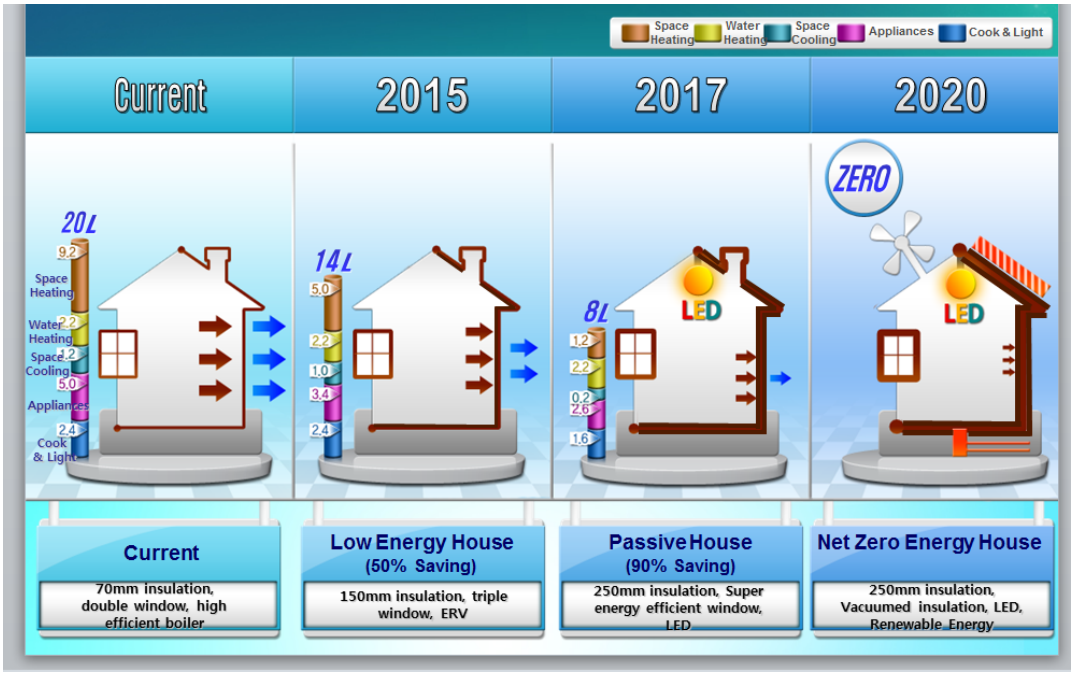


Figure 3.Steps to Net Zero Energy House

Some assumptions should be accompanied, but reports from developed countries show that in long-term analysis, the economic efficiency of zero energy buildings is high in comparison with investments, but in short-term, it is not an easy thing for all European countries to recommend low energy or zero energy, and problems such as expensive costs, lack of skilled specialists, and lack of preparation from construction industries is being pointed out for the causes. Looking at analysis results from the aspect of costs, it expected that there will be approximately 7%-15% cost rise for low energy buildings in European Union. This expectation does not contain all variables, and it is surely not a generalizing numerical as it did not consider distinct characteristics of individual countries (Government policy on carbon emissions, costs, and etc). Therefore at this time, it is urgent and important for countries to establish stable ways to make a roadmap to supply long-term low energy or zero energy buildings which fits one's country's state.

Conclusion

In order to fulfill greenhouse gases reduction properly, the first thing is the setting of national reduction goals. As there were no specific goals, it can be seen that 'Low-speed low carbon policy' were performed until now. Korea has announced their carbon emission goals for the nation, and fundamental law on low carbon green growth has also been confirmed. Now, the only thing left is to find clear and deliberate ways to fulfill it.

The carbon emission reduction goal of buildings is set to a higher level than other industries, and for houses, it presented to obligate zero energy houses from 2020 and zero energy building dissemination from 2025 onwards. This goal is almost the same level with Europe and other developed countries. It is obviously a difficult thing to implement every zero energy buildings after 10–15years from now on, but goal setting is important. It is because if the goal is set, progressive goals will be made, and progressive plans, priorities of required skills and required budget can be set. Due to properties of the technology development, it is a definite fact that zero energy buildings will sometimes be generalized in markets. The problem is its speed. Decision making on shortening time on what will be done after 50years to 30, 20, 10years, and policy to make it work and budget support are the roles of policy. In order for

zero energy buildings to be implemented autonomously, from the dimension of consumers, economic feasibility and reliability should be secured. If not, specific ways and plans on how to resolve that gap cost efficiently in a fast time should be set in details.

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APPROACH TOWARD ZEB IN JAPAN

Yuriko Terao , Japan

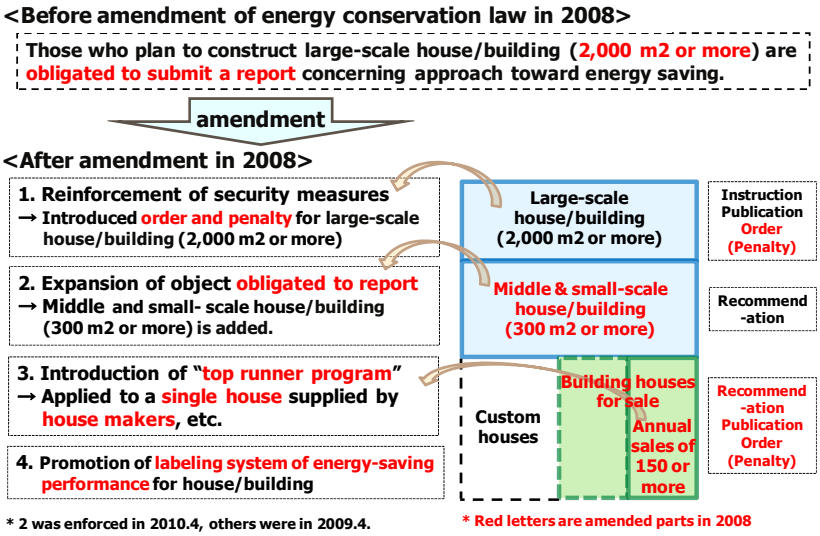
Abstract: ZEB (Net Zero Energy Building) is a building that emits zero CO2 on annual net basis by reducing the energy consumption through enhancement of the energy efficiency performance of the building envelop and facilities, networking on neighboring buildings, on-site utilization of renewable energy and so on. In Japan in order to examine the roadmap to realization and the dissemination of the ZEB a "Committee on Realization and Dissemination of ZEB" has been held and a report has been published in 2009. Focusing on the trends of final energy consumption, business & residential sector accounts for more than 30% and compare to transportation and industrial sector it has been increasing rapidly so the energy saving in this sector is most important. By introducing energy saving measure system for the buildings they proposed to realize ZEB as the standard for the new buildings by 2030.

Introduction

The 4th Assessment report of the United Nations Intergovernmental Panel on Climate Change (IPCC) has concluded that global warming, which today calls for urgent response, is "very likely" to have been caused by an increase in the atmospheric concentration of carbon dioxide (CO_2) that accompanies mass consumption of fossil fuels as a result of human activity. To prevent the global warming Japanese government has set a mid-range target to reduce CO_2 emissions by 25% by 2020(compare to 1990). In order to achieve this goal higher energy saving measures of the new buildings and energy saving renovation of the existing building in the business & residential sector is definitely needed. Moreover Japan has long-range target to reduce CO_2 emission by 60 to 80% by 2050. The building average life span is about 40 years so if most buildings are assumed to be rebuilt by 2050 energy efficient building is a must.

Actions plan

In order to achieve energy efficiency performance the strengthening regulation is highly needed. Below is the figure which explains what revision was made in the Energy conservation law recently.



Technologies to realize ZEB

Annual CO2 emissions and energy consumption could be reduced by 30-40% even with the existing technologies. But to realize ZEB(100% reduction), progress in individual technologies, as well as comprehensive design and integrated control to effectively combine such technologies, is needed. Overall cost analysis, including cost-up at design stage and cost-down at operation stage, is another challenge.

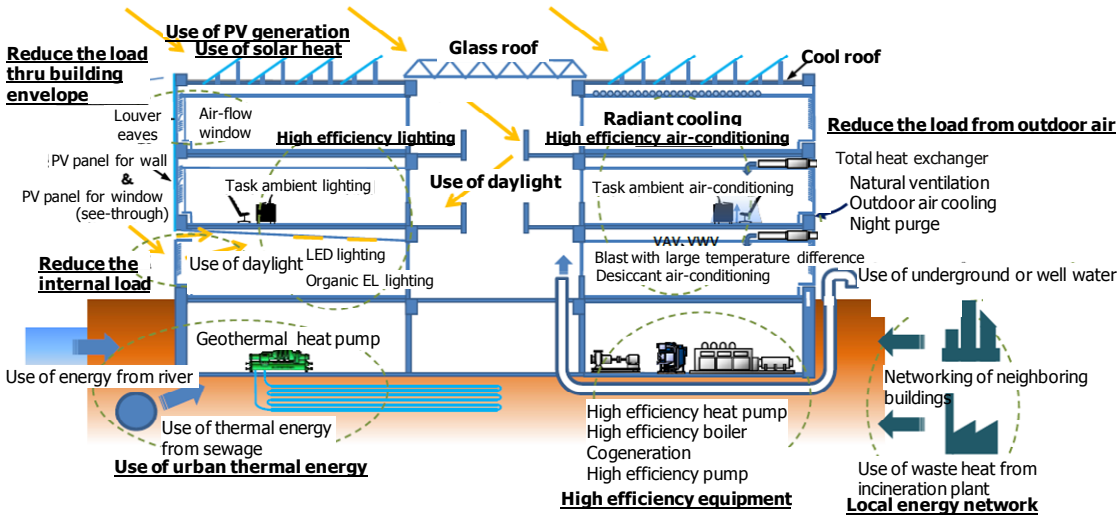


Figure 2. Technologies of realizing ZEB

Analysis on the potential to realize ZEB

Our initial estimate is that it should be possible to realize ZEB by around 2030 in medium and low-rise office buildings with certain technological progress as outlined below. Furthermore, possibility of achieving ZEB should become even greater, if potential for area network of neighboring buildings is taken into account.

[Assumptions]
1. Office building with about 5,000 m2 per floor
2. Primary energy consumption: 2,000 MJ per square meter per year
3. Technological progress by around 2030 written below
   - Passive architecture: high thermal insulation, solar shading
   - Use of natural energy: outdoor air cooling, night purge, and outdoor air intake control based on indoor CO2 concentration
   - High-efficiency heat sources: development of heat sources with about 20% higher efficiency than at present (raising the current COP 6.4 turbo chillers to around 8.0)
   - Low energy consumption conveyance: thorough use of inverters, high-efficiency motors, pumps and fans, low friction loss piping and duct size
   - High-efficiency lighting: development of high-efficiency lighting equipment and brightness setting with one-third of the current level of power consumption, and thorough use of variable light and blinking control
   - Low energy consumption OA equipment: development of low-consumption OA equipment, security and disaster prevention equipment, and standby power equipment with one-third of the current level of power consumption
   - Electric power emission coefficient: 2030 energy supply and demand estimates
   - Photovoltaic power generation: installation of panels with conversion efficiency that is double the current level on two-thirds of rooftop area

[Result]
Low-rise buildings with three floors or less will achieve ZEB, and buildings even with around 10 floors will be able to reduce emissions by about 80%.

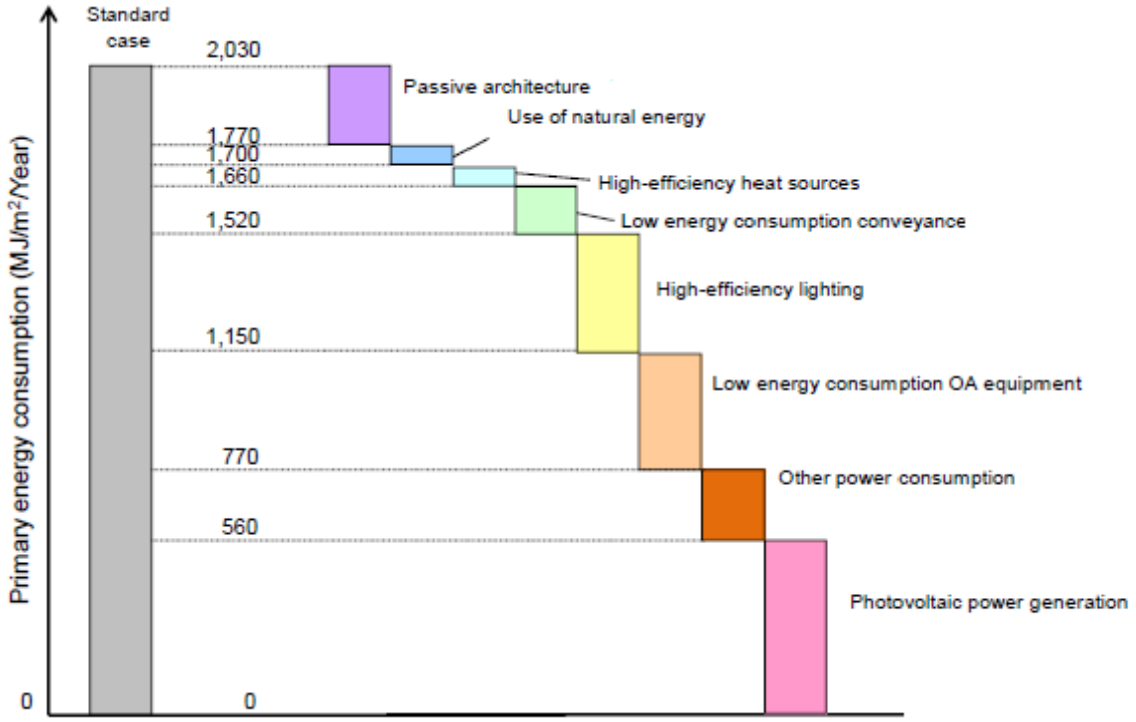


Figure 2. Various Energy Efficiency Technologies for ZEB and Their potential

Action plan of ZEH

Future shape to be aimed as below

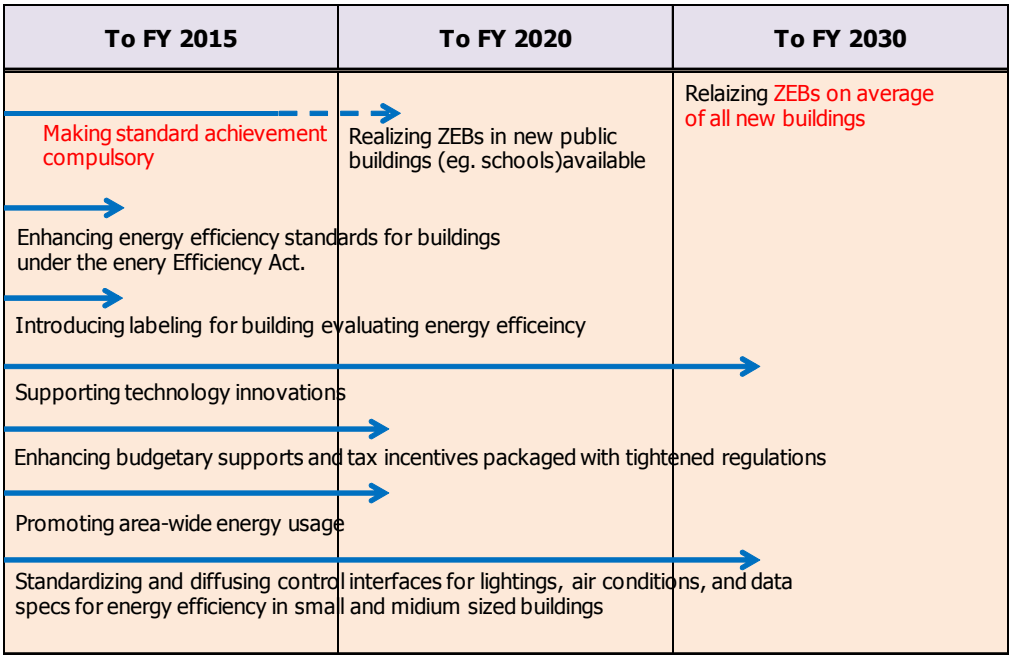
◆ZEH (Net Zero Energy House) to be the standard as for new single houses by 2020.
◆To double the number of renovating energy-efficient houses by 2020.
◆To realize ZEH as for new single houses on average by 2030.

To FY 2015	To FY 2020	To FY 2030
Making standard achievement compulsory	Making ZEHs available	Relaizing ZEHs on average of all new houses
Establishing energy efficiency stantards for whole houses including not only heat insulation but high efficiency water heaters, lightings, PVs and other facilities		
Strengthening enforcement of the Energy Saving Act (Increasing achievement rate of the standard)		
Promoting energy efficiency with residential Eco-points		
Supporting technology innovations		
Enhancing budgetary supports and tax incentives packaged with tightened regulations		

Action plan of ZEB

Future shape to be aimed as below

◆To realize ZEB as for new public buildings, etc by 2020.
◆To realize ZEB as for new buildings on average by 2030.



Conclusion

To promote market transformation for realization and dissemination of ZEB, it is essential to carry forward 1) regulations, 2) supportive measures and 3) information dissemination to and enlightenment of the society in a balanced manner. And cooperate with the United States and Europe countries are definitely needed.

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TOWARDS NET ZERO ENERGY BUILDINGS IN CHINA

XU WEI, CHINA

Abstract: A common view of the building energy efficiency work is that the net zero energy building is an effective solution. China government at present has a series of policy in the building energy efficiency and reduces the GHG emission. Retrofitting the heating system, promote the compliance of the building energy efficiency standards, the huge public building energy usage metering, renewable energy application, all these measures toward to achieving a higher goal of building energy efficiency of China. This article introduces the contribution of China's building energy efficiency work up to now, then give the short term national plan of the next five-year period. The policy and technical road map to reach the goal are also introduced.

Introduction

To respond to the climate change, the Chinese government attaches great importance to energy conservation and emission reduction, has promulgated the Law of the People's Republic of China on Conserving Energy, the Law of the People's Republic of China on Renewable Energies, and the Regulation on Civil Building Energy Conservation.
During the 11th-five year plan, building energy efficiency work is promoted nationwide through various national policies and got a good result. Further, the requirement of building energy conservation has been claimed in the Twelfth Five Year Plan for the National Economy and Social Development, the Long-term Planning on Renewable Energy Development, and the Twelfth Five Year Energy Saving and Emission Reduction Comprehensive Work Program, etc. As the important part of the national energy saving and emission reduction strategy, the energy conservation of buildings is valued highly by the whole society.

The building energy efficiency work status in quo

From the mid 1980's, China has been finishing 1.7-1.8 billion m^2 new constructions every year, which includes 700-800 million m^2 urban buildings and 1 billion m^2 rural buildings. In the urban area, there are 500-600 million m^2 are residential buildings and 200-300 million m^2 are public buildings. At the present, China is in the period of rapid urbanization, the scale of new construction will continue increasing. In 2010, the urban construction finished 1.8 billion square meters; in 2011 the urban construction finished 2.2 billion square meters. And there are nearly 45 billion square meters existing buildings. The building energy conservation potential is huge. From the situation of developed countries, building energy consumption in general accounts for the whole society end-use energy more than 40%. Thus in China, the total amount of building energy consumption and the building energy consumption proportion will continue increasing.

At present the building energy consumes about 27.5% of the whole society end-use energy consumption in China. Public buildings' (nonresidential buildings) electricity power consumption intensity is 50-120 kilo Watts hour per square meter each year, except the central heating energy consume. As the progress of the building energy conservation work, northern urban heating energy consumption from 24.3 kilogram standard coal equivalent per square meter in 1996 drops off to 16.6 kg standard coal equivalent per square meter in 2011, but the thermal comfort level is low in these old buildings. In Shanghai, as a representative of

the hot summer cold winter zone, the air conditioning energy efficiency is low, as the movable sunshade, passive energy saving measures not in use. The indoor thermal comfort is poor during winter, with the room temperature below 10 Celsius degree in general. In this area, the decentralized heating or local heating is widely used, which consumes 2-5 kg standard coal equivalent per square meter, neither reasonable nor effective. In Guangzhou, as a representative of the hot summer and warm winter zone, the passive energy saving measures such as sunshade, ventilated measures are not used widely effectively either. It results in the bad indoor thermal comfort in summer and low energy efficiency. In the north area of China, the winter average indoor temperature is 8-16 celsius degree in the rural area, which is 7-9 celsius degree lower than in the urban area of the same climate zone. People in the rural area have less domestic hot water to use than in the cities and towns.

Contribution by the end of the 11th Five Year Plan

During the 11th Five Year Plan period, with the former policies and programs, China made genuine progress in energy conservation, emissions reduction, ecological improvement and environmental protection. Energy consumption per unit of GDP fell 19.1%, chemical oxygen demand by 12.45% and sulfur dioxide emissions by 14.29%. This saving equals to 630 million tce and 1.46 billion CO_2.

By the end of 2010, the compliance ratio of energy efficiency standard on construction stage of new buildings achieved 95.4%; MoHURD has promoted 217 demonstrated projects of low energy consumption and green building; finished the heating system retrofitting and monitoring on 182 million m2 in north area. The output of new wall material is above 55% of the total output of wall material.

With the development of economy, China continues increasing the working force of building energy conservation. Set up the building energy regulation system, basically completed a building energy efficiency standard system, and has promulgated the mandatory building energy conservation design code for the main climate zone, the national Public building energy conservation design code, and the Code for acceptance of energy efficient building construction, etcetera. To expand the renewable energy building application, by the end of 2011, over 580 demonstration projects have been implemented national wide; nearly 200 cities and counties have appraised as demonstration district, including the demo program in solar heating, solar photovoltaic, geothermal heat pump for heating and cooling, using of Industrial waste heat and city sewage, etc. Vigorously promote heating measurement and energy efficiency retrofitting of the residential buildings in north China, by the end of 2011, the northern 15 provinces have complete the retrofitting area of 316 million square meters. Steadily promote national office buildings and large public building (over twenty thousand square meters) energy efficiency supervision system, by the end of 2011, 34 thousand and 59 office buildings and large public buildings have done their energy consumption statistics, more than 1500 buildings implement the energy consumption dynamic monitoring. Organize 114 Resource Saving Campus pilot. Promote the green building and low energy building demonstration, by the year 2011, a total of 353 projects get the green building certification.

The compliance ratio of building energy efficiency standard keeps increasing. By the end of 2011, 23% of the urban existing buildings are energy efficient buildings, the mandatory building energy standards are in a relative low level. Below the table shows standards compliance status in the 11th five-year plan.

Table 1：Compliance of Energy Efficiency Standards of New Buildings in the 11th five-year plan

YR	Accumulative energy efficient building structure area (bm^2)	Compliance Ratio on Design Stage （%）	Compliance Ratio on Construction Stage （%）
2006	1.06	95.7	53.8
2007	2.12	97	71
2008	2.85	98	82
2009	4.08	99	90
2010	4.86	99.5	95.4

The Goal in the 12th five-year plan

As the National Plan of the 12th five-year plan, the energy consumption per unit of GDP by 2015 fell 16% of the 2010 level. The chemical oxygen demand and sulfur dioxide emissions reduce 8% of the 2010 level separately. The emissions of ammonia nitrogen and nitrogen oxide reduce 10% of the 2010 level separately.

By the end of twelfth five-year (2015), building energy conservation comes into 116 million tons of standard coal equivalent energy-saving ability, reduces carbon dioxide emissions about 300 million tons. Among them, green building and new buildings energy conservation comes 45 million tons of standard coal equivalent energy-saving ability; deepening the heating system reform, the full implementation of the heat metering and charging, promote the north area heating area heating system and energy saving renovation, comes 27 million tons of standard coal equivalent energy-saving ability; Strengthen the public building energy efficiency supervision system, promote energy saving retrofitting and operation management, comes 14 million tons of standard coal equivalent energy-saving ability. Promote renewable energy and building integrated application, comes 30 million tons of standard coal equivalent energy-saving ability.

Technical Roadmap towards NZB

A. Heat metering and energy efficiency improvement in existing residential heating systems in North China.

The State Council requires that "metering and energy efficiency improvements in existing heating systems shall be started with 150 million square meters of residential buildings in North China". The Ministry of Construction (now called the Ministry of Housing and Urban-Rural Development, MOHURD) has broken down the target to 15 provinces and cities in the north. The Ministry of Finance, together with the Ministry of Construction, has put forward a fiscal policy of using central budget funding as incentives for such renovations. A total of RMB 900 million was earmarked for subsidising installation of heat metering devices in 2007. From 2006 to 2008, the number of buildings in which heat was metered doubled every year. By 2009, the total number of buildings with heat meters was three times as great as in 2008.

B. Substantial percentage increase of new buildings conforming to the energy efficiency standards.

As long ago as 1986, the central government required that all the new buildings should comply with the energy efficiency codes, which means 50% or 65% energy efficiency (depending on where in the country that the province or city was) in comparison with the same type of building and type of construction in the 1980s. Statistics collected from different localities show that 99% of all the urban new-builds across the country in 2009 conform to energy efficiency codes in terms of their design, and 90% of them in terms of their construction stage; improvements of respectively 46 and 69 percentage points over 2005.

In the future, the government will regard energy efficiency as one of the most important requirements to be met before acceptance of designs etc., and will extend the energy efficiency codes and green building standards to small cities and rural areas as well.

In the future, China will gradually improve energy efficiency in new buildings. In 2015, newly issued energy-saving design standard will fully implement in the severe cold and cold zone, hot summer and cold winter zone. Urban new buildings energy efficiency will raise more than 30% compared to the end of eleventh five-year (2010). Megacity such as Beijing and Tianjin will executive higher level building energy efficiency standards, the building energy efficiency level of new buildings will reach or approach the developed countries in the same climate condition. Finish a batch of low energy consumption and extra-low energy consumption demo buildings. By 2020, the green building will account more than 30% of new buildings; the energy efficiency level of construction and operation process will reach or approach the developed countries current level.

C. Energy-saving regulatory system for state-owned office buildings and large public buildings.

The State Council proposes that "demonstration projects shall be initiated for energy-efficient operation, management and transformation of large public buildings, with experiments to be made in 25 demonstration provinces or cities to put large public buildings under the control of an energy consumption monitoring and energy auditing scheme, with public notification of energy efficiency and energy consumption quota system". In the energy consumption quota system, the owner of a building pays a higher price for energy above a certain threshold of energy consumption. The Ministry of Construction and the Ministry of Finance has identified 24 provinces and cities for the first group of demonstration localities where action plans have been developed for establishment of an energy-saving regulatory system for state office buildings and large public buildings, and investigations made into the basic conditions and energy consumption data of such buildings. Energy auditing of state office buildings and large public buildings has been started in some provinces and cities. So far, energy use has been measured in over 30,000 buildings, with continuous measurements being made in 700 buildings. The on-line building energy monitoring system has been established in Beijing, Tianjin and Shenzhen.

D. Promotion of overall decorated house and fabricated constructions

It is estimated that compared with the traditional construction method, green construction methods can reduce energy consumption by about 20 % per square meter, water consumption by 63 %, timber formwork consumption by 87 %, and general construction waste can be reduced by 91 %. This means that if we are greatly to reduce energy consumption in the construction stage, the only way is to include overall fitting-out, in combination with pre

fabricated construction. In this context, the term 'fitting-out' refers to most interior necessities of a house, which are not normally provided with new houses in China.

China will adopt three main counter-measures. Firstly, implement residential prefabricated fitted-out house-building by a group of large enterprises, in turn influencing small and medium-sized enterprises. For example, large enterprises such as Vanke have announced that they will deliver overall fitted-out houses and pre-fabricated buildings in all the real estate projects in which they are involved throughout the country. Second, provide incentives. Beijing has encouraged developers to choose overall fitted-out houses and prefabricated construction by volume bonuses and partial refund policies for municipal construction. Third, accelerate the publication of standards; make more new materials, new technology and new construction methods, all of which can be adopted by the vast number of small and medium-sized enterprises.

E. Renewable energy application in buildings

China has published regulations and announced incentives for renewable energy use in buildings. According to (incomplete) statistics, total world solar collector area for water heating amounts to nearly 150 million m^2, of which China accounts for about 60-70 %, with an annual growth rate of about 30% for solar water heater applications for buildings.

The next major work area includes acceleration of publication of regulations and standards, aiming for issue of the relevant standards in the next two years, and raising the profile of demonstration of renewable energy application in buildings, aiming to choose 20 cities as renewable energy demonstration cities each year, with the central government giving 60-80 million RMB (about USD 10-12 million) subsidies to the selected cities. The demonstration cities for renewable energy demonstration must deliver 3 million m2, and have established renewable energy utilisation policies for construction etc. In addition, input is needed in such areas as tax reduction, partial refunds for municipal construction etc., and we need also to speed up the promotion of renewable energy applications in rural housing.

By the end of 2010 the solar heating apply in 1.48 billion m2 area national wide, the GSHP apply in 0.57 billion m2 area national wide, the PV installation capacity is 1727.5 MW (including under construction).

For each demonstration city of renewable energy building application area above 3 million m^2 in China, the central government provides 60-80 million RMB allowance; for the demonstration county with application area above 0.3 million m2 area, the central government provides 1.8 million RMB allowance

The renewable energy building application will keep promote in the 12^{th} five year plan. It is planned to have new application area 2.5 billion m^2 by the end of the 12^{th} five year plan, which replace the fossil energy 30 million ton equivalent of coal.

F. Demonstration and promotion of green building

The Green Building Initiative in China started in 2008. By the end of 2009, 56 buildings had achieved the China Green Building Evaluation Label. In 2010, 200-300 large buildings will achieve the China Green Building Evaluation Label. Green building is of great significance, as it can make a valuable contribution to energy conservation, water conservation and material conservation in buildings, while also improving efficient land use. It can also improve indoor environmental quality and reduce external environmental impact, and is an important measure for fighting climate change. Green building must be combined with green design and construction. At present, the China Green Building Evaluation Label is achieved mainly by

public buildings, as there is increasing awareness of energy consumption in public buildings, which should be a model of energy efficiency. It is planed to have new constructed green building 800 million m2 during the 12th five year plan, 20% of the urban new buildings achieved the requirements of green building.

In view of the above difficulties, there are four measures to be implemented. First of all, perfect the relevant incentives policy. All buildings fulfilling green building star standards should receive preferential policy treatment. Second, accelerate publication of green building standards, matching the standards to the requirements of all climate zones and different types of buildings and residences. Third, promote integrated innovation of materials and systems. Fourth, strengthen the training of assessors, and extend training to architects.

Conclusion

In order to fulfill the emission reduction goal in the building industry, China need to impellent step by step. As discussed above, China government has not claim a specific goal of net zero energy buildings or near zero energy buildings as there is no clear technical roadmap for that so it might be too hard to achieve for the real estate developers. However, the policies of the building energy efficiency substantially move the country forward to the zero energy building. Meanwhile, it is also necessary to balance the energy reduction goal of other industries of the national economy. As China is a developing country, the increasing requirement of the people's life quality is also a very important factor to be considered in the building energy work. We are looking forward to see the more advanced building energy efficient target promulgate and more stimulate from the government.

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Approach toward ZEB in India

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Abstract: In India, Buildings in Residential and commercial sectors account for approximately one-third (33%) of total electricity consumption and this percentage will increase to 37% by 2021 due to rapid urbanization. Considering the amount of electricity consumed and its growth in building sector, it becomes quite evident that energy efficiency across the building sector is of utmost concern and is of prime importance. Net zero energy building is one of the solutions to combat this increase in electricity consumption. Currently in India, Government has many policies (like energy codes, star labeling of equipment, star rating of existing buildings and rating system for new buildings) which promote energy efficiency in buildings. However so far there has not been any specific policy or a well-defined government program to integrate these initiatives and promote a common NZEB strategy for the country.

Introduction

India is facing formidable challenges in meeting its energy needs. As per the Planning commission's Integrated Energy Policy Report (Planning Commission 2006), if India perseveres with sustained growth rate of 8% per annum, its primary energy supply will need to grow by 3 to 4 times, and electricity generation capacity / supply by 5 to 6 times compared to 2003-04. It is estimated that by 2031-32, the country's power generation capacity of 800,000 MW would be required as against the installed capacity of 160,000 MW inclusive of all captive plants in 2006-07. Central Electricity Authority (CEA) has estimated that the country is currently facing electricity shortage of 9.9% and peak demand shortage of 16.6% (CEA 2009).

Domestic and commercial sectors account for approximately one-third of total electricity consumption and these sectors are likely to consume around 37% of electricity in 2020-21. The residential buildings consume 24% of total electricity consumption in the country which can be attributed to higher disposable income and better access to finance for purchasing home appliances among the households. The commercial buildings sector which comprises of the office buildings, hotels, hospitals, educational institutes, retails malls, etc., consumes 9% of total electricity consumption in India. This sector has experienced electricity consumption growth rate of 12-14% in recent years which is attributed to the increasing electricity consumption in the existing buildings as well as increasing energy intensity of newly constructed commercial buildings.

It is therefore, critical that policy interventions are put in place to improve energy efficiency in both new as well as existing buildings in these sectors.India has already identified buildings as one of the sectors in its fight against climate change. However, a long term policy initiative that encourages the development of cutting edge research and cost effective technologies can bring about step changes in the energy use in building.

Government Initiatives on Building Energy Efficiency

To give impetus to energy conservation in the country, Government of India enacted the energy Conservation Act (EC Act), which came into force on 1st March 2002. Under the Act, Government of India established the Bureau of Energy Efficiency (BEE) in March 2002, a statutory body under the Ministry of Power, Government of India. The EC Act directs BEE to

spearhead improvement in energy efficiency through various regulatory and promotional measures. The EC Act has empowered the Government both at the Central as well as at the State level to put in place a legal framework that could help in creating an institutional set-up that promotes energy conservation in the country, and also helps in monitoring the efforts to meet the energy saving targets and energy intensity of the economy.

Under the Prime Minister's National Action Plan on Climate Change, the Government has launched eight national missions, out of which following three missions can promote higher energy efficiency levels in the buildings.

- National Mission on Enhanced Energy Efficiency
- Jawaharlal Nehru National Solar Mission
- National Mission on Sustainable Habitat

There have been landmark initiatives by the Government of India for improving energy efficiency in commercial buildings.

- The Energy Conservation Building Code (ECBC) launched by the Government of India under the Energy Conservation Act 2001, for voluntary adoption in the country, sets minimum energy performance standards for commercial buildings.
- BEE has also developed a Star Rating Program for existing commercial buildings, which is based on actual energy performance of the building, expressed as an Energy Performance Index (measured in terms of annual electricity consumption per unit of built up area).

Figure1showsthe steps taken by Indian government for promoting energy efficiency in new and existing buildings.

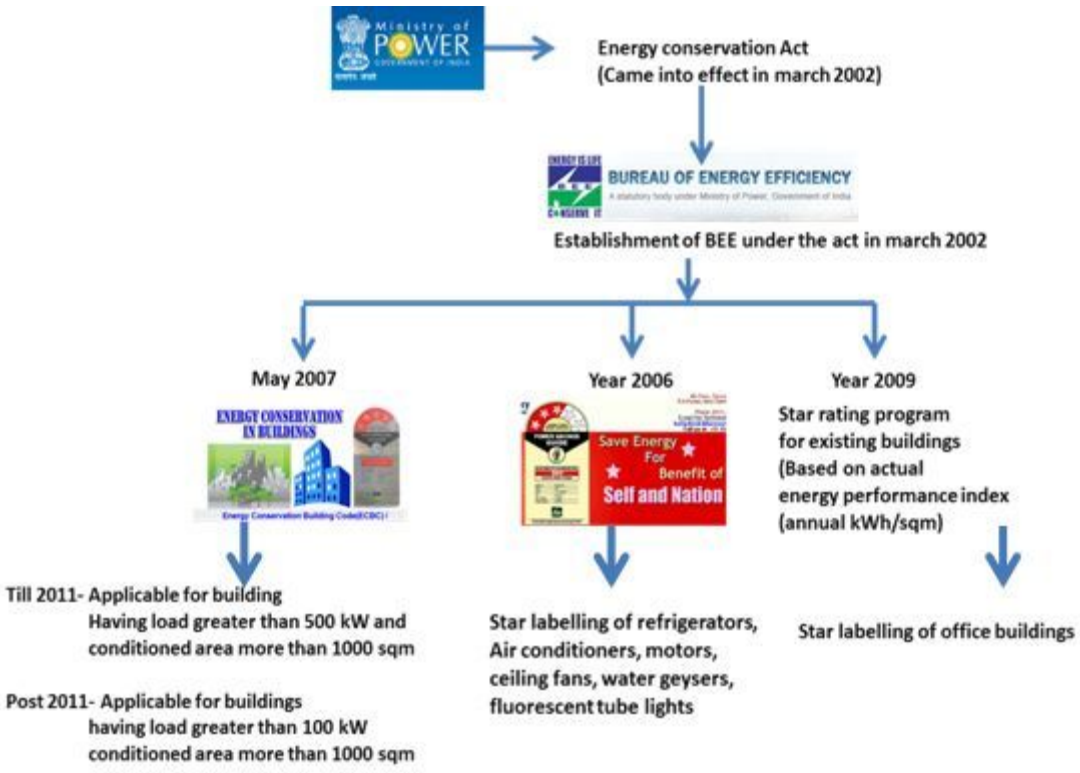

Figure 1: Steps taken by Indian government for promoting energy efficiency in buildings

Designing NZEB

Designing of a NZEB typically requires successful integration and optimization of several architectural concepts and strategies such as building orientation with respect to sun path, natural ventilation, solar shading, day lighting, solar heat gains, thermal comfort as well as deployment of well proven insulation practices, energy efficient glazing, air conditioning and lighting system, and incorporation of renewable energy technologies for on-site power generation.
Annual CO2 emissions and energy consumption could be reduced by 30-40% even with the existing technologies. But to realize ZEB(100% reduction), progress in individual technologies, as well as comprehensive design and integrated control to effectively combine such technologies, is needed and is shown in figure 2.

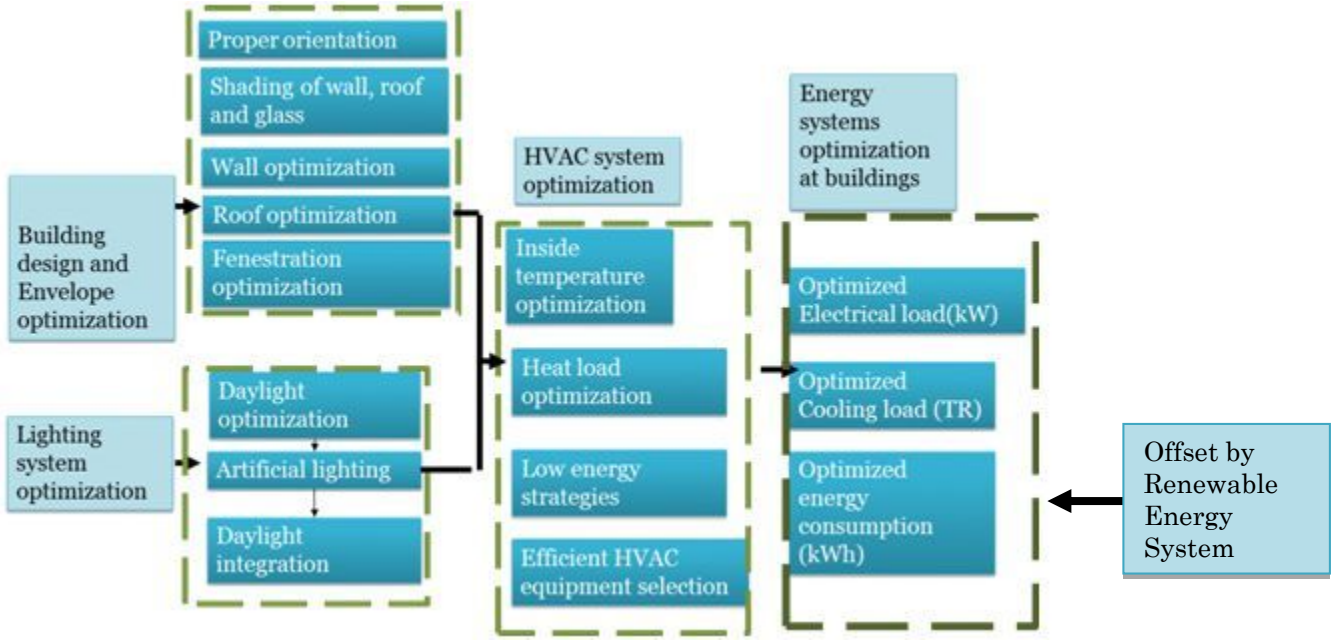

Figure 2: Comprehensive design approach for buildings

1. Building design and envelope optimization
   - Planning site orientation preferably with longer axis of the buildings to be in east-west direction, as far as feasible
   - Designing building fenestration with low window-wall ratio (preferably less than 40$) having lesser window on south and West.
   - Adoption of horizontal shading devices (overhangs and louvers) on windows on south side, and vertical shading devices (side fins and louvers) on east and west side of building façade.
   - Energy efficient Wall and roof having lower heat transfer coefficients.
   - Energy efficient glass having lower heat transfer coefficient and solar heat gain factor.

2. Building lighting system optimization
   - Integration of day lighting with artificial lighting using appropriate controls (For e.g, dimming sensors)
   - Optimization of artificial lighting system by installing energy efficient lighting lamps (CFLs, LEDs, etc) and fixtures.

3. Building air conditioning system optimization
    - Optimization of cooling demand (TR) of the building by designing air conditioning at higher inside temperatures.
    - Precooling of fresh air with energy recovery wheels.
    - Installation of low energy design features like geothermal system and radiant cooling system.
    - Installation of energy efficient chillers(higher COPs for e.g., Variable refrigerant volume systems, heat pumps), pumps and motors.

NZEB Targets

Commercial buildings can be classified into number of categories depending upon what functions are being carried out in the building. Broadly these can be categorized as office buildings, hotels, hospitals, shopping malls, etc. Energy consumption in each one of these could vary significantly from others, Also within the same category, energy consumption in different buildings, can also vary substantially depending upon the energy intensiveness of facilities deployed and services offered, and to what extent the working space in the building is air conditioned.

For instance, the energy consumption per unit built up area of a multi-specialty hospital could be many times that of an un-conditioned or partially air conditioned government hospital. Same is true for office buildings. Well organized compilation of buildings' energy date in the country is still infancy. Thus fixing a specific NZEB energy consumption targets for each category of the buildings becomes a complex task.

Barriers on NZEB Path

The following barriers on NZEB path have been identified

- **Policy and Program on NZEB:**
  Government has taken a number of initiatives (include development of ECBC and Energy Star Rating Program for commercial buildings and renewable energy systems including technologies for electricity generation from wind power, solar energy and bio-mass by providing several financial subsidies in India.) to improve energy efficiency in commercial buildings. However so far there has not been any specific policy or a well-defined government program to integrate these initiatives and promote a common NZEB strategy for the country.

- **Nonexistence of Market for commercial NZEBs:**
  Building constriction cost is a very important factor for construction companies. Financial benefits of NZEB are mainly for the building users. Building developers and construction companies do not see this as a specific advantage for them for developing NZEBs. There is also no demand for NZEBs from the Government for the construction of their own and public sector buildings.

- **Absence of public awareness on NZEBs**:
  The developers of commercial building complexes and individuals who intend to build their homes are not aware of energy efficient architectural guidelines and renewable energy opportunities which can fit effectively into their buildings' functional requirements. Therefore such efficiency measure does not get incorporated at the design stage.

- **Higher costs of EE and RE technologies for NZEB**:
  A range of advance energy efficient technologies and systems for buildings, initially developed in other countries, are being made available by a few vendors for the indigenous construction industry. However their higher first cost over the conventional building material and system impedes their penetration in real situations.

- **Limited design expertise in the market:**
  There is inadequate knowledge and expertise on NZEB concepts amongst majority of building designers and architects on upcoming energy efficient building materials and technologies, solar passive architecture, and lack of knowledge and working experience on renewable energy systems.

- **Lack of specialized energy simulation and modeling skills:**
  Designing of a NZEB typically requires successful integration and optimization of several architectural concepts, deployment of energy efficient technologies and renewable energy technologies using computerized energy simulations software. A number of energy simulation software are available in the market but there are a very few professionals in India who have the requisite energy simulation expertise.

Recommendations on Roadmap for NZEBs

- Government of India should constitute an international coordination mechanism, a unified policy and a national program and targets on NZEFs involving Bureau fo Energy Efficiency, Ministry of Power, Ministry of New and Renewable Energy as well as the Ministry of Urban Development.
- A national level NZEB Consortium with an overall objective of promoting NZEBs needs to be created in India to actively involve and encourage architects, consultants, builders, technology providers and other stakeholders.
- Government of India needs to review the existing fiscal incentives on advanced renewable energy technologies for power generation as well as energy efficient technologies pertaining to buildings primarily with a view to promote newer time bound polices and schemes to give impetus for the construction of NZEBs in India. The Government should gradually withdraw these when the cost of these technologies' come down due to higher off take in the market and paybacks on investments on such technologies and system become commercially attractive.
- The Government (Centre/State), to demonstrate its commitment towards NZEB path, and acquire firsthand experience, should initiative 4-5 pilot projects in the on-going 5 year span (ending 2015) in different cities /states possibly in different climate zones for constructing government building.
- Programs should be initiated to build capacity of building construction companies to equip them with specialized project management and execution services for effectively implementing NZEB projects in real situations.
- For public awareness, mainstreaming of well-established architectural guidelines and best practices for net zero energy residential buildings and complexes should be promoted widely through awareness campaigns.
- Large pool of professions and young architects should be identified in the country and trained to run building energy simulation tools so that their services can be fruitfully utilized by building designer community in designing NZEBs.

Building close to NZEB in India

(1) PimpriChinchwad New Town Development Authority (PCNTDA) Building

Features:

PCNTDA Building is located in Pune which falls under warm and humid climate zone of India. The Building is oriented towards 45 deg to north. The total area of the building is around 110000 sqft. 95% of the building area is non-air conditioned and 5% of the building area is air conditioned and is equipped with unitary air conditioners. Two types of glasses have been provided. Single glaze windows across all thenon-air conditioned spaces and double glaze windows across all the air conditioned spaces. All the windows are properly shaded with horizontal shades above the window. The overall window wall ratio of the building is lower than 40% and is sufficient to provide adequate daylight in almost 80% of the living spaces across the building. The non air-conditioned spaces are provided with ceiling fans (BEE star labelled) and with a provision of opening up the windows to maintain adequate air changes per hour inside the spaces. The airconditioned spaces areequipped with BEE star labelled split ACs and Inverter ACs. It was found using computerised simulation that for almost 63% of the occupied hours in the non -airconditioned spaces of the building, the dry bulb temperature is lower than 33 deg C. The artificial lighting at the building is provided using compact fluorescent lamps, Light emitting diodes (LEDs) and fluorescent tube lights. Daylighting has been properly integrated with artificial lighting using adequate controls.

The details of the total electrical load and consumption of the building is given below:

Total Lighting load	: 57 kW
Total ceiling fan load	: 21 kW
Total unitary air conditioners load	: 36 kW
Building total electrical load	: 114 kW
Simulated annual energy consumption of building	: 170173 kWh

Solar photovoltaic (PV) system details

Total peak load	: 100 kWp
Simulated energy units generated by 100 kWp PV	: 145985 kWh
% building energy offset by PV	: 86%

Offset of 86% of the building energy by solar photovoltaic system.

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Strategy roadmap for netzero energy buildings in India, USAID Eco III Project

PROMOTING ENERGY EFFICIENCY AND CONSERVATION FOR BUILDINGS IN VIETNAM

PHAM Hoang-Luong, Vietnam

Abstract: During the past ten years, electricity consumption in the residential and public commercial buildings in Vietnam has been in the order of 38-43% of the total final electricity use in the country. Within the framework of Vietnam National Energy Efficiency Program (VNEEP) for the period of 2006-2015, a number of policies and measures are recognized that aim at minimizing waste of energy in the industry, agriculture, transportation and construction sectors. However there has not been yet any specific strategies or policies to promote a so-called Zero Emission Building (ZEB) in the country. Instead, the Government and Ministries concerned has attempted to promote energy efficiency and conservation (EE&C) for the building sector.

Introduction

Since 2000, Vietnam has enjoyed a steady Gross Domestic Product (GDP) growth rate of about 7.2% per annum that leads to an increasing demand for the final energy consumption from all the nation's economic sectors. For the period of 2004-2006, the industrial and commercial & residential sectors were the first two dominant electricity consumption sectors with the former consuming approx. 42-47% of the total electricity consumption while the latter 38-43%. In June 2006, the Government of Vietnam endorsed the Vietnam National Energy Efficiency Program (VEEP) aiming at reducing 3% to 5% and 5 % to 8 % of the energy consumption for 2006-2010 and 2011-2015, respectively compared to the business as usual scenarios for these two periods. In June 2010, the Vietnam National Assembly passed the Law on Energy Efficiency and Conservation which took effect from January 1st 2011. In this Law, major responsibilities of designated energy using units from industry, construction, transportation and agriculture sectors are clearly addressed which include establishing an energy management action plan (EMAP) with an every-3 year energy audit reporting.

Buildings in Vietnam can be categorized into three groups depending on their flooring surface areas as below.

- Small-scale construction: from 300m^2 to 2,449m^2;
- Medium-scale construction: from 2,500m^2 to 9,999m^2;
- Large-scale construction: from 10,000m^2 and above.

For Hanoi and Ho Chi Minh City only, there are hundreds of large-scale construction projects each consumes approx. 1 to 2 million kWh per annum. On the other hand, recent surveys have shown that in most of small-scale three-star hotels in Vietnam, electricity consumptions from electric water heaters and split-type air-conditioners account for 30% and 50% of the total electricity use in the hotel, respectively. The remaining 20% is for lighting and other auxiliary equipment or devices.

Government initiatives to promote EE&C for Buildings

On the 3rd September 2003, the Government issued Decree 102/2003/ND-CP on energy efficiency and conservation that officially paved the way to the promotion of energy efficiency measures in all economic sectors of the nation. In Chapter 3 of this Decree, major energy efficiency options were identified such as : i) making use of favorable natural geographic conditions and architecture measures to reduce the use of electricity for lighting, ventilation, cooling and heating, ii) use of insulation materials to minimize the heat flux through building envelope and ii) utilization of high energy efficiency equipment and devices for the buildings. On June 17, 2010 the National Assembly approved the Law on energy efficiency and conservation. Finally, on March 29, 2011 the Government issued Decree 21/2011/ND-CP addressing clearly responsibilities of key energy using entities in getting regular energy audits done as well as in implementing energy efficiency measures to ultimately reduce their energy consumption volume.

Current status of energy use in the building sector

Pattern of energy use

For large-scale commercial buildings or big hotels, electricity, diesel oil (DO) and LPG are normally used for energy provision. Electricity is for Air-conditioning (AC) system, lighting, lift. DO is, on the other hand, used for running emergency generators and operating thermal supply system. Finally, Liquefied Petroleum Gas (LPG) is normally used for cooking. On average, share of these three types of energy is approx. 63%, 29% and 8%, respectively.

Building architecture

Before the Decree 102/2003/ND-CP was enacted, most buildings in Vietnam were not well designed and constructed from energy efficiency point of view. Insulation materials were not yet used in the buildings which were then equipped with relatively low-energy efficiency appliances. Recently, new constructions were made with glass windows and interior curtains. Roof of these constructions were, in addition, made from waterproof and insulation materials. With such improvements, energy consumption in new buildings were significantly reduced.

Air-conditioning system

For small-scale residential and office buildings, split-type Air-Conditioners are normally used while in most large-scale commercial construction, a chilled water system is employed. Use of inverter AC system has not yet been popular in Vietnam.

Lighting system

Lighting normally accounts for 15-20% of the total electricity consumption in the buildings. A strict regulation for turning on/off of the lighting system is normally applied in most hotels and commercial buildings where LED and CFL are widely used to save energy.

Thermal system

For 4 or 5-star hotels and newly constructed commercial buildings, a centralized thermal system is made to provide both low pressure steam for sauna, massage, washing and ironing as well as hot water for cooking and other heating/drying purposes. In these places, oil-fired boilers are often employed in which no-cost and low-cost energy efficiency measures are commonly applied such as modulate control of oil burners with load variation, heat recovery from the boiler blowndown, use of steam traps. However, for small hotels and existing constructions, individual electric water heaters are still in use.

Barriers to the promotion of EE&C for buildings

Three major barriers which have been identified are as follows.

- **Institutional / policy barrier**
  Although lots of initiatives to improve energy efficiency in commercial buildings were already made which include application of solar water heater, energy efficiency labelling of fluorescent lamps and and home-type Air-Conditioners, so far there has not been yet any specific policy to integrate these initiatives and thus promote EE&C buildings for the country.

- **Financial barrier**
  Use of insulation materials and advanced high energy efficiency appliances for buildings normally increase the initial cost of the building that most of indigenous developers try to avoid.

- **Technological barrier**
  There is inadequate knowledge and expertise among the local building designers and constructers on waterproof and insulation materials for buildings as well as on integration of solar and wind energy technologies into conventional energy system of the buildings.

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