



# Developing “zero energy” buildings to effectively implement the Vietnamese Government’s commitment to responding to climate change

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## 1. INTRODUCTION

According to the Report of the Ministry of Construction, currently, the energy used in construction projects accounts for nearly 35% of the country's total energy. Therefore, the development of "Zero Energy Building" (ZEB) with design, construction and operation that meets the criteria and standards of economically and efficiently use of energy will contribute to reducing emissions into the environment and fulfilling the commitment of Vietnam to reach net zero emission by 2050. The article presents an overview of the ZEB, criteria, technical solutions and experience in developing ZEBs in Japan, basing on that, we would like to make recommendations on developing ZEBs in Vietnam to respond to climate change in the current period.

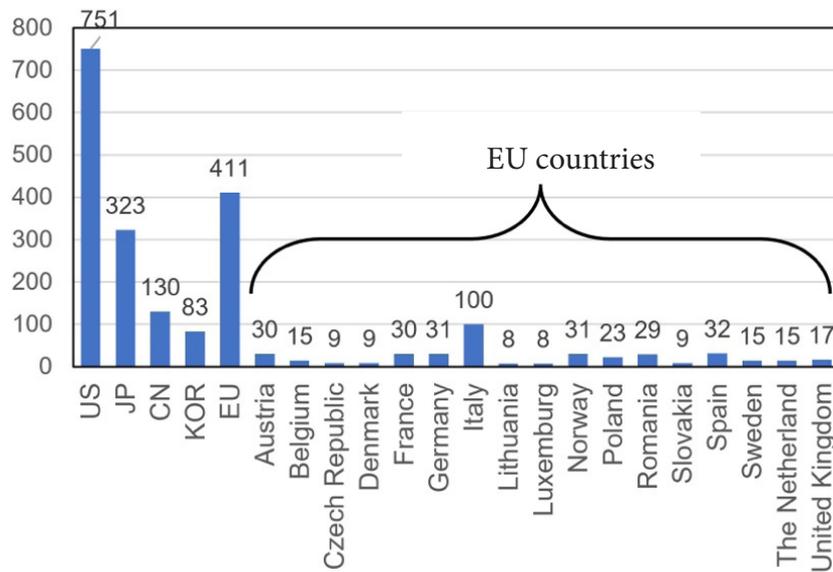
## 2. ZEB AND DEVELOPMENT TREND

A ZEB is a building that generates its own renewable electrical energy equal to or greater than its actual effective energy consumption, without using traditional energy from fossil fuels, reducing greenhouse gas (GHG) emissions, ensuring environmental quality in the building that meets comfort requirements [1]. In order to the ZEB can be achieved the criteria of being a ZEB, when designing and constructing the building, it is necessary to thoroughly and successfully apply the following 3 groups of innovative technical solutions: (1) The ZEB uses advanced technology solutions to self-generate renewable electrical power from natural resources (mainly from solar radiation energy), this self-generated renewable power source is equal to or greater than the reality demand for electricity consumption of the project; (2) The ZEB is designed and installed with systems of ventilation, air conditioning, electric lighting, water supply and drainage and other equipment... using energy most economically and efficiently to minimize the actual electricity consumption of the building as much as possible; (3) The ZEB has a shell with the best sun shading, best thermal insulation, taking advantage of natural ventilation and natural lighting to reduce the building's heat load to the lowest possible level. Reality has shown that the ZEB construction is the absolute pinnacle of the development of projects that use energy efficiently and effectively.

According to estimates by the World Bank (WB), construction and operation of construction projects globally consumes nearly half of natural raw materials and about one-sixth of clean water and consume about 40% of the world's total energy production and emit about 30% of the GHGs that cause climate change. Therefore, in the 90s of the last Century, when humanity faced the risk of increasingly scarce natural resources, the living environment was increasingly polluted, and oil energy was in the second crisis, climate change is increasingly threatening the survival of humanity, countries around the world, including a number of developed countries, have issued regulations and policies policy on economical use of energy, to cope with climate change. According to calculations by scientists, due to the construction industry consumes about 40% of the entire energy source that humanity has exploited and produced, in most countries when making the policy on “use energy efficiently and economically” must first be applied to the construction industry, thereby forming and developing the movement to design and construct buildings that use energy efficiently and economically.

However, a summary of experience in developing buildings that use energy efficiently and economically in the world in recent times shows that the development of new green buildings only achieves energy savings of about 10 - 30% compared to traditional construction projects, unable to meet the requirements of minimizing GHG emissions to limit climate change according to Vietnam's commitment at the 26<sup>th</sup> United Nations Climate Change Conference (COP26), reducing net emissions to "zero" by 2050. Thus, for energy efficient buildings to meet the level of response to climate change, in addition to developing green buildings, it is necessary to develop ZEBs in the construction industry in Vietnam. Currently, many countries around the world have

promoted the development of ZEBs to meet the requirements of COP26. Specifically, Figure 1 introduces the statistical results of the number of ZEBs that have been actually built in these countries around the world in the last 10 - 15 years.



▲ Figure 1. Number of ZEB constructions were built in the world (2022). (Source: References [4])

From Figure 1, it shows that the 5 countries with the largest number of ZEBs in the world include: United States of America (751 ZEBs), Japan (323 ZEBs), China (130 ZEBs), Italy (100 ZEBs) and Korea (83 ZEBs).

The following are images introducing some typical actual ZEBs from some countries around the world (USA, Japan, China, Korea, Singapore and Thailand) (Figure 2).

### 3. EXPERIENCE IN DEVELOPING ZEBs IN JAPAN

In Japan, green buildings and energy efficient buildings began to develop in the 90s of the last century and since 2015, ZEBs have been developing. To gradually develop ZEBs in Japan, the concept of expanding “ZEB Family” has been introduced: The first step is to aim for ultra-low-energy buildings (buildings save about 50% energy compared to the reference energy consumption) which are defined as “ZEBs Ready”, then aim for “nearly ZEB” (buildings save about 75% of



▲ Figure 2a. A ZEB of USA (Source: References [5])



▲ Figure 2b. A ZEB of Japan (Source: References [5])



▲ Figure 2c. A China's ZEB (Source: References [5])



▲ Figure 2d. Olympic Stadium in Tokyo 2020. Total area 194,000m<sup>2</sup>, 68,000 seats (Source: References [6])



▲ Figure 2e. A ZEB in Singapore (Source: References [1])



▲ Figure 2f. Khonkean International Convention Center. A ZEB in Thailand (Source: References [3])

▲ Figure 2. Introducing images of some typical ZEBs in some countries



energy compared to the reference energy consumption level), and the next step is to develop a building that meets 100% criterion, ZEB (a project that generates its own renewable energy by approximately 100% balanced with reference energy consumption (Net ZEB).

According to references [3, 4, 5, 6], some experiences on developing ZEBs in Japan can be drawn as follows: To begin the strong development of the ZEB in 2015, Japan started from amending and completing relevant laws, regulations, standards and technical instructions for these projects. The program uses energy effectively and saves energy in accordance with promoting the implementation of the "ZEB Family" development plan. Specifically, in 2015, the revised Energy Law was promulgated and introduced the concept of "ZEB Family" and truly began the development phase of ZEBs in Japan.

- Japan has created a specific and detailed plan for the development of "ZEB Family" and resolutely implemented the set plan. In 2002, in Japan, the State Management Agency issued a notice mandating the application of energy saving measures for all types of new construction, expansion and reconstruction: Since 2006, it was applied for buildings with a total floor area of 2,000 m<sup>2</sup> or more and from 2010 for buildings with a floor area of 300 m<sup>2</sup> or more. Since 2015, the initial phase of the ZEB construction development plan has focused on applying mandatory ZEB construction standards and regulations for large construction projects (with a total floor area of the building from 10,000 m<sup>2</sup> or more), because the number of the new large buildings accounts for only about 1% of the total number of new buildings were built in Japan, but the annual energy consumption of these large buildings account for 36% of the total energy consumption of the construction industry. The plan is that by 2025, all types of commercial buildings, public houses and newly built houses must comply with mandatory regulations applying ZEB construction. By 2030, ZEB development must achieve the goal of using energy economically and effectively to contribute to reducing the country's total energy consumption by about 62 million kj by 2030. In that case, industries reduced by 13.5 million kj (including LED lighting: 1.08 million kj, industrial heat pumps: 0.88 million kj, efficiency motors and inverters: 1.66 million kj, energy management according to the FEMS system is 0.74 million kj); Housing sector reduced by 12.1 million kj (including LED efficient lighting: 1.93 million kj, improved energy efficiency of household appliances: 1.73 million kj, economical home Zero Energy House (ZEH) energy: 3.44 million kj); Commercial sector reduced 13.8 million kj (of which LED lighting reduced 1.95 million kj, improving equipment efficiency reduced 3.42 million kj, energy management through Building Energy Management System (BEMS): 2.38 million kj, ZEB energy-saving buildings decreased by 5.46 million kj); The transportation sector decreased by 23.1 million kj (including the advanced generation cars decreased by 9.90 million kj, effective freight transportation decreased by 8.52 million kj, effective passenger transportation decreased by 4.63 million kj).

- Accurately identify 4 key areas of technical innovation and creativity to achieve ZEBs: (1) Minimize energy consumption in areas related to architectural planning, building shapes, reasonable layout of rooms and spaces in the building, construction methods, selection of materials to build the structure covering the building...; (2) Areas related to energy efficiency of equipment systems in buildings; (3) Establish and utilize renewable energy (mainly solar radiant energy) to provide electricity for the project; (4) Energy saving related to methods of operating, controlling and managing the building's equipment system.

- Japan has proposed policies to encourage and preferentially develop ZEBs, label ZEBs, and provide technical guidance on the design and construction of ZEBs. Conduct evaluation, selection, recognition, and awarding star for actual ZEBs.

- Promote propaganda and dissemination of knowledge and improve awareness and skills of designing and constructing ZEBs in Japan, with special attention being given to investors in society and architectures, engineers, construction engineers and engineers in related fields at Institutes and Centers for design and research in construction and architecture.

#### 4. SOME RECOMMENDATIONS ON DEVELOPING ZEB IN VIETNAM

In Vietnam, since the first decades of the 21<sup>st</sup> Century, legal documents have been issued such as: Decrees of the Government, regulations and standards on the development of buildings that use energy efficiently and economically. Currently, there are a number of architectural constructions that have been evaluated and recognized as efficient and energy-saving projects, or as green buildings, green urban areas, but there is almost no information or plans on construction and development of ZEBs. Meanwhile, the Government announced a commitment at the COP26 Conference to reduce GHG emissions to reach "net zero" emissions by 2050, therefore Vietnam must urgently develop ZEB projects in the near future. From experience developing ZEB in Japan, there are some recommendations on developing ZEBs in Vietnam as followings:

*Firstly*, the Government needs to issue regulations on the development of ZEBs. Currently, the State has issued legal documents on economical and efficient use of energy, such as: Decree No. 21/2011/ND-CP - Detailing the Law on Economical and Efficient use of energy and measures for its implementation; Decree



No. 134/2013/ND-CP stipulates regulations on sanction against administrative violation in the field of electricity, safety of hydroelectric dam, thrifty and effective use of energy; Decree No. 15/2021/ND-CP on elaborating certain regulations on management of construction projects; Decision No. 280/QĐ-TTg, dated March 13<sup>th</sup>, 2019 on approval of the National Energy Efficiency Program for the period of 2019 - 2030 was issued by the Prime Minister; National technical regulations on buildings that use energy economically and efficiently (QCVN 09: 2017/BXD)... These are important legal bases for promulgating regulations on the development of ZEB.

*Secondly*, it is recommended to establish a specialized department at the Ministry of Construction to manage the development of energy efficient buildings and ZEBs. This organization will closely coordinate with relevant organizations such as the Ministry of Industry and Trade, Ministry of Natural Resources and Environment to manage the development of energy efficient buildings, green buildings and ZEB. It is necessary to overcome the current situation of loose management and development of energy efficient and green buildings.

*Thirdly*, build and plan the development of energy efficient buildings and ZEBs until 2030 and a vision to 2050 in a detailed and specific manner similar to the Development Plan for ZEB in Japan.

*Fourthly*, promulgate preferential policies and encourage the development of green buildings and ZEBs: The private sector is an important factor promoting the development of green buildings and ZEBs. However, many private investors do not understand the benefits of green buildings and ZEBs, so they do not invest in construction of green and ZEB buildings, because it will incur more costs or risks. Therefore, it is necessary to develop and issue policies and mechanisms to remove barriers and obstacles for green buildings and ZEB development; Develop monetary and non-monetary incentives for private economic sectors investing in green buildings and ZEB construction (monetary incentives such as: green buildings or ZEB investors are given priority loans with low interest rates, tax deductions and other financial incentives; non - monetary incentives such as: Labeling with green buildings and ZEB; or Selection, recognition and certification for buildings that meet the criteria of green buildings and ZEB; The State rewards the investor of the project and the design consultancy for special constructions and zeb buildings). At the same time, it is necessary to issue regulations, standards, design standards and construction of green building and ZEB.

*Fifthly*, promote propaganda and dissemination of knowledge and improve awareness and skills in designing and constructing ZEBs. The subjects of special attention are investors in society and architects, construction engineers and engineers in related fields at Institutes and research centers for construction and architecture.

*Sixthly*, focusing on training and improving the capacity of human resources for design and construction technology, developing energy efficient buildings, green buildings

and ZEB. International experience shows that to develop energy efficient buildings, green buildings and ZEB quickly and firmly, it needs to be tried to re-train and complement knowledge for architects and construction engineers, and engineers of related industries who are currently operating in the construction industry, as well as training generations of future architects and construction engineers on skills and design principles and technology for green buildings and ZEB, including the following specific activities: (1) Organize training courses for experts on design and construction of green and ZEB buildings for architects, construction engineers and engineers of other relevant industries (environment, energy, materials, equipment indoors...) who are currently working in the construction industry; (2) Organize training courses to enhance the management and appraisal of green and ZEB constructions for state management agencies; (3) Complementing knowledge about green buildings and ZEBs and renovating university and university training programs for related industries, to have human resources for developing green and ZEBs, in order to effectively implement the country's sustainable development goals ■

## REFERENCES

1. Phạm Ngọc Đăng (Editor). *Green building design solutions in Vietnam*. Construction Publishing House. Hanoi - 2014.
2. Phạm Thị Hải Hà. *Obstacles and opportunities for implementing energy equity projects (ZEB) in Vietnam*. Report at the international workshop "Sharing experiences in developing and implementing ZEB in Japan and recommendations for Vietnam", in Hanoi, August 9<sup>th</sup>, 2023.
3. Yoshita Usshio. *Update on ZEB situation and policy in Japan*. Report at the International Conference "Sharing experiences in developing and implementing ZEB in Japan and recommendations for Vietnam", in Hanoi, August 9<sup>th</sup>, 2023, (Vietnamese version).
4. Hajime Moroo. *Content of ISO/TS23764 Standard and its application in the policy framework*. Report at the International Conference (Vietnamese version).
5. Masayuki Ichinose. *ZEB for Carbon Neutral Construction*. Report at the international conference (Vietnamese version).
6. Manbu Narimatsu. *Advanced technology optimizes renewable energy, aiming for energy-balanced buildings (ZEB)*. Report at the international conference (Vietnamese version).