VIETNAM ENERGY EFFICIENCY BUILDING WEEK 2021

Tuần Lễ Công Trình Hiệu Quả Năng lượng Việt Nam 2021

# BUILDINGS & CITIES

## RACE TO NET-ZERO

EEN VIETNAM ENERGY EFFICIENCY NETWORK

An initiative of VSSE

# PROCEEDING OF THE OPENING WORKSHOP'S VIETNAM ENERGY EFFICIENCY BUILDING WEEK 2021
# BUILDINGS & CITIES: RACE TO NET-ZERO

Hanoi, Vietnam
November 3, 2021

Vietnam Energy Efficiency Building Week 2021 (VEEBW 2021) is hosted by the Vietnam Energy Efficiency Network (EEN-Vietnam) and supported by the Goethe-Institut and Friedrich-Ebert-Stiftung Vietnam (FES). The three-event program is co-hosted by the World Wild Fund Vietnam (WWF), the International Energy Agency (IEA), GIZ's Commercial and Industrial Rooftop Solar (CIRTS) and LIXIL Corporation's brand - GROHE. VEEBW 2021 also has the participation of expert partners includes Katholieke Universiteit Leuven (KU Leuven), Hanoi University of Civil Engineering (HUCE), University of Science and Technology - the University of Da Nang (DUT), Except Integrated Sustainability, Edeec Ltd, and Vietnam Institute of Building Materials (VIBM). The program is sponsored by Royal HaskoningDHV Vietnam, Phuc Khang Corporation and Elithis Asia.

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# ABBREVIATIONS

| | |
|---|---|
| AAC | Autoclaved Aerated Concrete |
| BAU | Business as Usual scenario |
| BM | Building material |
| GDP | Gross Domestic Product |
| NDC | Nationally Determined Contribution |
| NZEB | Net-zero energy building |
| OPCC | One Planet City Challenge |
| OTTV | Overall thermal transfer value |
| PCM | Phase changing materials |
| PDP 8 | National power development plan in 2021- 2030 with a vision toward 2045 (Power Development Planning 8) |
| SHGC | Solar heat gain coefficient |
| U | Thermal transmittance |
| VEEBW | Vietnam Energy Efficiency Building Week |
| VIBM | Vietnam Institute for Building Materials |
| VLT | Visible light transmittance |
| QCXDVN | Vietnam Technical Regulations on Construction |
| WWF | World Wildlife Fund |

# INTRODUCTION

Given the climate change happening, construction industry plays an important role in achieving greenhouse gas emissions reduction targets. According to World Green Building Council (WGBC), construction industry accounted for 40% total of greenhouse gas emissions and 50% total of resource consumption globally in 2021. In developed countries, net-zero energy building (NZEB) has become an internationally-accepted solution combining building design to minimize energy needs and renewable energy systems that meet these reduced energy demands in order to tackle carbon emissions in the construction sector. However, the complexity of this concept creates huge technological and resource barriers, impeding to the development of NZEBs and net-zero target in Vietnam, especially in major cities in Vietnam.

Vietnam Energy Efficiency Buildings Week (VEEBW 2021) coordinated by Vietnam Energy Efficiency Network (EEN-Vietnam) features three events where experts, institutions and organizations from fields of architecture, building, construction and energy in Vietnam and developed countries come together to discuss about the common goals of NZEBs development. With this collective effort, the program offers an opportunity to provide a comprehensive approach to low-carbon city planning development strategies, application of innovative solutions and technologies in regard to building design, materials and renewable energy system for the development of NZEBs.

"Buildings & Cities: Race to Net-zero" is the Opening Workshop of VEEBW 2021 aiming at developing the strategy of construction industry with lessons learned from international experiences. The event attracted great attention of top-leading experts, enterprises, engineers, architects, investors and stakeholders in the fields of energy, construction, architecture and urban planning. The Proceeding of the Opening Workshop "Buildings & Cities: Race to Net-zero" comprises of short articles followed by question-and-answer sections from the speakers sharing case studies and initiatives of world-leading urban NZEBs and providing their thoughts on opportunities and challenges of Vietnam's construction industry. Furthermore, the context of Vietnam is positioned in the center of the discussion with an aim to discover meaningful and feasible ways forward for the development of NZEBs in Vietnam.

# GREEN & SUSTAINABLE CITY INITIATIVES

## Launching Vietnam as a Southeast Asian leader in sustainable development

*Tom Bosschaert & Sonia Gholami, Director, Except Integrated Sustainability*

Vietnam is turning a new page in its history. As it continues to experience rapid economic development, the country now has the opportunity to determine its long-term future. If it decides to become the first Asian country to widely adopt sustainable development policies, Vietnam could establish itself as a major innovator in the region. Despite having a strong economic position today, Vietnam has to deal with a number of long-term challenges, most of which affect the entire region of Southeast Asia. Air pollution, as well as poor solid waste and water management are some of the most pressing ongoing issues. Moreover, the nation faces threats to food and water security, as well as the consequences of population growth amidst rapid urbanisation and industrialisation.

Vietnam is expected to soon start experiencing the severe impacts of climate change and rising sea levels. According to the medium-high emission scenario, by the year 2050, Vietnam will have less rainfall during the dry season, affecting agriculture, industry, and water security. In this scenario, Vietnam will also face a sea-level rise of at least 1 meter, resulting in the permanent flooding of 15-20.000 $km^2$ in the Mekong Delta alone (Vo Thanh Danh, 2014). Climate change is expected to affect more than 11% of the Vietnamese population on an annual basis. The serious nature of these and other related problems makes it imperative that these challenges are dealt with promptly. Far from being unique to Vietnam, these challenges also threaten most Southeast Asian countries. In fact, one-third of the region's population live in areas susceptible to rising sea levels, soil degradation and seasonal flooding. At the same time, Southeast Asian nations have to deal with air pollution, deforestation, water security issues, and increased urbanization given its relatively open economy and culture, Vietnam has the opportunity to leverage its recent socio - economic achievements and become the region's leader in sustainable development. Specifically, looking up to 2030, Vietnam will need to focus on adopting innovative and sustainable approaches to its housing, energy, food, water and industrial systems. Although this process will require certain investments, it could make Vietnam the fastest growing sustainable economy in Asia, while preempting the issues that would otherwise affect its population. The rising housing construction (about 1.5 million housing units per year) is the most potent economic cycle capable of boosting Vietnam's sustainability profile (Statista, 2021). With relatively little additional investment, newly built cities and housing neighborhoods can be turned into sustainable development projects that could help Vietnam achieve considerable progress. For this reason, Except Integrated Sustainability has determined that Vietnam is ideally suited as one of the optimal countries to develop Orchid City, the first integrated sustainable city.

Orchid City is an example of such an integrated sustainable city development. It is a blueprint designed to address all the aforementioned challenges simultaneously. The holistic blueprint enables the construction of an affordable, fully self-sufficient city capable of meeting all daily needs, from housing and education to work and production. The project addresses social, environmental, financial, and material challenges, meeting the needs of the present without compromising the welfare of future generations. In this sense, integrated sustainable cities go beyond the function of smart cities, which tend to focus only on technological aspects, thereby insufficiently addressing social and environmental challenges. By integrating all the aspects of life into a single self-contained environment, Orchid City is able to tackle a wide range of issues, as well as have a higher overall performance while reducing development expenses.

Orchid City is self-sufficient in energy production and self-sustainable in all areas, including water and waste management, food production, employment, social services, and educational programs. The designs are circular, flood-proof, climate adaptive, and carbon negative. Food is produced inside the cities using bio-organic sustainable agriculture, allowing for fresh affordable food, as well as sustainable jobs for rural dwellers. The cities can be built with mostly bio-based construction and operation materials. The models are scalable for developments of anywhere between 500 and over 50.000 houses. They provide affordable housing, create jobs, and deliver an attractive return on investment. With the innovative sustainable city design as a vessel, Vietnam can secure its position as a leader in Asia for the next cycle of economic development. It is an exceptional opportunity for the country to become the regional leader in sustainable urban and rural development. Consequently, Vietnam's role in sustainable development could attract substantial foreign investment that would benefit both the financial sector and the Vietnamese population as a whole. In the following year, we aim to build strong partnerships with Vietnamese government agencies, contractors, suppliers, and educational institutions. Once established, these relationships could lead to the rapid design and construction of sustainable cities in Vietnam and beyond. The success of the project in Vietnam would establish a new standard in sustainability in the region, which could spark further sustainable development on a local, national, and international scale.

## Q&A

**What are the differences between Orchid City and a smart city?**

Smart cities are focused on implementing new technologies to increase the performance of existing city models. Orchid City fundamentally re-addresses the way we design, build, and live in our cities from the ground up. In this way, with Orchid City, technology becomes less of a focus, but more of a tool to support a much larger performance improvement, while also being able to use already existing technologies. In short, OC has lower cost, higher performance, and is ready to be implemented right away.

**Why did you choose Vietnam as one of the three countries in which you intend to launch the Orchid City model?**

We scanned the globe for locations that would be sufficiently developed in terms of their market and culture, while also being faced with critical challenges related to climate change, environmental management and housing. We believe that Vietnam stands to gain greatly from investing in sustainable development both economically and in terms of safeguarding its own future. Moreover, we also believe that Vietnam is capable of capitalizing on this opportunity politically and becoming a frontrunner in sustainable innovation in Asia.

**Could you evaluate the current feasibility of the Orchid City model and the obstacles it may face in Vietnam?**

The feasibility study of Orchid City Vietnam, specifically of the selected Mekong Delta location, was conducted during the model development stage. It took into account all the local landscape, climate, economy, and culture characteristics and challenges. The most challenging aspect of implementing Orchid City is also its most powerful one: its integration of sustainable food, energy, and water production. To that end, Orchid City requires suitable land and surroundings. Finding the location, connecting with the local governments and investors in order to acquire it, and building the master plan is the most challenging step. Once this stage is completed, large scale real estate investment in the project should be relatively easy to procure.

"The holistic blueprint enables the construction of an affordable, fully self-sufficient city capable of meeting all daily needs, from housing and education to work and production."

**Tom Bosschaert**

*Direator, Except Integrated Sustainability*

# Assessment on current state of Da Nang city and a low-carbon model proposal in 2040

*Assoc. Prof. Dr. Arch Nguyen Anh Tuan, University of Science and Technology, the University of Da Nang*

## Introduction

Based on the idea of establishing a "low-carbon economy" (United Kingdom Department of Trade and Industry, 2003), the low-carbon city model has become a new target for cities in the context of energy crisis and climate change. The goal of low-carbon cities is to adopt sustainable development solutions to minimize $CO_2$ emissions (Figure 1). In Vietnam, with the help of organizations and other countries in providing information, technical solutions, and financial resources, the low-carbon city model has been already implemented in a number of cities, including Da Nang, where the Ngu Hanh Son district was selected for pilot application (M. Itakura, 2013). Since data from Da Nang show that $CO_2$ emissions come from many different activities (Figure 2), implementing the low-carbon city model in the city requires the participation of various sectors and multiple synchronous solutions.

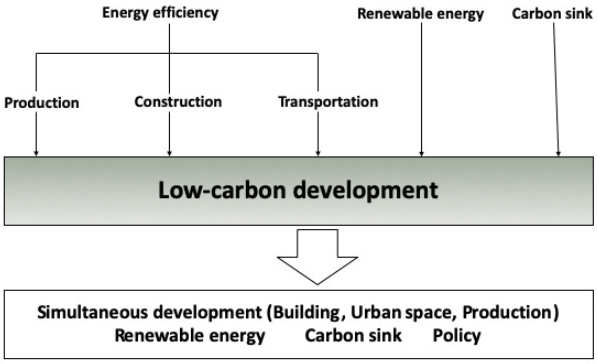



*Figure 1. Concept of a low-carbon city (United Kingdom Department of Trade and Industry, 2003)*

On the basis of analyzing successful models around the world and from China specifically, the research group of Baeumler et al has introduced action solutions towards the goal of creating low-carbon cities including energy; urban traffic; management of water, waste, air pollution, and other solutions. (A. Baeumler et al., 2012). Towards the goal of "The typical low-carbon capital of the world by 2025", the London model has been introduced as an example, with four specific steps as follows:

Step 1: Determine the city's baseline greenhouse gas emissions in 2002.

Step 2: Set a goal of reducing $CO_2$ emissions by 60% by 2025, and by at least 80% by 2050, compared with the 1990 levels. Pledge to become a carbon-free city by 2050 (BreatheLife, 2018).

Step 3: Establish policy and supporting activities, including 17 strategies, which would contribute up to 40% of intended emission cuts.

Step 4: Monitor and report $CO_2$ emissions (both direct and indirect) over time, and continuously refer to them each year, to make sure the city is on the right track throughout the carbon reduction process.

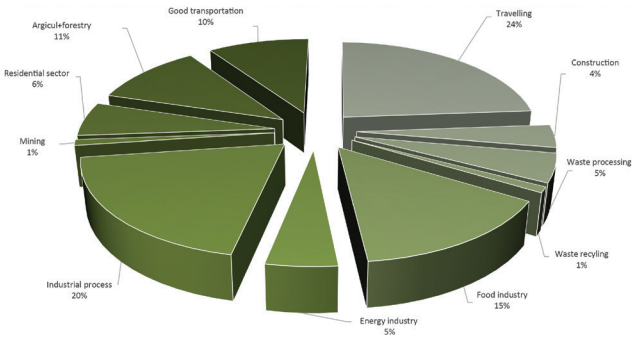



*Figure 2. Sources of $CO_2$ emissions in Da Nang in 2010 (Da Nang city Department of Natural resources and Environment, 2011)*

## Status of the pathway toward a low-carbon city of Da Nang

Da Nang currently has the advantage that its citizens' living standards and energy needs are still relatively low compared to those of people living in developed countries. At the same time, the city

| Da Nang | Beijing | Shanghai | Stockholm | Tokyo | Singapore | London | New York |
|---|---|---|---|---|---|---|---|
| 1.65 | 10.1 | 11.7 | 3.6 | 4.9 | 7.9 | 9.6 | 10.5 |

*Table 1. $CO_2$ emissions per capita in Da Nang and other urban areas (unit: tons of $CO_2$e/person) (D.R. Ostojic et al., 2013, A. Baeumler et al., 2012)*

dwellers of Da Nang follow a low-emission lifestyle (Table 1). Therefore, it is necessary to promote the implementation of a low-carbon city in Da Nang, making it easier to achieve $CO_2$ emission control targets. In recent years, Da Nang city has undertaken a number of important first steps as follows:

1. Execution of a pilot low-carbon model in the Ngu Hanh Son district in 2011 (sponsored by World Bank).
2. Completion of a city-wide carbon emissions inventory in 2016 (sponsored by the Department of Natural Resources and Environment and the Department of Industry and Trade).
3. Successful implementation of the Environmental City project phase 1 (2010 - 2020) and continued pursuit of the phase 2 project (2020 - 2030).
4. The setting of ambitious carbon emission reduction targets (by 25% from 2016 emissions before the year 2030).
5. Approval of an action plan to respond to climate change and reduce emissions for the 2021 - 2030 period, with a vision to 2050.
6. Achievement of the title of the National Green City of Vietnam in 2018 granted by WWF.

Based on the roadmap for achieving the low carbon target, Da Nang needs to complete two more important steps: (1) Enacting new polices and favourable activities and (2) Continuous monitoring and reporting of $CO_2$ emissions. Given the resources required to achieve these goals, the implementation of a low-carbon economy presents a serious challenge.

## A proposed model for Da Nang

In order to become a low-carbon city, Da Nang needs to follow a multi-sectoral strategy to reduce $CO_2$ emissions and to achieve the sustainable development goal based on the significant characteristics of the city.

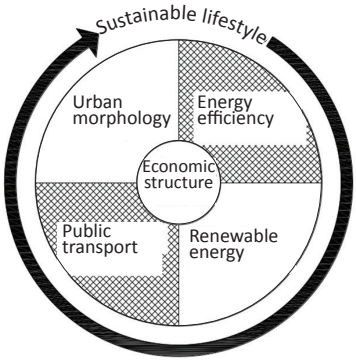



*Figure 3. Proposed low-carbon model of Da Nang city (Source: author)*

Figure 3 presents our proposal with the basic steps for Da Nang to become a low-carbon city.

First, the city must make constant efforts to reduce carbon emissions by maintaining and promoting energy - saving measures, especially in industrial production, energy production, and housing. At the same time, it is necessary to promote the use of clean and renewable energy sources.

Second, the city needs to reduce carbon emissions in the transportation sector through the application of smart transportation technology, the development of high - quality public transport, and the promotion of other non - emission transportation modes.

Third, in master planning and detailed urban planning, spatial morphology and organization should be given special attention. Cities with higher density are likely to have lower greenhouse gas emissions (Figure 4). Additionally, public transport networks and a more compact urban form make cities not only more crowded, but also smarter.

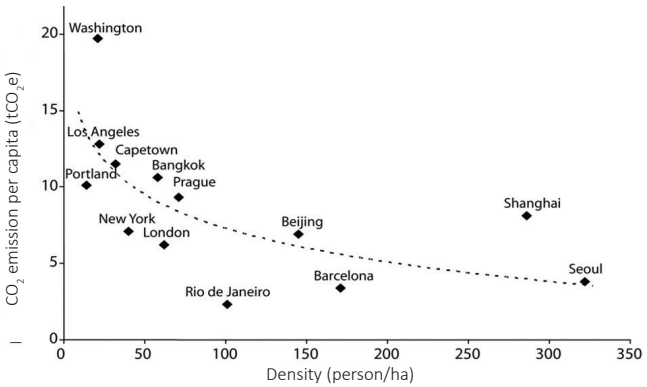



*Figure 4. Population density and $CO_2$ emissions (A. Baeumler et al., 2012)*

Above all, the city needs the support and advocacy of the local people in form of the universal adoption of a low-carbon, resource-efficient lifestyle. With the increasing standard of living and energy demand, a low-carbon lifestyle is a crucial factor in reducing the city's energy dependency. Finally, the city needs to implement policies that would adjust the structure of the entire economy so that Da Nang's future GDP growth would focus primarily on services and clean industrial production.

## Q&A

### What are the important factors that need to be addressed in making cities green and carbon-neutral?

Since $CO_2$ emissions come from many different activities, implementing the low - carbon city model in Da Nang requires the participation of various sectors and the development of multiple synchronous solutions. The key action areas involve energy use, urban traffic, water and waste management, and air pollution, among others. However, the implementation of any solutions is often difficult due to the lack of synchronization between the policies, resources, and the compliance of the people. In developing countries, in general, the low - carbon city model often witnesses stagnation after the policy issuance. From our research, the key to achieve the low-carbon goals is mainly based on the people's lifestyle while management policies play a role of in-principle guidance and external resources serve for the purposes of setting driving force and the prerequisite to foster the low – carbon transition.

"In order to become a low carbon city, Da Nang needs to follow a multi-sectoral strategy to reduce greenhouse gas emissions and to achieve the sustainable development goal based on the significant characteristics of the city. "

**Assoc. Prof. Dr. Arch Nguyen Anh Tuan**

*University of Science and Technology, the University of Da Nang*

*(Continued from page 13)*

## Q&A

### How would you evaluate the current status of urban planning in Vietnam and in Belgium?

We observe that the focal point in urban expansion in Vietnam is the rapid urban growth towards metropolitan areas. The rate of urbanization is higher in smaller cities than in large ones. A good example of this phenomenon is the Ha Tinh region. In Belgium, urban development is being regulated on a regional level. Since open space is limited, there is a tendency to conserve the remaining open space. Each day, 6 hectare of land are taken away in Flanders. The authorities intend to lower this figure by the year 2030. Currently, despite the existence of several ambitious policy plans, there is no political agreement on a specific plan. Additionally, the scope of densification of the existing centers in the vicinity of transportation junctions is rising rapidly. The real estate market continues to push for urban expansion in city centers.

### How could the multi-stakeholders approach help optimize the built environment?

The multi - stakeholder approach may be the key to finding an inclusive solution. It is aimed at keeping the focus on the users and the citizens, who otherwise have a very limited platform to contribute to the design of the built environment. Typically, the users of buildings have been identified as passive 'recipients' of the end-product, even though they may come up with innovative ideas. Therefore, it is important to pay attention to their opinions. It is also a big challenge for the real estate market to apply dramatic changes. This also involves the public legislation aspects as well. Public sectors should invest on very low energy buildings as a good model to drive the construction industry towards a better built environment.

# A Belgium–Vietnam cooperation on urban climate resilience

*Dr. Nuri Cihan Kayaçetin, Prof. Alexis Versele, KU Leuven, Department of Civil Engineering, Building Physics and Sustainable Design Unit, Technology Campus Ghent, Belgium;*
*Dr. Ngo Hoang Ngoc Dung, Dr. Nguyen Tien Dung, Hanoi University of Civil Engineering (HUCE), Hanoi, Vietnam*

## Introduction

Urban metabolism is a complex structure with various sub-domains such as urban planning, transportation, building typologies, sociology, and public ownership. Hence, a multi-stakeholder approach is both a necessity and an advantage that combines the fragmented pieces of expertise in an interdisciplinary fashion. Most of the sectors involved call for a new approach to move the construction sector towards "smart" buildings and cities (Ballon, 2017). In order to gain a new perspective on optimized and sustainable neighbourhood development, a team of Belgian and Vietnamese experts set out to investigate urban development in an international context by utilizing a research methodology based on the quadruple helix framework (Carayannis & Campbell, 2009). In this context, the research questions are considered from the perspective of the entities that are an integrated part of the framework: (1) Academia, (2) Civil society, (3) Industry and (4) Government. The Global Minds programme funded by the Belgian Development Agency through VLIR-UOS enables collaborative research on urban development in Belgium and in Vietnam, as well as in other South Initiative countries.

## Urban Climate Resilience

A considerable amount of research has explored issues related to smart buildings, cities and urban areas (Ballon, 2017, Caragliu et al., 2011). The main focus of these researches is to utilise information technology developments to process the immense data on urban environments. To have a broader perspective on urban development, the Ecopolis framework developed by Tjallingii (1995) was analysed in detail. In Table 1, the Ecopolis framework displays the three key qualities of a city as being responsible, living and participating.

## Research Questions

The need to optimize the built environment originates from the pressure of urbanization. Urban growth results in two specific consequences:
First, a central urban densification, which increases the building density and calls for new buildings and urban typologies. This approach decreases the overall quality of life and has adverse environmental impacts (air pollution, the heat island effect, and excessive amounts of waste, among others).
Second, a suburban development, which creates satellite cities with low building density and calls for new development on agricultural land. This approach increases the economic and environmental impact of transportation. It also replaces valuable agricultural land needed to sustain the increasing population. This project aims to find methods to convert data from building and urban physics, as well as from material flows, into meaningful decisions for sustainable building and urban development.

## Belgian Context

In many neighbourhoods in Flanders, the building stock originates from the large city expansion projects that answered the rising demand for housing in the vicinity of large 19th century factory buildings of the industrial revolution. In most cases, these buildings are concentrated in neighbourhoods housing the most vulnerable households (Vanderstraeten, 2021).

*Kick-off meeting of the project "Optimization of Built Environment in Neighbourhood Scale"*

In Ghent, specifically, a number of initiatives have focused on the renovationof the neighbourhoods in the belt of the city. Since the 1970s, the city started to stimulate renovation projects on a systematic basis by designating 'urban renovation districts' that received special financial resources and subsidies. The project's goal has been to generate added value in three areas:

1. Social added value: social justice, improved social contacts and cohesion.
2. Ecological added value: reduced environmental impact, $CO_2$ emissions, waste, etc.
3. Economic added value: employment, improved quality of life and health.

Lombardi (2011) performed a detailed analysis of the ways in which the quadruple helix approaches were adapted to smart cities. In a case study of Flanders (Idea, 2019), a similar approach was utilized in order to systematically tackle issues related to urban areas and several new policies had been generated. Moreover, the "Climate Neutral" wave in Flanders provides a solid background for the context of net-zero development in Flanders. Specifically, the 'ZECOS' project developed a zero $CO_2$-eq emission certificate system as a tool for sustainable communities in an inter-regional project, including 44 urban areas as case studies.

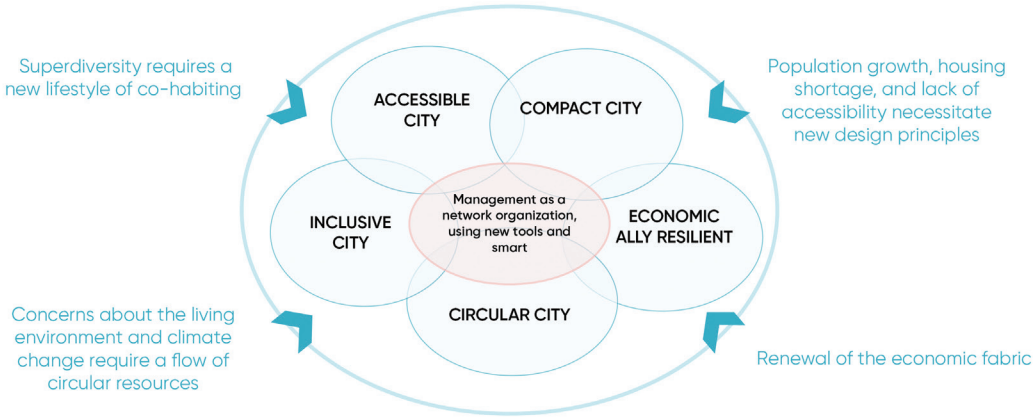



*Figure 1. Five transitions for cities (Idea, 2019)*

## Methodology

The Quadruple Helix is an innovation and collaboration model with a citizen/ end-user perspective. It is useful in an innovation process where the user needs are central, in this case the urban context. As shown in Figure 2, the helix approach was interpreted and utilized for identifying the flow of input and output data between project partners. The data flow was often determined as an iterative process where certain stakeholders receive data and process them into refined knowledge, which they then transfer back to other partners.

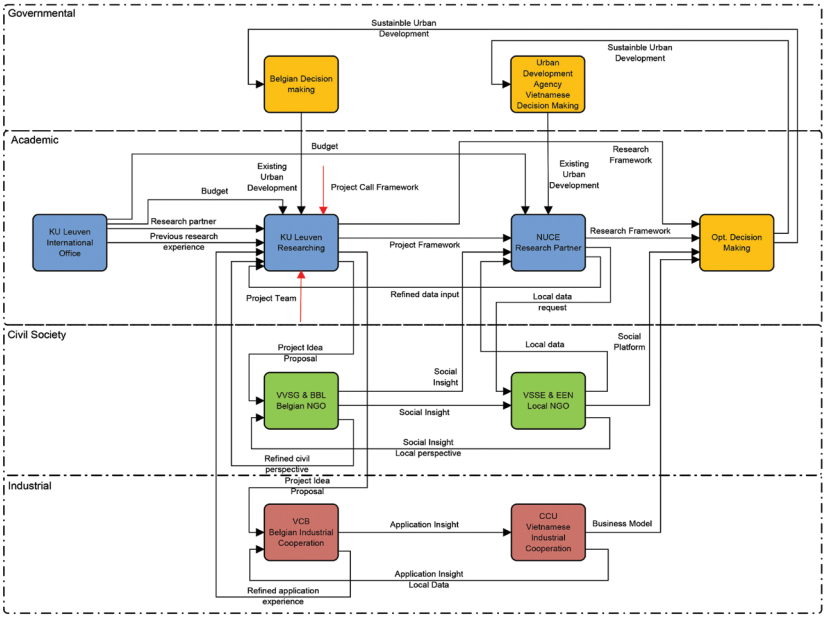



*Figure 2. Quadruple helix framework for the GM-MSH Project*

This data flow was analysed thoroughly, resulting in the development of an E-Tool for reception of different stakeholders. The tool was designed to provide both data input method and specific output for each stakeholder. In Figure 3, a workflow of the software is presented as an iterative process.

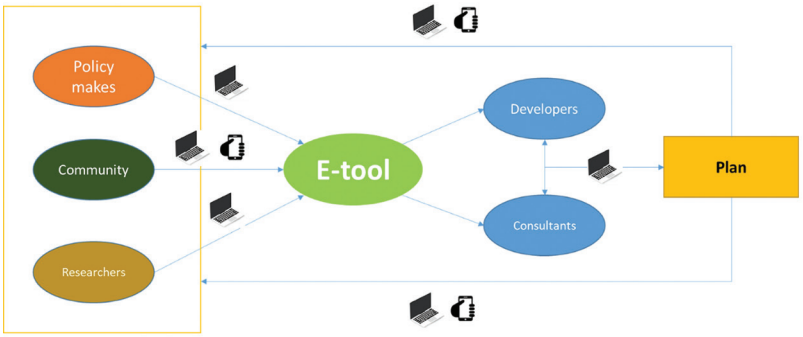



*Figure 3. E-Tool workflow*

## Data Collection

In order to achieve the goals of this approach, case studies from each country (the Dampoort district in Ghent, Belgium and the Nghia Tan neighbourhood in Hanoi, Vietnam) were conducted. For optimized solutions, the methodology was carefully tested for data collection and analyses. The data were collected using the following means: User surveys, on-site measurements and international workshops.

*Figure 4. Measurement campaign conducted at the Nghia Tan neighbourhood*

## Conclusions

The ultimate purpose of this study is to develop a practical business model that would enable the creation of a non-profit consulting office attuned to input from the public, the private sector, and academic organizations. It is expected that the organization would provide consulting on collective neighbourhood renovations and neighbourhood developments.

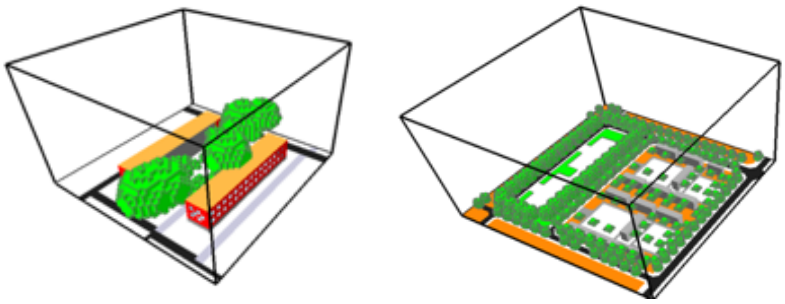


*Figure 5. An ENVI-Met simulation model of the Nghia Tan neighbourhood, (left) and of the urbanized peri-urban neighbourhood of Ha Tinh (right)*

| Categories | Responsible City | Living City | Participating City |
|---|---|---|---|
| **Object** | Flows | Areas | Participant |
| **Social objective** | Production - Quality | Usefulness - Attractiveness | Prosperity - Well-being - Justice |
| **Problems** | Depletion Pollution Disturbance | Health - Functions | Alienation - Indifference |
| **Eco objectives** | Sustainable flow mng - Planning for prevention | Sustainable use of areas<br>Planning with local potentials | Sustained commitment to ecological relations |
| **Policy** | Source oriented chain management | Effect or ienting area management | Target policy group |
| **Guiding principles** | Economical in use - Reuse - Renewable sources - Responsibility for material flows | Use for local, natural and cultural potential - Spatial structure for flows - Health and human habitat - Habitat, corridors for wildlife | Creating conditions for market operation and cooperation - Ecological relationships - Enforcement |

*Table 1. Ecopolis Strategy Framework (Tjallingii, 1995, 2005)*

*(Continued on page 10)*

# Challenges and Criteria for One Planet City Challenge program (OPCC)

*Vu Quoc Anh, Project Manager cum VCCA/CCWG Coordinator, WWF-Vietnam*

The One Planet City Challenge program (OPCC) initiated by the WWF International and implemented by WWF Vietnam has an ambitious objective for Vietnam: to reduce $CO_2$ emissions by 2030 in Vietnamese cities in order to actively contribute to the conditional target of the country's Nationally Determined Contributions (NDCs) and Paris Agreement goals (25% $CO_2$ emission reduction) and to accelerate the movement named "Race to Zero".

Despite receiving passionate support from the national and provincial authorities, the project has faced difficulties in public engagement due to the ongoing Covid-19 pandemic. OPCC plans to encourage cities to meet commitments on carbon adaptation and mitigation, as well as to attempt implementing green solutions nationwide.

There are numerous challenges in motivating cities to join the program. Above all, most Vietnamese cities have never conducted a carbon inventory assessment, and those that have did it are unsystematic and inconsistent. Athough carbon inventories assessments is considered an important activity to store and aggregate data on carbon emissions across economic sectors, there are many challenges in accessing the complete and accurate data. Furthermore, some of the cities that are most suitable to participate in OPCC have already been engaged in previous OPCC projects. Other cities face the challenge of meeting the Carbon

"Carbon inventories assessments is considered an important activity to store and aggregate data on carbon emissions across economic sectors, there are many challenges in accessing the complete and accurate data."

**Vu Quoc Anh**

*Project Manager cum VCCA/CCWG Coordinator, WWF-Vietnam*


Disclosure Project's (CDP) climate criteria, which require higher standards based on the 1.5°C Paris Agreement. This can be difficult and demotivating for cities because they have limited competence and Vietnam's NDC only commits to a 9% carbon reduction, or 27%, conditional on international support.

Although it may be challenging to meet OPCC's targets, there are examples from around the world that demonstrate the project's value, many of which involve urban nature-based solutions (UNbS). For instance, the Bosco Verticale ("Vertical Forest") in Milan, Italy is a successful example of an effective urban nature - based solution project. Consisting of two residential towers enveloped by dense vegetation, the development has managed to transform a neglected 34 ha area into a thriving business and residential district. The project's benefits include disaster risk reduction, improved air quality, reduction of $CO_2$ emissions, employment creation, and social benefits. In order to achieve the low carbon emissions necessary for the development of green and resilient cities in Vietnam, OPCC has established criteria that evaluate the city's climate targets and their alignment with the Paris Agreement shared by other cities. The criteria include (1) Political commitment, (2) Mitigation targets, (3) Adaptation targets, (4) Emissions reporting, (5) Climate change risk or vulnerability assessment, (6) Mitigation actions in the climate action plan, and (7) Adaptation actions in the climate adaptation plan.

The more committed the government is at the national and provincial level, the higher the chances of a successful outcome. With the OPCC, cities can be guided towards effective climate action, with the most ambitious cities recognized as leaders in the field.

## Q&A

**What are some challenges in motivating Vietnamese cities to promote green solutions and move toward the race to net-zero?**

Despite showing interest in green solutions, Vietnamese city authorities are facing numerous technical and financial difficulties in identifying the appropriate course of action in areas such as energy, transportation, waste management, and services. In addition, the authorities need to put more effort into implementing greenhouse gas inventory measures in all major emitting sectors at the community level.

**What are the key factors in making Vietnamese cities low carbon and green?**

The effort to make Vietnamese cities green requires an inclusive and multi - stakeholder approach. The key factor is each city's people's committee's motivation and long - term strategic orientation towards setting emission reduction targets and promulgating the appropriate policies.

**What can Vietnam learn from cities across the world?**

Many of the world's cities, particularly those in Europe, have had practical experience in implementing green solutions. Specifically, their adoption of nature-based solutions to benefit the community and preserve nature and habitats has been recently discussed in OPCC's sustainable development networks. It provides useful guidelines for cities that are prioritizing green development and want to join the OPCC program, especially involving the application of technical measures.

**What are the key roles in the effort to promote green cities?**

Each city's people's committee plays a crucial role in coordinating a consistent and comprehensive approach to climate change. The input from research institutes and universities is also essential in formulating effective green solutions. Another important factor is the role of businesses and civil society organizations in promoting and investing in green initiatives that are implemented successfully. Finally, the community is responsible for realizing the implemented green policies and the beneficiary of the initiatives, serving as a strong rationale for the sustainability of the initiatives.

# FACTORS CONTRIBUTING TO NET-ZERO ENERGY BUILDINGS

## Energy efficient buildings toward net-zero carbon emission

*Tran Thanh Vu, Director of Edeec Co. Ltd,*
*President of International Building Performance Simulation Association – IBPSA Vietnam*

In recent years, the Vietnamese government has been implementing a number of policies aimed at promoting the development of green and efficient buildings. Since promulgating the first National Energy Efficiency Building Code QCXD 09:2005, the Ministry of Construction has issued the amendments to the technical regulations in 2013 and 2017. In June 2020, the Government has for the first time amended Law 50/2014/QH14 dated 18 June 2014 on construction to make energy saving solutions mandatory in the planning and designing of buildings. Decree 15/2021/ND-CP dated 03 March 2021 of the Government on management of construction investment projects continues to emphasize the mandatory implementation of energy savings for construction, encouraging resource efficient buildings and green buildings. Finally, in July 2021, the Government set its priority in the Decision 1246/QD-Ttg on orientation of development of Vietnamese architecture to 2030, vision to 2050 is to reduce energy consumption in construction, as well as encouraging the development of resource-efficient and green buildings. Other factors, such as competitive prices of products and real estate rates or the increased public awareness of environmental issues, also drive the shift towards greener construction. Consequently, investors and developers are motivated to ensure that their buildings not only meet the expected aesthetic and quality standards, but are also environmentally friendly.

Conventionally, energy-efficient buildings are associated with comprehensive technical systems that require high operation and maintenance costs as well as a relatively high amount of material-bound energy. This type of building requires optimal usage with carefully selected materials, cost-effective, energy saving approach right from the design - building - operation phase. A typical example of passive design efficiency is the Villa Hoi An, the first Vietnamese hotel project to achieve the HQE Green Building certificate. The complex of scattered cubes proivdes plenty of shade creating many narrow spaces inspired from the idea of village roads. This design creates local ventilation conditions without obstructing wind flow to the neighboring areas and partially shades the area. (Figure 1)

Combining optimal design solutions, energy efficient design not only ensures comfort and reduces environmental impact, but also provides the highest return on investment. As shown in research by the USAID Vietnam Clean Energy Program, the application of energy efficiency measures (which include green approaches to ventilation, materials, lighting and optimized facades) results in savings of about 29% on annual energy costs. In-depth research also shows that energy savings of up to 50% could be achieved if integrated design practices were implemented at an earlier stage.

"Every advancement in design, materials, or equipment could contribute to the process of achieving carbon balance. However, the most important factor is the design's feasibility which mostly depends of competence of the designers. Other factors such as technology or technique should be counted later."

**Tran Thanh Vu**
*Director of Edeec Co. Ltd*

In summary, energy-efficient buildings play an important role in optimizing comfort, investment costs and building performance. Combined with other renewable energy strategies, energy-efficient buildings are the fundamental step to achieving carbon neutrality.

## Q&A

### What are the main factors in achieving NZEBs?

Key factors are design method, technology and environmental awareness. In order to realize NZEBs at a national level, macro and micro perspectives should be taken into consideration. In particular, from the macro perspective, the premise to realize NZEBs is the mechanisms and policies which aim at pushing the real estate industry towards sustainable development for a long term vision. From the micro perspective, the authorities also need to provide detailed guidelines to implement and enforce the policies and regulations, as well as an enforcement roadmap by way of gradual decrease of energy and resources consumption.

### What is your advice to real estate investors in Vietnam?

It is necessary for the investors to apply appropriate technologies and invest considerably on architectural designs. It makes no sense for a project to achieve design optimization with the participation of only one architecture firm in the project. Compared to the international benchmark on building design, Vietnam lags behind in terms of procedure, technology, state management and even design ideology. Therefore, it is of importance for third - party experts to monitor and supervise, so that the construction projects can attain the desired results in the aspects of commerce, quality and environmental sustainability.

### Which advancement is currently making an important contribution towards the goal of achieving carbon balance in Vietnam?

Every technological advancement in design, materials, or equipment could contribute to the NZEBs. However, the most important factor is the design optimization which mostly depends on the competence of the designers, followed by technology solutions or systems.

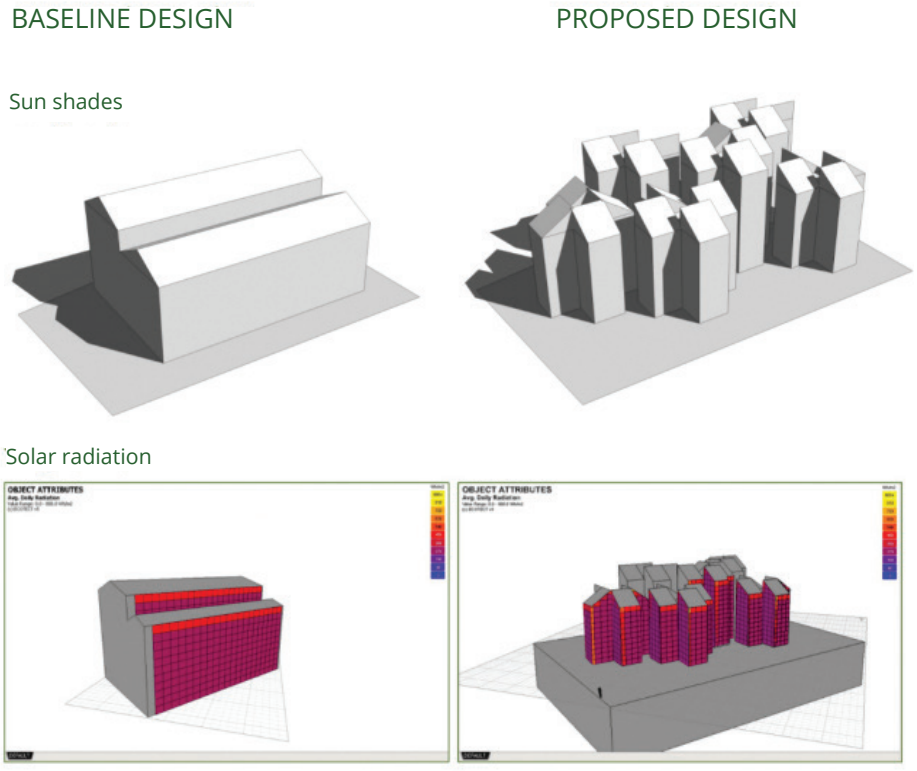



*Figure 1. Two designs' simulation of the sun shades and solar radiation for the same building block. The proposed design (dispersion block design) provides better shading effect.*

# Countercyclical design: smart design of intelligent buildings

*Esther Gerritsen, Consultant integrated sustainability built environment, Royal HaskoningDHV*

Welcome to the future! Together we travel to the year 2038. For the first time in history, global energy production involves primarily renewable energy sources rather than fossil fuels. Solar farms are omnipresent on land, while the seas teem with wind farms. Thanks to smart technology, large amounts of sustainable electricity can also be distributed effortlessly over large distances. Buildings use much less energy than in the past, partly due to the advanced building envelopes and the intelligent building control system. Electricity has become one of the most important energy carriers for buildings. Home batteries and large-sized hydrogen batteries have become our energy storage bases. Energy exchange with our neighbours is perfectly normal. What a green transformation we have made!

## Achieving the hypothetical scenario

The key to achieving this scenario is ensuring that renewable or "green energy" is generated in much greater quantities than "grey energy". Now, the main challenge in making renewables the dominant source of energy is their unpredictability. Since the energy from wind and sun depends on erratic patterns that are difficult to control, it is currently unable to meet the energy needs of buildings. Therefore, smart building designs that would regulate the energy demand pattern are required to solve the problem.

"Countercyclical buildings make optimal use of sustainable energy sources, both on an hourly and seasonal basis."

**Esther Gerritsen**

*Consultant integrated sustainability built environment, Royal HaskoningDHV*

## Smart design

Smart design comprises intelligent building controls that shift the building's needs profile to better match the energy generation profile. This can be done by directly or indirectly shifting the needs of the users. With the direct shift, the user's demand is adjusted so that electrical appliances switch themselves on only when there is a surplus of energy. Since the direct shift restricts the user's ability to use electric devices, its appeal is limited. In the case of indirect shifting, the building delays and smooths out peaks in energy demand through the buffering of thermal and electrical energy. The latter is also referred to as countercyclical design.

## Countercyclical design

In contrast to cyclical building design, which uses energy balancing to ensure sustainable net energy consumption, countercyclical building design is based on the availability of sustainable energy. Countercyclical buildings make optimal use of sustainable energy sources, both on an hourly and seasonal basis. The figure below shows the energy profile of a building with peak demand in the early morning. Systems are started up to warm up or cool down the building before the first users enter. A countercyclical building design predicts this peak and proactively regulates the building. The buffering effect of the building is optimally used to smooth out the peak demand for electricity as much as possible by using Phase Changing Materials (PCM), buffers in the central heating and cooling systems, by cold charging the BM at night, and/or by exchanging energy with other buildings.

In case the countercyclical design cannot provide sufficient energy, electricity can be stored, for example in batteries or via hydrogen. Although energy storage is a solution for filling the mismatch, it is not recommended because of the high energy losses and the space required.

### Starting the process today

The buildings that could respond to the mismatch between energy demand and supply in 2038 are the buildings we are designing and building now. Given the increased demand for electricity and the policy shift towards more sustainable energy, countercyclical design should be universally encouraged. This way, users can be better prepared for future changes in the availability of electricity and avoid the stress associated with variable energy rates.

## Q&A

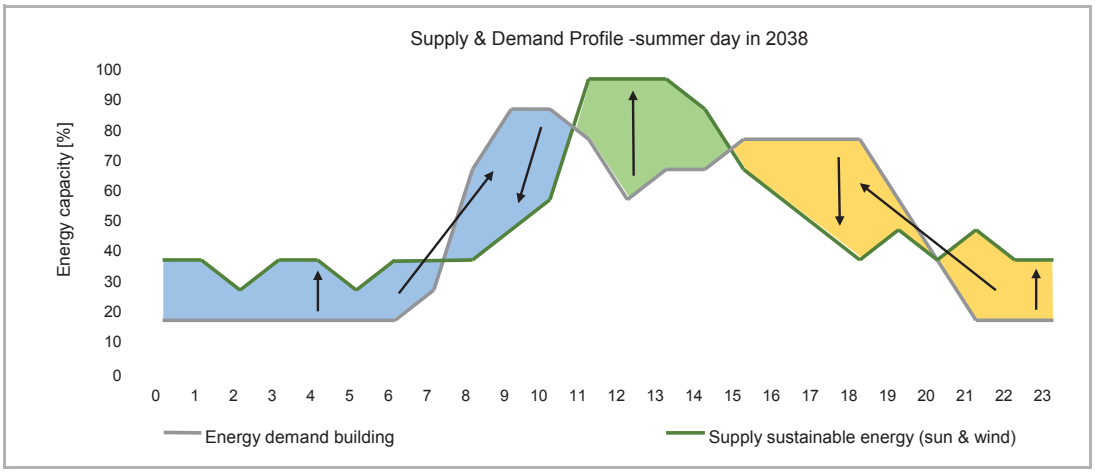
### What is your assessment on the emission balance potential of Vietnamese cities?

While European Union countries aim to carbon neutrality by 2050 and China by 2060, Vietnam does not currently have a target date for carbon neutrality. According to the draft PDP 8, $CO_2$ emissions are expected to rise to 246 Mt $CO_2$ in 2030 and 348 Mt$CO_2$ in 2045 with an estimated population of 120 million, this would result in 2.9 t $CO_2$e/capita. Vietnam will potentially reach a point of peak emissions by 2050 and subsequently reduce emissions to carbon neutrality by 2060 or 2070. In the latest discussion with COP26 President Alok Sharma, Vietnam has affirmed its intention to reach net - zero emissions in the near future, with a heavy emphasis on sustainable consumption and the green transition process in all economic sectors. With its natural renewable energy potential, technological progress, and international support, Vietnam could become a net-zero country in the near future. The PDP8 will be the best time for Vietnam to strategically roadmap renewable energy and to succeed in securing international financing for green recovery.

### What are the challenges in developing an energy transition roadmap for factories, office buildings, and constructions field in Vietnam?

Industrial manufacturing accounts for roughly 28% (approximately 14 gigatons $CO_2$e) of global $CO_2$ emissions. Like other developing countries, Vietnam faces many challenges in terms of technical, financial, policy, social and, institutional aspects. Of these challenges, the following five are the most significant:

1. Limited awareness and strategic commitments,
2. Limited technical capacity,
3. Lack of innovation and financial models,
4. The absence of policy incentives,
5. Energy transition master plan in the key economic and industrial zones to foster ecosystems.




INDIRECT SHIFT OF DEMAND (THERMAL)
Cooling of the building through mass/PCM or charging of buffer

DIRECT SHIFT OF DEMAND (THERMAL)
Charging cars / using appliances

STORAGE (ELECTRIC)
Charging and discharging of batteries

The direction of the shift in need profile is adjusted based on the demand shift of the storage

# Strategy on the development of energy saving building materials in Vietnam

*Assoc. Prof. Dr. Le Trung Thanh, President of Vietnam Institute for Building Materials (VIBM), Ministry of Construction*

Energy-saving BMs in Vietnam is an important topic that has attracted considerable attention from the Vietnamese government, the Ministry of Construction, research agencies and various businesses. Indeed, the production of BMs and the operation of construction works do consume a large amount of energy.

According to the VIBM, it takes approximately 100 kWh of electricity and 865.000 kcal of heat energy to produce one ton of cement. Additionally, the average yearly energy consumption associated with construction works is approximately 150 kWh/$m^2$ for office buildings, 320 kWh/$m^2$ for commercial centers, and 145 kWh/$m^2$ for hospitals.

The development of energy-saving BMs in Vietnam is also one of the key aims of the Strategy for Construction Materials Development for the period of 2021-2030 with a vision to 2050 that has been approved by Decree 1266/QĐ-TTg of the Prime Minister. Specifically, the plan has set the following maximum energy consumption targets for the production of major building materials and building products: heat energy consumption: 730 kCal/kg for cement clinker, 1100 kcal/kg for products of ceramic tile, 2300 kcal/kg for sanitaryware products, and 1500 kcal/kg for glass products; power consumption: 0.930 kWh/kg for cement products, 0.12 kWh/kg for ceramic tile products, 0.5 kWh/kg for sanitaryware products and 0.1 kWh/kg for glass products. Additionally, the policy encourages construction companies to continue to develop large-size unburnt bricks, components, wall panels, and lightweight materials that could reduce construction time and save energy during operation. The Ministry of Construction has also issued the National Technical Regulation on energy - efficient buildings that indicates technical requirements for building envelopes (including total heat resistance, SHGC coefficient of glass, total heat transfer index OTTV, and coefficient of thermal conductivity) that construtions companies must comply with when designing a new construction or renovating an existing building with a total floor area of 2500 $m^2$ or more.

The development of energy-saving BMs and products that comply with the National Technical Regulations and the target of the Strategy for Construction Materials Development have been the focus of various research centers and manufacturing companies. In general, energy-saving BMs are mainly used for the covering structures of buildings (such as external walls and roofs). When used properly, these materials can save considerable amounts of energy compared to using the same type of traditional products. Of the many benefits of energy-efficient BMs, their role in temperature control is particularly significant.

In Vietnam, approximately 50% of high - rise buildings are installed with central air conditioning systems, which typically consume a large amount of electricity. Nevertheless, the energy consumption of these systems can be greatly reduced with covering structures that provide optimal insulation efficiency. According to research by the VIBM on heat loss for 24 typical buildings for houses and offices in the Northern and the Southern regions of Vietnam, the results show that the percentage of heat transfer through building walls and glass is quite large (between 6 - 32%, depending on the type of building). VIBM has also cooperated with the University of Stuttgart (Germany) and

"VIBM has developed labels for energy-saving building materials, which provide information about the thermal performance of the materials. The research outcomes of VIBM will be considered to be added in essentially technical regulations promulgated by the Ministry of Construction in the near future."

**Assoc. Prof. Dr. Le Trung Thanh**

*President of Vietnam Institute for Building Materials (VIBM), Ministry of Construction*

other organizations to develop energy saving BMs adaptable to the Vietnamese climate. Experimental results from this project show that the average thermal conductivity coefficient is 0.363 W/m.K, 0.142 W/m.K and 0.739 W/m.K for fired clay brick (two-hollow brick), autoclaved aerated concrete (AAC) brick and concrete brick, respectively. For glass materials, the results show that energy-efficient (EE) glass has much better performance than the common tempered glass. The research findings clearly establish that the replacement of traditional BMs (such as fired clay bricks and clear glass) with energy-saving BMs (such as AAC, foam concrete, hollow concrete, acotec wall panels, and energy-saving glass) is an effective way of reducing energy consumption. Therefore, VIBM has developed labels for energy-saving building materials, which provide information about the thermal performance of the materials (e.g. solar heat gain coefficient (SHGC) and visible light transmittance (VLT) for glass thermal transmittance (U value) and leak tightness for windows or thermal conductivity (λ) for external wall materials). The research outcomes of VIBM will be considered to be added in essentially technical regulations promulgated by the Ministry of Construction in the near future. With the continued efforts of the Vietnamese government, the Ministry of Construction, research agencies and enterprises, the market share of energy-saving BMs in Vietnam will certainly increase and enable the creation of energy-saving constructions and cities in the near future.

## Q&A

### What is the significance of BMs in reducing $CO_2$ emissions in Vietnam?

BM is important for the social-economic development of Vietnam. Each year, Vietnam produces approximately 100 million tons of cement, 600 million $m^2$ of tiles, 19 million units of sanitary products, 230 million $m^2$ of architectural glass, and 20 billion units of burnt clay bricks. Since the production of these materials is associated with considerable $CO_2$ emissions, its reduction would greatly alleviate Vietnam's environmental problems. Moreover, as energy-efficient BMs reduce electricity consumption, their adoption would help further decrease $CO_2$ emissions.

### What are the biggest market challenges and solutions in promoting energy-saving BMs and products?

The biggest challenge in promoting energy-efficient materials is their quality and cost. Therefore, the quality of energy - efficient BM products should be legally certified and they should be reasonably priced. Moreover, the implementation of energy-efficient construction requires the coordination and technological capability of the investors, design consultants and construction workers.

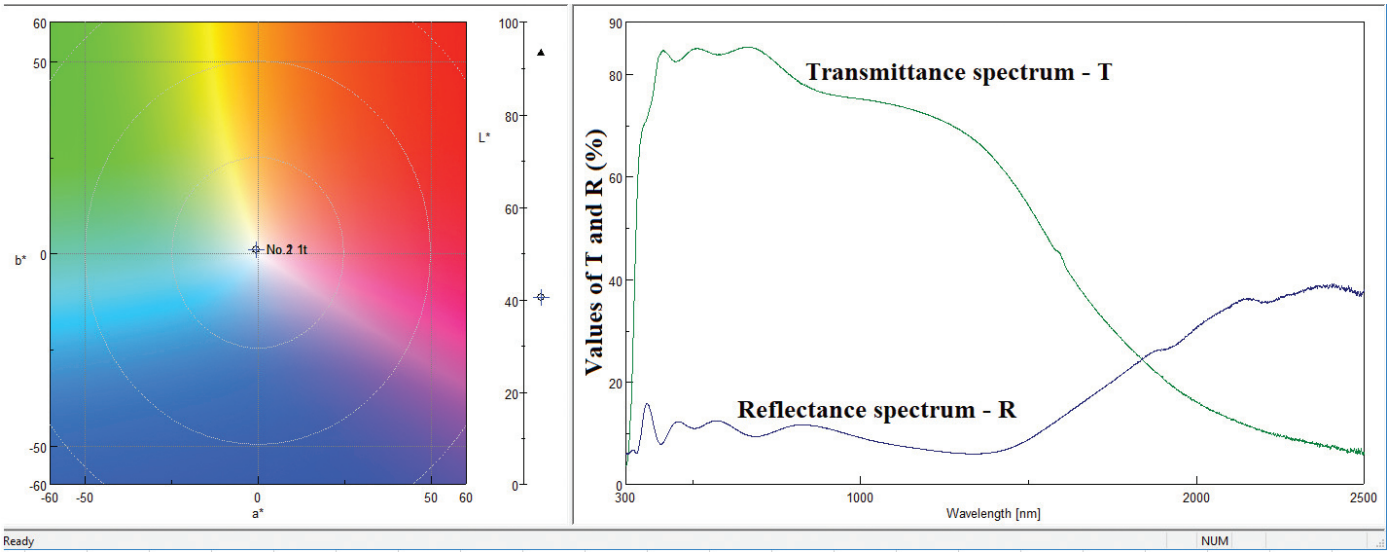



*Figure 1. Measurement of optical parameters of energy-saving glass at VIBM*

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