Energy Efficiency Improvement in Commercial and High-Rise Residential Buildings in Viet Nam

PROJECT EXIT STRATEGY REPORT

Hanoi, 08/2021

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List of Acronyms

AAC	Aerated Autoclave Concrete
AC	Air Conditioning
BAU	Business as Usual
CFL	Compact Fluorescent Lamp
CMU	Concrete Masonry Unit
DOC	Department of Construction
DOSTE	Department of Science, Technology and Environment
EE	Energy Efficiency
EEBC	Energy Efficiency in high rise residential and commercial buildings project.
EJ	Exa Joule (10^{18})
EOP	End of Project
ESCO	Energy Service Company
GEF	Global Environmental Fund
GFA	Gross Floor Area
GHG	Green House Gas
HCMC	Ho Chi Minh City
HVAC	Heating Ventilation and Air Conditioning
IEA	International Energy Agency
IBST	Institute of Building Science and Technology
IFC	International Finance Corporation
IPMVP	International Performance Measurement and Verification Protocol
ISO	International Standardization Organization
LED	Light Emitting Diode
M&E	Monitoring and Evaluation
MRV	Monitoring Reporting and Verification
M&V	Monitoring and Verification
MOC	Ministry of Construction
MOIT	Ministry of Industry and Trade
NZEB	Net Zero Energy Building
PV	Photo Voltaic
R&D	Research and Development
SEC	Specific Energy Consumption
TFEC	Total Final Energy Consumption
UNDP	United Nation Development Program
VIBM	Viet Nam Institute of Building Materials
VGGS	Viet Nam Green Growth Strategy
VSD	Variable Speed Drive

List of figures:

1. Background and context

1.1 Worldwide building and construction sectors.

At present, the construction industry is building a surface equivalent to Paris every day, and a one equivalent to Japan every year. By 2050, it is estimated that 280 billion m^2 will be added to the current building stock [1].
According to the International Energy Agency (IEA), buildings account for about 35% (when including the construction industry) of final energy use and for more than 55% of global electricity consumption in 2019. Although the building sector energy intensity (i.e., the final energy use per m^2) has been decreasing by 0.5% to 1% per year since 2010, final energy use still grew by more than 8% from 118 EJ in 2010 to around 128 EJ in 2019 [2]. This growth has been mainly driven by the organic growth of floor space and by growing end uses (like space cooling, appliances, and electric plug-loads).

As a result, Green House Gas (GHG) emissions related to buildings and construction industry rose to 10 $GtCO_2$ in 2019, the highest level ever recorded.

Consolidated emissions of buildings and the construction industry represented 38% of global emissions in 2019. To achieve a net zero carbon building stock by 2050, the IEA calculated that building emissions should be reduced by 6% annually from 2020 to 2030. To illustrate the needed level of effort, the Covid19 crisis generated a 7% fall in CO_2 emissions of the global energy sector[3].

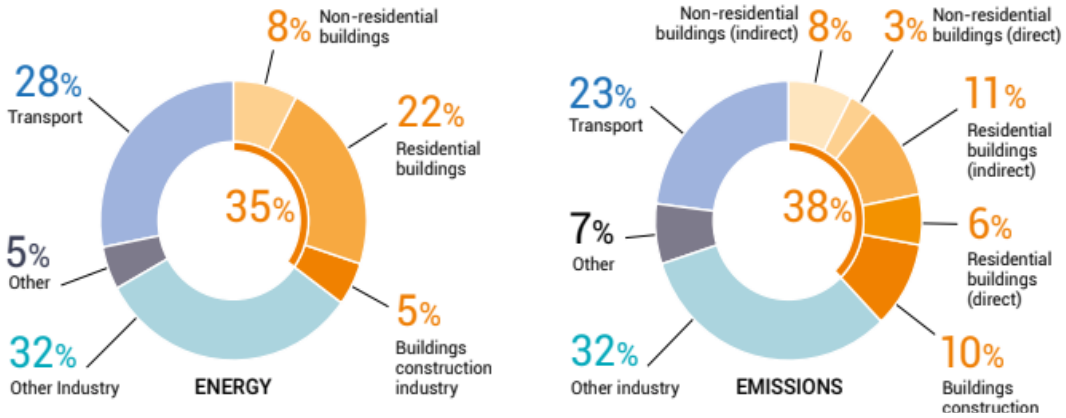


Fig.1: Global share of building and construction final energy and emissions 2019 (Source Global alliance for Building and Construction – IEA)

Although the building sector represents the largest emitter of GHG, it constitutes a source of enormous untapped efficiency potential.

1.2 Viet Nam building and construction sectors

Following the last conducted census in 2018, the population increased by approximately 1% each year since the year 2000. In 2020, the World Bank estimated the total population to be 97.4 million, and the booming urban population to reach 36.3 million[4]. Approximately 37% of the total population is now living in cities, a 53% increase compare to 2000. The urban population is planned to continuously grow

[1] https://www.gbpn.org/our-story/).
[2] https://www.iea.org/reports/tracking-buildings-2020
[3] 2020 Global Status Report for Buildings and Construction – Global alliance for building and construction-UNEP, executive summary, p5
[4] https://data.worldbank.org/indicator/SP.URB.TOTL?locations=VN

and it is forecast that more than 50% of the population will be living in cities before 2040[5]. Such trends will steadily accelerate the need for more urban residential and commercial buildings.
In 2017, the total final energy consumption related to residential and commercial buildings represented 23.4%, and 38% of total electricity consumption[6]. The growing urban population, known to consume more energy than the rural one, will undoubtedly contribute to significantly increase the total energy and electricity consumption and then weigh heavier on the country's infrastructure.

As regards GHG emissions, the Viet Nam first INDC report stated that both residential and business (including commercial buildings) sectors were estimated to account for 7.8% of total national GHG emissions for the year 2014 (excluding the amount of emissions of related electricity generation). Although still limited in terms of proportion, if the BAU scenario still continues, the organic growth of the building stock will mechanically increase, and concerned GHG emissions that shall soon reach the 28% world average.
During the implementation of the EECB project, the technical assistance provided to demonstration buildings further showcased that up to 50% energy savings can be achieved through retrofitting existing buildings, and up to 55% through optimized EE design and construction practices in new buildings. Drastic and coordinated EE policies and actions shall then be implemented nationwide to replicate these demonstration buildings' achievements in a large scale. Carrying out such measures shall significantly improve building design, construction and operations, as well as building materials and equipment manufacturing, to finally ensure long-term energy security and limit related GHG emissions.

1.3 Energy Efficiency in high rise commercial and residential buildings (EECB) project - General information

The Ministry of Construction (MOC) has implemented the Project "Energy Efficiency Improvement in Commercial and High-Rise Residential Buildings in Viet Nam" funded by the Global Environmental Fund (GEF) through the United Nations Development Programme (UNDP) and co-financed by Viet Nam agencies/institutions and enterprises between 2016 and 2021.
The project's goal was to reduce the intensity of GHG emissions from the building sector in Viet Nam. The project objective is to improve the energy utilization performance of commercial and high-rise residential buildings in Ho Chi Minh and Hanoi. Realization of this objective was intended to be achieved through implementation of three following components:

1) Improved Enforcement of Energy Efficiency Building Code;
2) Building Market Development Support Initiatives, and
3) Building EE Technology Applications and Replications.

Each component comprised a number of complementary activities that were designed to remove barriers to the stringent enforcement of the revised EEBC, and to the greater uptake of building energy efficiency technologies, systems, and practices in commercial and residential buildings. The project was designed to have catalysed direct GHG emission reduction of about 37,680 tCO2e by end of project (EOP). The cumulative direct reduction in GHG emissions over the lifetime of the project was envisioned to be 236,382 tCO2e.

[5] Infographics: Urbanisation and Urban Development in Viet Nam @ https://www.urbanet.info/vietnam-urban-development-infographics/)
[6] Viet Nam Energy Outlook Report 2019, p42

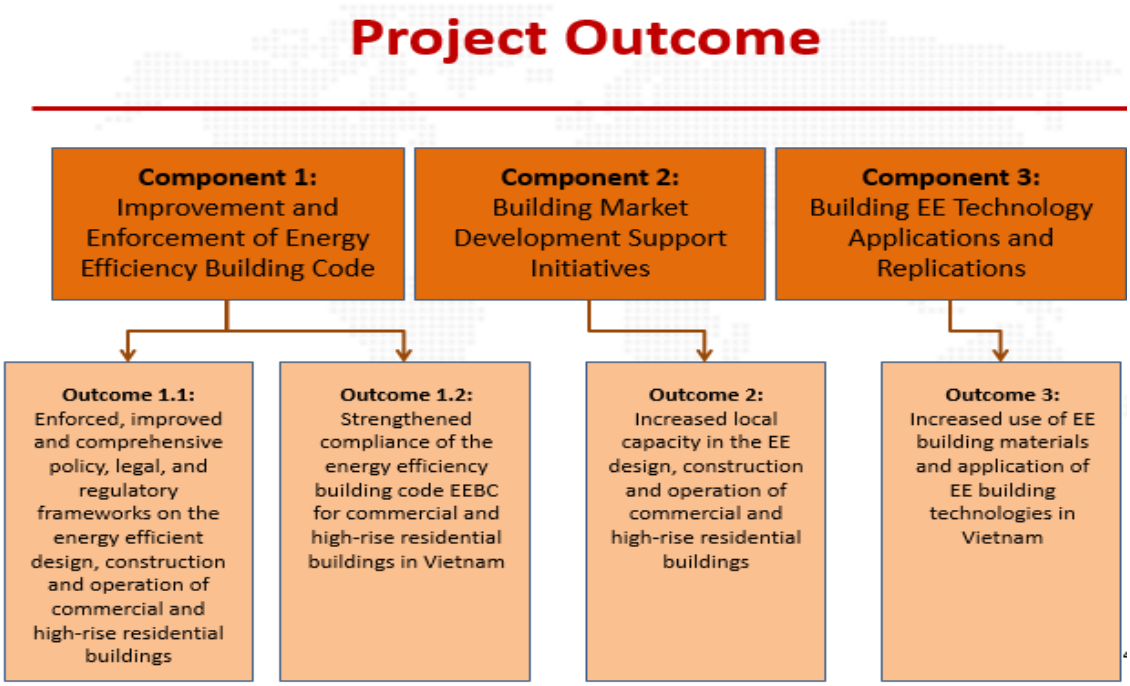


Fig.2 EECB project outcomes

2. Project's achievements

By mid of 2021, although impacted by the global COVID19 crisis, the EECB project has completed the following below tasks related to the project's framework.

2.1 Project results framework

Project Strategy	Indicator	Baseline	EOP[6] Target	Achievements as of August 2021
GOAL: Reduced intensity of GHG emissions from the building sector	**Indicator 1:** Cumulative CO_2 emission reduction from the building sector by End-of-Project, tCO_{2e}	1,568	37,680	73.035
OBJECTIVE: Improved energy utilization performance of commercial and high-rise residential buildings in Ho Chi Minh and Hanoi	**Indicator 2:** Cumulative energy savings from the commercial building by EOP MWh	2,528	61,137	113.909
	Indicator 3: % of new buildings that are fully compliant with the revised Energy Efficiency Building Code by EOP	20	50	58
	Indicator 4: % of existing commercial and high-rise residential buildings that adopt EE technologies and practices and achieve at least 10% electricity savings by EOP	Less than 5%	20%	25

[6] EOP = End of Project

Project Strategy	Indicator	Baseline	EOP[6] Target	Achievements as of August 2021
	Indicator 5: No. of people gainfully employed in the building sector in Viet Nam by EOP	20	60	135
COMPONENT 1: Improvement and enforcement of energy efficiency building code				
OUTCOME 1.1: Enforced, improved and comprehensive policy, legal, and regulatory frameworks on the energy efficient design, construction and operation of commercial and high-rise residential buildings	**Indicator 6:** % of DOCs nationwide that reference EEBC compliance toolkits and guideline developed by the baseline and the projects by EOP	30% of DOCs nation-wide	70% of DOCs nation-wide	70
	Indicator 7: % of building practitioners nationwide that reference EEBC compliance toolkits and guideline developed by the baseline and the projects by EOP	20% of building practitioners	50% of building practitioners	51
	Indicator 8: % of applications for new commercial and high-rise residential building constructions submitted to DOCs comply with EEBC-2013 by EOP	20%	50%	
	Indicator 9: No. of national testing standards for energy performance of building construction materials promulgated by EOP	0	5	5
	Indicator 10: No. of existing and new commercial buildings and high-rise residential buildings in Viet Nam certified as EE buildings by EOP	0	20	17?
OUTCOME 1.2: Strengthened compliance of the energy efficiency building code for commercial and high-rise residential buildings in Hanoi and HCMC	**Indicator 11:** % of building practitioners nationwide that reference the EE design guideline to achieve a higher level of EE than the EEBC requirements by EOP	20%	50%	69
	Indicator 12: % of commercial and high-rise residential buildings referencing M&V schemes in EE implementation by EOP	0%	25%	
COMPONENT 2: Building market development support initiatives				
OUTCOME 2: Increased local capacity in the EE design, construction, and operation of commercial and high-rise residential buildings	**Indicator 14:** No. of financial mechanisms and incentives for commercial and high-rise residential buildings approved and implemented by EOP.	0	1	2
	Indicator 16: % of CEEB trainees that are engaged in EE building designs, implementation and M&V by EOP	0%	50%	
COMPONENT 3: Building EE technology applications and replications				
OUTCOME 3: Increased use of EE building materials	**Indicator 19:** No. of demonstration projects that adopted EE equipment, building materials and building energy monitoring and	5	21	23

Project Strategy	Indicator	Baseline	EOP[6] Target	Achievements as of August 2021
and application of EE building technologies in Hanoi and HCMC	management/control systems promoted by the EEBC Project by EOP			
	Indicator 20: No. of completed M&V exercises in accordance with the guidelines proposed by the Project by EOP	0	16	HA

2.2 Project outcomes and outputs related to Component 1: Improvement and enforcement of EE building code

This first component of the EECB project was expected to bring 2 outcomes and the 2 following related outputs:

1/ Enforced, improved and comprehensive policy, legal, and regulatory frameworks on the energy efficient design, construction and operation of commercial and high-rise residential buildings

2/ Strengthened compliance of the energy efficiency building code for commercial and high-rise residential buildings in Hanoi and HCMC

By August 2021, the following list of initiatives and outputs were completed:

Growing implementation of QCVN09 on the ground:

Up to 70% of Departments of Construction (DOCs) and 50% of construction practitioners nationwide have referred to QCVN 09:2017/ BXD (EE Building Code) and to its guideline during their respective practice.

These significant figures are demonstrating a wider application of the EE building code in practice, which also implies a strengthened knowledge of related practitioners in energy efficiency principles in their design and construction practices.

Strengthening of the EE legal and technical framework:

- Proposed Green and EE building development roadmap

A report with technical and policy recommendations was produced based on the analysis of various countries in the world, to support MOC defining its own green and EE building roadmap. It contributed to the decision 1677/QD-BXD, issued on 30/12/20, regarding MOC's tasks implementation plan related to energy efficiency for the period of 2020-2030.

- Revision of the Construction Law and associated documents

Policy recommendations were provided to include energy efficiency provisions into the Revised Construction Law approved by the Viet Nam National Assembly on 17 June 2020. For the first time, the principle of "encouraging activities of investment and certification of construction works that are economical, energy and resource efficient, and ensuring environmental protection requirements" was mentioned in the Construction Law. It then creates a legal foundation for the development of decrees and complementary guiding documents as well as for the promulgation of the EE building certification system, defined and produced by the EECB project.

- Decree No15/2021/ND-CP (name?)

Draft content?

The article 7 of this decree is explicitly related to the promotion and encouragement of green and EE building development (more precise info needed).

- Development of technical standards for EE materials

The project also provided support to develop 05 standards related to energy efficiency properties of building materials in Viet, based on ISO standards. These following ones got approved by MOC.
These standards include:

1. **TCVN 13101:2020/(ISO 6946:2017)**: Building components and building elements. Thermal resistance and thermal transmittance. Calculation methods.
2. **TCVN 13104:2020/(ISO 12631:2017)**: Thermal performance of curtain walling. Calculation of thermal transmittance.
3. **TCVN 13103:2020/(ISO 10456:2017**): Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values.
4. **TCVN 13105:2020/(ISO 13789:2007)**: Thermal performance of buildings. Transmission and ventilation heat transfer coefficients. Calculation method.
5. **TCVN 3102:2020/(ISO 10211:2017):** Thermal bridges in building construction. Heat flows and surface temperatures. Detailed calculations.

- Development of technical standards related to Energy consumption benchmarking

In addition, the EECB project led the development of 06 technical standards related to the methodology definition of Specific Energy Consumption (SEC) profiles, energy consumption benchmarking and EE certification/labelling. They have been submitted to MOC and are under evaluation.
These technical standards are expected to support the legal basis for a ministerial validation and promulgation of SEC profiles and energy benchmarking results produced by EECB project.
These standards include:

1. **TCVNxxxx:2021/(EN 16231-2012)**: Energy efficiency benchmarking methodology.
2. **TCVNxxxx:2021/(ISO 52003-1:2017):** Energy performance of buildings. Indicators, requirements, ratings and certificates. General aspects and application to the overall energy performance.
3. **TCVNxxxx:2021/(ISO 52000-1:2017):** Energy performance of buildings Overarching EPB Assessment. Part 1: General Framework and Procedures.
4. **TCVNxxxx:2021/(ISO 17741:2016):** General technical rules for measurement, calculation and verification of energy savings of projects.
5. **TCVN xxxxx:2021 (ISO/TR 52000-2:2017)** Energy performance of buildings – Overarching EPB Assessment - Part 2: Explaination and Justification of ISO 52000-1:2017
6. **TCVN xxxxx:2021 (ISO/TR 52003-2:2017)** Energy performance of buildings - Indicators, requirements, ratings and certificates - Part 2: Explaination and Justification of ISO 52003-2:2017

- Legal consideration for specific EE consulting fee

With technical support by the project on …., an updated circular (16/2019/TT-BXD), mentioning the possibility of charging additional consultancy fees for the design of EE buildings was promulgated on ??????. This new development is expected to bring positive outcomes for EE designers, whom fees have only been considered as a commodity, based on a very small percentage of the total project cost. Such a new consideration is therefore expected to create a momentum for design consultants to take EE into account when they design both public and private buildings.

Establishment of an online EE building materials database

Surveys got implemented in 2018 to identify and collect data related to available building materials on the market such as CMU blocks, AAC blocks, bricks, paints, insulation materials, tiles, glazing, etc. More than 2,500 product references have been input in this database.
Hosted on MOC related website, it features necessary technical and commercial information to enable designers and builders selecting more energy efficient materials during their projects. http://tietkiemnangluong.xaydung.gov.vn/page-t274.html

Establishment of an online EE equipment database

Further surveys got also implemented in 2018 to identify and collect data related to building technical equipment and appliances, like AC units, lighting types, solar and electrical water heaters, heat pumps, Solar PV panels, fans, water pumps, etc.
A total number of more than 7,000 product references were input in this database.
Similarly hosted on MOC related website, it features necessary technical and commercial information to support designers and builders in their selection of more energy efficient Mechanical and Electrical equipment during their projects. http://tietkiemnangluong.xaydung.gov.vn/page-t275.html

Definition of buildings Specific Energy Consumption (SEC) profiles, Energy consumption Benchmarking.

The last phase of SEC profiles and building energy consumption benchmarking definition got completed in December 2020 for 6 typologies of buildings (as stated in the table below), in 3 climate zones (including namely Hanoi, Da Nang, and Ho Chi Minh City). This important work started by the review, analysis and final acceptance of calculation methodologies to define SEC profiles and related energy benchmarking system for each concerned typology.

Building typology	Collected in
Governmental Administrative Office	Hanoi & Ho Chi Minh City
Small Commercial Office (GFA < 7500 m2)	Hanoi & Ho Chi Minh City
Large Commercial Office (GFA > 7500 m2)	Hanoi & Ho Chi Minh City
Mall	Hanoi & Ho Chi Minh City
2&3-star Hotel	Hanoi & Ho Chi Minh City & Da Nang
4&5-star Hotel	Hanoi & Ho Chi Minh City

A total of 195 buildings were surveyed. Final data were built on a 15 buildings sample for each typology and climate zone, to enable the targeted 95% confidence level.
Although such sample sizes should be expanded in the future to bring further accuracy, they prove to be consistent in between each other's, during the 3 collected years, but also with Indian and Singapore data overall. Therefore, they represent a good starting point to follow up building energy performance, and to set up and launch a national EE labelling / certification system. (See ANNEX 1: SEC profiles and energy consumption profiles). It should be noted that MOC is encouraged to broaden the current scope of building typologies to later encompass apartment buildings, schools (universities, colleges, vocational training centers, high schools, secondary schools, primary schools) etc. so that all building types encompassed in the QCVN09 are finally considered. Further surveys should then be implemented in this regard.

In parallel, to complement these previous works, the project released several other related outputs, such as:

Definition of an Online building energy consumption submission platform/database

To facilitate building energy data collection nationwide, and to avoid the tedious and complicated exercise of surveying buildings, an online submission platform has been developed and handed to MOC by Q3 2021. This online platform shall enable the automatic calculation of SEC profiles, Energy consumption benchmarks, as well as to define the EE certification rating under the supervision of qualified personnel. Such a tool is already implemented in Singapore, Hong Kong and many other countries. Besides, specific written recommendations have been provided to MOC as regards the

definition and implementation of an energy consumption information disclosure system for a later nationwide promulgation.

Definition of a pilot EE certification system for existing buildings

A building EE certification scheme has been introduced by the project. Based on ISO 17741:2016 and ISO 52003-1:2017 related international standards, it has been tailored to suit Viet Nam context. Such a system is addressing existing building operations and is based on the building yearly energy consumption, size and occupancy data. It provides the opportunity to rank building by allocating them a class level depending on their respective performance. Classes are ranging from class A (most efficiency) to class G (least efficient), similar to EE labelling systems implemented in EU and several other countries. (See Fig.3) This certification system has been successfully tested with 30 pilot buildings, selected among surveyed building.

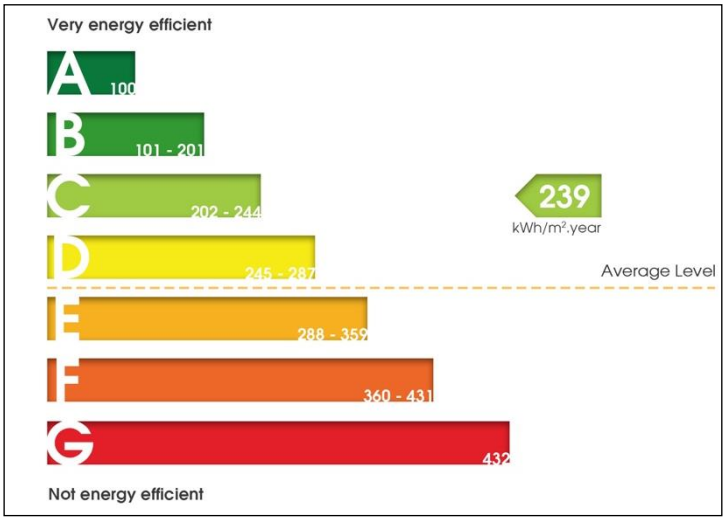


Fig3: Example of EE certification for a specific typology and climate zone, based on performance classes

Recommendations for the definition of a national Energy Monitoring and Verification system

Currently, too few Energy Service Companies are implementing Energy Performance Contracts, as no common methodology to measure energy savings has been approved and promulgated nationwide. The project studied international best practices and provided detailed technical and analysis reports proposing an adapted **Energy Monitoring and Verification system** and **its implementation guidelines** for Viet Nam during Q3 2021. It recommends the adoption and customisation of the already widely endorsed "International Performance for Measurement and Verification Protocol" (IPMVP or ISO 17741:2016) for the Vietnamese context. A promulgation of such a scheme shall highly contribute to facilitate the deployment of energy retrofitting and Energy Performance Contracts.

Raising Awareness - Communication activities

To operate a deep and long-term transformation of the building sector towards more EE and green building, it is crucial to raise the general awareness of the public, as every citizen is a building user. Most people are too often unaware of Green and EE buildings benefits in terms of environmental, financial and health related aspects. To support this market transformation by the bottom, the project published dozens of legal and technical articles on the dedicated MOC EE website, but also in the press. A specific video has been produced to highlight retrofitting works benefits for the Somerset Grand Chancellor buildings, and 2 others related to SEC, energy benchmarking and EE certification, etc.

Besides, several workshops recapping lessons learnted, including the 4-days Viet Nam green building week 2019 and 2020 were organised, attracting thousands of participants.(See below links for illustration). Unfortunately, although planned the Green Building Week 2021 could not be organised because of the sanitary situation.
http://tietkiemnangluong.xaydung.gov.vn/news-t558.html
http://tietkiemnangluong.xaydung.gov.vn/news-t656.html

2.3 Project outcomes and outputs related to Component 2: Building market support initiatives.

This second component was aiming at increasing local capacity in EE design, construction and operation of commercial and high-rise residential buildings. Some of expected outputs have been revised at the early stage to be more relevant to the current context. As of August 2021, the following outputs have been produced:

EE incentives scheme development:

In general, EE and green building developments are initially considered costly and as difficult exercises by the private sector. It is sometimes necessary to define incentive policies to encourage developers to move forward in a more EE or sustainable pathway. A green and EE building incentive schemes analysis and recommendation report has then been produced, based on worldwide green and EE financial and non-financial incentive schemes successfully implemented in various countries. It shall provide MOC with all necessary elements to later shape an adequate incentive policy with other relevant government agencies that shall also be involved (like MOF, MOIT, etc.).

National training programmes.

2 main training programmes have been developed and implemented nationwide:

- 2-day Training on Integrated design, construction, and acceptance of EE buildings in June 2019

Implemented in all 3 main regions of Viet Nam , it gathered a total of 261 persons: building developers, design and appraisal professionals and Department of construction officials of 49 provinces in Viet Nam. The training provided participants with theoretical background about the new QCVN09:2017 version of the codes, as well as with practical and group-work exercises related to practical cases studies. It has equipped them with the necessary knowledge and know-how to undertake integrated energy design techniques and to implement and check EE code requirements during design and construction phases. Building on this success and responding to the demand from practitioners, additional sessions of this specific training are expected to be organised in 3 cities by Q3 2021.

- 2-day training on Energy Audit and Energy management in December 2020

Sessions have been implemented in 3 different locations, attracting 171 participants.
Similarly, to the first training organised by the project, this one was also a mix of theory and practical exercises.
The first part detailed purpose, content and benefits of energy audits, and provided tools / calculators to perform related financial analysis of proposed technical recommendations. Besides, it also provided insight about the need and means to set efficient energy management and verification systems to adequately monitor energy savings.
It gathered numerous experts from building management, energy auditors, service providers, equipment manufacturers, and academia sectors.

Guidebooks -Technical manuals:

- **Design, construction and acceptance works of EE buildings guidebook**

To build on trainings' success and to sustain its knowledge, an EE guideline about "design, construction, and acceptance works of EE buildings" has been released during Q3 2021. This guideline document is structured based on the 2019 performed training related to QCVN09 compliance checks. However, it is set to provide an insight of EE going far beyond just strict code compliance. It intends to compile and showcase appropriate EE tools and techniques to ensure optimized EE design, construction and testing and commissioning steps. It targets architects, engineers, commissioning agents, quality controller, project managers, equipment and material manufacturers etc.

- **Energy audit, renovation consultancy and energy management in buildings guidebook**

With the same objective as above, following the performance of Energy audit and Energy management trainings performed late 2020, the project has worked on developing a specific guidebook to recap Energy audit, retrofitting works and energy management principles. It is also based on developed training materials and complemented with further add-ons to better illustrate the theory. It was published by Q3 2021.

- **Support to comment on the energy efficiency relevant contents of 06 training manuals of construction** for the National University of Civil Engineering.

This assignment aimed at reviewing and providing comments to improve 06 training manuals including the following specific subjects:

- Environment controlling, Volume 1, Climate, heat, and architectural lighting (for Architecture major);
- Energy Efficient Architecture (for Architecture major);
- Energy efficient consumption in buildings (for In-door Engineering Systems major);
- Indoor engineering systems (for Majors in Architecture, Building and Industrial Construction Engineering, Environmental Engineering, Water Supply and Sanitation, Construction Economics);
- Electrical systems in building (for Architecture major);
- Building materials selection (for Building material major).

Online financial calculator

An online tool, featuring calculators to determine Simple Payback Period, Return on Investment, Net Present value, Internal Rate of Return, shall be available on MOC EE dedicated website.
This set of calculators should support building developers and building operators comparing potential technical solutions relevance and profitability and then make wiser decisions as regards technological choices. Its beta version was tested during Q2 2021 and the final version will be made available online by Q3 2021.

2.4 Project outcomes and outputs related to Component 3: Demonstration buildings

This component's main outcome was intending to increase the use of EE building materials and application of EE building technologies in HCMC and Hanoi's commercial and high-rise residential buildings. A combination of new and existing office, residential et educational demonstration buildings could benefit from the EECB project's technical support. As a result, yearly direct energy savings from all demonstration projects were estimated to reach 21,893MWh.
The scope of the provided technical assistance was their 2-fold, as it was dealing with 2 different target groups: New and Existing demonstration buildings, requiring different approaches.

New Buildings:

Technical assistance was provided to new buildings during design, construction, and commissioning (T&C) stages. The main objective was to meet and even surpass QCVN09 compliance requirements during all above-mentioned stages for 5 buildings. The 4 other projects were only supported during their design stage. The provided technical assistance, although specific to each building, mainly consisted in providing recommendations to improve buildings' envelope including the use of sun shading devices, concrete masonry unit (CMU) blocks for walls, insulation layers of roofs, low Solar Heat Gain Coefficient and Low-E double glazing for transparent surfaces. In addition, the team of consultants also explored M&E systems for improvement by: recalculating actual cooling loads and recommending the usage of high Coefficient of Performance AC units, heat recovery units for the ventilation system, geothermal energy for a radiant cooling system, and high efficiency LED lighting and control systems, Variable Speed Drives (VSD) for some electric motors, installation of Solar PV panels on site., etc.
(See list of supported building in Annex 2)
As a result, Energy savings of Proposed design cases were estimated to range from 22 to 67% when compared to the defined "Business As Usual" BAU case.

- Premium cost is estimated to range from 0 to 5.3%
- Return on Investment varies from 0 to 6.3 years, but accounted for 3.6 years in average. which remains below the 5 years generally commonly accepted rule worldwide.
- GHG emission cuts are estimated to reach about 13,616 ton $Co_{2\,eq}$ yearly.

Existing Buildings:

In parallel, the EECB project also provided technical assistance to 14 existing buildings. The technical; work mainly consisted in performing a walkthrough energy audit, providing recommendations for retrofitting works, supporting during works implementation, and in defining a dedicated an Energy Monitoring and Verification system.
Most proposed technical recommendations focused on improving HVAC, lighting and water heater / boilers systems, through their replacement by more efficient, and adapted ones. In parallel, whenever possible, , it was proposed to install solar PV systems to reduce the demand on the grid.
All technical proposals were complemented with a related financial analysis to demonstrate their financial viability and relevance. (See list of supported buildings in Annex 2)

Several different energy saving solutions have been recommended and planned for implementation in some of the 14 demonstration buildings. Most solutions focused on M&E systems improvement (like upgrade / replacement of AC systems (i.e., of higher Coefficient of Performance), replacement of CFL by LED lights, replacement of oil / electrical boilers by heat pumps-based systems, use of energy M&V systems, installation of solar PV panels, etc.). Besides, although usually more difficult and costly to implement, a few recommendations have also been made to improve building envelopes (adding reflective films to existing glazing exposed in highly irradiated orientations).
Finally, when possible, the technical assistance also defined dedicated energy M&V system specifications and terms of reference for bidder's selection. It finally oversaw the installation and testing and commissioning works.
Estimated potential energy savings throughout these demonstration buildings are set to range from 6 to 50%, and simple payback periods to be less than a year for lighting systems, and about 6 years for the costliest AC system retrofitting option. In average is accounted for 3.6 years, which falls within the range of commonly accepted payback periods, i.e. within 5 years.
Expected average yearly energy savings: 6,661 MWh / year
Expected GHG emission cuts6,081 $tCO_{2\,eq}$ / year

3 Project's outputs handover to relevant partners/stakeholders to ensure sustainability

3.1 Potential factors ensuring project's outputs sustainability

After 5 years of implementation, the project team could identify several important and conducive factors to ensure sustainable project's outputs. Indeed, the government has a crucial role to play to ensure a robust and sustainable take-off of EE and green buildings. MOC already made a major move in this direction by integrating EE in the new version of the Construction Law. This new legal foundation would be crucial to utilise and sustain EECB project's outputs. It is an opportunity to further build on them to push the Energy Efficiency agenda by encompassing the whole building life cycle, such as building design, construction and operations, building materials, equipment, dedicated roadmap, policies, incentives, capacity building and raising awareness activities . To achieve such an endeavour, MOC shall consider focusing on the following tasks:

Definition of a clear long-term vision and development strategy

To accomplish concrete developments on the ground, the MOC shall first define and communicate a vision with quantified objectives and strategies. It shall define and implement tasks related to Decision 1677/QD-BXD through:

- considering the whole life cycle of buildings and set up specific targets for each important step and phase.
- defining a clear roadmap including quantified objectives in terms of number of buildings, GFA or any other relevant quantifiable parameters. They should be defined for short, medium- and long-term perspectives including both EE and green buildings. These ones shall be specific enough and broken down by building typology and development stage, to send a clear signal to the private sector.
- defining and proposing incentive schemes for both new and existing EE buildings (see Annex 3 and 4).
- pursuing the annual definition of SEC profiles, energy benchmarking, and EE certification to ensure adequate monitoring and follow up of building operations and to get an appropriate feedback loop to upgrade / update EE building code and other related regulation (See Annex 1).
- officially endorsing and supporting already operating third party Green Building rating schemes to send a strong signal to the private sector and then enable a faster development of certified buildings nationwide among the private sector (See Annex 3).
- regularly upgrading / updating QCVN09 and strengthening its implementation and enforcement at both design and construction stages. Linking building operation monitoring with building codes is crucial to ensure continuous and long-term improvement of building performance. Ideally, EE building codes shall evolve from a current prescriptive/ best effort pathway to a performance-based one to ensure final operation performance, by setting minimum energy consumption targets per m^2 (see Annex 1).
- Promulgating the proposed energy Monitoring and Verification system to enable the national deployment of EE retrofitting works by ESCOs (See Annex 4).

Leading by example

The government has a central and leading role to play by setting a vision for the building and construction industry. It shall then lead by example through ensuring every new public building shall be at least EE or even certified green. It shall also closely monitor its own building stock performance.

Coordination and collaboration with other donors

To continue building on recently produced outputs, the government shall ensure continuity of donors' support to implement long term goals. Energy Benchmarking implementation, training performance,

incentive definition, etc. shall be systematically integrated in any future EE related project funded by other donors. Besides, international donors could also build on component 3 achievements, and then upscale the development of energy audits and retrofitting works in existing buildings, by providing technical and/or financial assistance to building owners.

Coordination of national initiatives

To encompass the whole building life cycle, it necessitates a close and comprehensive collaboration of the numerous concerned actors. Specific following actions shall then be considered:

- Cross ministerial coordination

MOC shall closely coordinate with MOIT to enable building operations follow up, to commonly agree on energy audit methodology and national energy Monitoring and Verification system. Besides, MOC shall also consider linking closely with MPI / MOF to define EE / Green building incentive schemes.

- Internal coordination between central and local agencies:

Ensure coordination/ supervision of DOCs and other local entities involved on the ground to get proper feedback / data from QCVN09 compliance checks implementation.
The central government shall gather, and coordinate needed internal resources. It shall ensure an effective vertical coordination in between central, provincial, and municipal agencies to ensure EE code compliance and energy consumption data collection and analysis.

- Coordination with other stakeholders.

Finally, MOC shall also plan for a transversal coordination involving all other non-institutional actors (private sector, NGOs and civil society) to create a national momentum and ensure a national awareness raising of building users and of the public.

Definition and identification of necessary EE technical resources.

MOC shall also consider:

- Identifying sufficient qualified internal (a new EE bureau / team or training centres) and external (from academia and private sector) resource to undertake and/or support planned operational works (See Annex 3).
- Defining related specific budgets for such centres to operate smoothly.

Raising awareness and capacity building activities

As mentioned above, dedicated EE training centres shall be appropriately funded and staffed (or outsourced to competent third-party entities or competent universities) to sustain the implementation of SEC profiles, Energy Benchmarking calculations, EE certification awards, EE related trainings, other capacity building and raising awareness activities, all year long.
Such centres shall also lead EE and green R&D for the country. They shall act as a one-stop-shop to provide EE and green related information to practitioners and the general public (See Annex 3).
Regular visits of EE and green demonstration buildings shall be organised, as well as EE design contests, EE certification / labelling awards, and raising awareness campaigns for the public.
Training performances shall be regularly organised nationwide (they can be physical based and/or available online to ensure further flexibility). Besides, other related tools, like building materials and equipment databases, and others shall be permanently updated and made available online, under the supervision of such EE centres (See Annex 5).

Broaden EE and green considerations to urban planning

Amidst the growing interest for smart and green cities, the government shall also define clear targets as regards EE and sustainable development for urban developments at large. Specific criteria shall be defined to ensure minimum environmental sustainability, climate change mitigation and adaptation considerations for all future new urban developments. Multisectoral committees shall be formed to apprehend the large variety of parameters to integrate to successfully achieve such a task.

3.2 Past and future project's technical outputs handover to relevant stakeholders

The involvement and coordination of multiple stakeholders have been conducive to the success of the EECB project. Under the leadership of MOC DOSTE, several other MOC agencies, Universities, National technical Institutes, and private sector actors have been mobilised to enable the materialisation of all outputs and outcomes. The below table lists all delivered outputs during the EECB project implementation. This table is also proposing recommendations on how to sustain and build further on these significant achievements.

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
	Component 1			
	Report on review and international experience of the legal framework on green buildings and EE buildings and policy inputs on energy efficient buildings, green buildings integration in the revised Law on Construction.	MOC and National Assembly	Oct 2019 – July 2020.	
	Green and EE Building development roadmap report	MOC/Department of Science and Technology	In December 2020	This report shall be updated and possibly simplified to state clear quantified targets.
	Proposed 5 standards related to energy efficiency properties of building materials and their related justification documents.	MOC/Department of Science and Technology	In November 2020	Ensure adequate dissemination and information to related national institutes and to the private sector .
	Proposed 4 technical standards related to the methodology definition of SEC profiles, energy benchmarks and EE certification/ labelling	MOC/Department of Science and Technology	To be handed in ???	A specific EE excellence centre / technical centre shall be established by MOC to handle and supervise such technical standard to enable adequate utilisation, dissemination and information to the general public.
	16/2019/TT-BXD, circular related to the potential levying of additional consultancy costs for design of EE buildings	MOC/Department of Science and Technology	Promulgated on 17/06/2020	Ensure adequate dissemination and information to DOCs, public and private developers, so that both public and

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
				private projects can be allowed to budget for high grade EE consultancy costs.
	Online EE building materials database uploaded on MOC website http://tietkiemnangluong.xaydung.gov.vn/page-t274.html	MOC / information department	March 2019	Appoint a governmental agency (VIBM?) to manage and update this database on a yearly basis
	Online EE equipment database uploaded on MOC website http://tietkiemnangluong.xaydung.gov.vn/page-t275.html	MOC / information department	March 2019	Appoint a governmental agency, academia or third party to manage and update this database on a yearly basis
	Recommendation to update/upgrade MOC EE website	MOC information department	Q3 2021	MOC IT team shall partner with competent official / academia and private sector
	Specific Energy consumption profiles and energy consumption benchmark calculation methodology	To be transferred to MOC/Department of Science and Technology	Handed by Q3 2021	MOC is recommended to appoint a competent technical entity and form an **EE technical centre** (IBST, University or Energy Conservation Centre, etc?) to ensure the technical handover, and then allow future updates/upgrades.
	Specific Energy Consumption profiles, Energy Benchmarks and EE certification system for 2017 – 2018 and 2019.	To be transferred to MOC/Department of Science and Technology	Handed by Q3 2021	Same as above point, the same appointed technical entity shall be entitled such a work.
	Energy consumption Online submission platform and EE certification simulator	To be transferred to MOC/Department of Science and Technology	Handed by Q3 2021	Similarly to the 2 above points, EE related works and research shall be handled by a specialized team (an **EE technical center**), either directly under MOC, or to an

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
				academia agency to sustain the knowledge and to be able to troubleshoot or assist building owners to entering their data. It is recommended that MOC shall officially appoint such a qualified entity and ensure the yearly update of such a database. Besides, a national information / dissemination campaign should be set up to raise awareness of building operators/ owners
	EE certification (labelling) methodology report	To be transferred to MOC/Department of Science and Technology	Handed by Q3 2021	
	Building Energy consumption Information disclosure system report.	To be transferred to MOC/Department of Science and Technology	Handed by Q1 2021	MOC shall base on this report to define and promulgate clear policy and plan as regards information disclosure principles / obligations on the long run.
	Energy saving Monitoring and Verification system report and M&V system guideline report	To be transferred to MOC/Department of Science and Technology	Handed by Q3 2021	MOC shall use this report to officially have the ISO 17741:2016 translated and promulgate it as the official energy savings M&V official framework for Viet Nam.
	Video clips about EE benchmarks and EE certification	??	??	Integrate/ upload on MOC website
	Component 2			

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
	EE incentives mechanism for EE buildings development report	MOC/Department of Science and Technology	Month? 2020?	Further consultation workshops should be organized to get feedback from other stakeholders. Such a report should be presented to international donors for their suggestions, advice, and support.
	Training materials on Integrated design, construction, and acceptance of EE buildings	Delivered to training participants. Training materials handed to MOC / Department of Science and Technology	June 2019	Further trainings shall be regularly organized (physically or online) nationwide based on these training materials. Training materials shall also be downloadable from MOC website
	Design, construction, and acceptance of EE buildings guidebook	MOC / Department of Science and Technology	To be handed by Q3 2021	Hard copies shall be printed out and distributed to concerned associations. The electronic version shall be made available for download on MOC website
	Training materials on Energy Audit, renovation consultancy and Energy management in December 2020	Trainings delivered Materials handed to MOC / Department of Science and Technology	December 2020	Further trainings shall be regularly organized (physically or online) nationwide based on these training materials. Training materials shall also be downloadable from MOC website
	Energy audit, renovation consultancy and energy management in buildings guidebook	MOC / Department of Science and Technology	To be handed by Q3 2021	Paper copies to be printed out and distributed. The electronic version shall be made available for download on MOC website

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
	Support to the development of 06 training manuals for the National University of Civil Engineering	National University of Civil Engineer	September 2021	??
	Online Financial calculator	MOC / Department of Science and Technology.- MOC EE website	To be handed by Q3 2021	Dissemination / information should be made to the building sector, a specific article shall be made published on the MOC EE website
	Component 3			
	Demonstration building - Lessons learnt report.	MOC / DOSTE	Q1 2021	
	Demonstration New Buildings			
	Summary Datasheets for CONINCO, FELIZ EN VISTA, CUWC, AN LAND and GOLDEN LOTUS projects	Distributed to public during EEBC events.	During Viet Nam Green Building weeks 2019, 2020	To be uploaded on MOC website
	CONINCO office building, CAPITALAND – FELIZ EN VISTA residential building, CUWC educational building, NAM CUONG – AN LAND2 residential building, - QCVN09 code compliance report - Design stage assessment report (including energy modelling / cost analysis) - Construction stage assessment report (updated energy modelling / cost analysis) - Terms of reference / technical specification for the energy Monitoring and Verification systems - 5-year Energy Efficiency and Conservation plan	Provided to building owner and design team	Between end 2017 and Q1 2021	
	GOLDEN LOTUS office building: - QCVN09 code compliance report - Design stage assessment report (including energy modelling / cost analysis)	Provided to building owner and design team	Between end 2017 and December 2019	

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
	DIC Hotel building, DIC Condotel building, DAIKIN office building, Holiday Halong Hotel - QCVN09 code compliance report - Design stage assessment report (including energy modelling / cost analysis)	Provided to building owner and design team	Between October 2019and January 2021	
	Demonstration existing buildings			
	Demonstration building - Lessons learned report.	MOC / DOSTE and building owners/operators/developers	Q3 2021	Building on these achievements, it should be noted the generally strong interest of building owners in getting an accurate picture of their energy performance through energy audits. At that stage, although the interest is high, not all building owners have enough financial resource to quickly implement retrofitting works as they would wish. Further international assistance shall be sought in this area to continue and scale up these achievements
	Somerset Grand Chancellor: - Audit report and technical recommendations - Retrofitting first phase assessment report - Retrofitting second phase assessment report - Terms of reference / technical specification for the energy Monitoring and Verification systems	To building owner	Between end 2017 and Q1 2021	
	MELIA Hanoi, Nam Linh office building in HCMC, People's committee office building in District 8 in HCMC, People's committee office building in District 10 in HCMC, DIC office	To building owner and MOC / DOSTE	Bertween August 2017 and	

No.	Project technical outputs	Agencies/Entity who received the project's products	Date of hand-over/Duration	Recommendations to sustain the technical products
	building in Vung Tau, Equatorial Hotel in HCMC, Ramana Hotel in HCMC, Majestic hotel in HCMC, Sofitel Metropole hotel in Hanoi, HTV building in HCMC, University of Food Industry in HCMC, Kinh Do hotel in HCMC, CEO office in HCMC, - Audit report and technical recommendations		December 2020	

4 Conclusion and recommendations

During these 5 years of the EEBC project implementation, the MOC and other stakeholders in the building sector again demonstrated their motivation to address Energy Efficiency and Sustainability concerns in the building sector nationwide. Building on previous achievements from other donors' project, EECB project's objectives and outputs however featured a broader and comprehensive scope of implementation, as it encompassed policy, legal, technical, demonstration projects, capacity building and raising awareness areas.

Further refinement of the EE development roadmap:

The proposed EE development roadmap should be further refined and complemented with clear quantified targets, and incentive policies at both national and local levels. The MOC is now equipped with several key tools and outputs to be able to plan, implement and monitor a comprehensive EE in building strategy.

Yearly implementation of existing building energy consumption benchmarking and EE certification

For the first time, building operation performance was assessed thanks to the very first definition of SEC profiles and related Energy consumption benchmarking for 6 different building typologies and 3 climate zones. The specifically developed online energy consumption submission database shall enable the necessary collection and calculation of such important indicators annually. Besides, the successfully piloted EE certification/labelling system for existing buildings shall be run annually and extended to further typologies to raise awareness about the importance of EE in buildings in operations. This shall represent a great opportunity to get a feedback loop from actual building performance on the ground to update and upgrade the EE building codes.

Establishment of a national EE technical center

All such tasks shall indeed require the official appointment of a national EE centre of excellence to handle the organisation, the technical supervision, capacity building and EE R&D for the whole country.

Promulgation of a national energy savings Measurement and Verification system / protocol

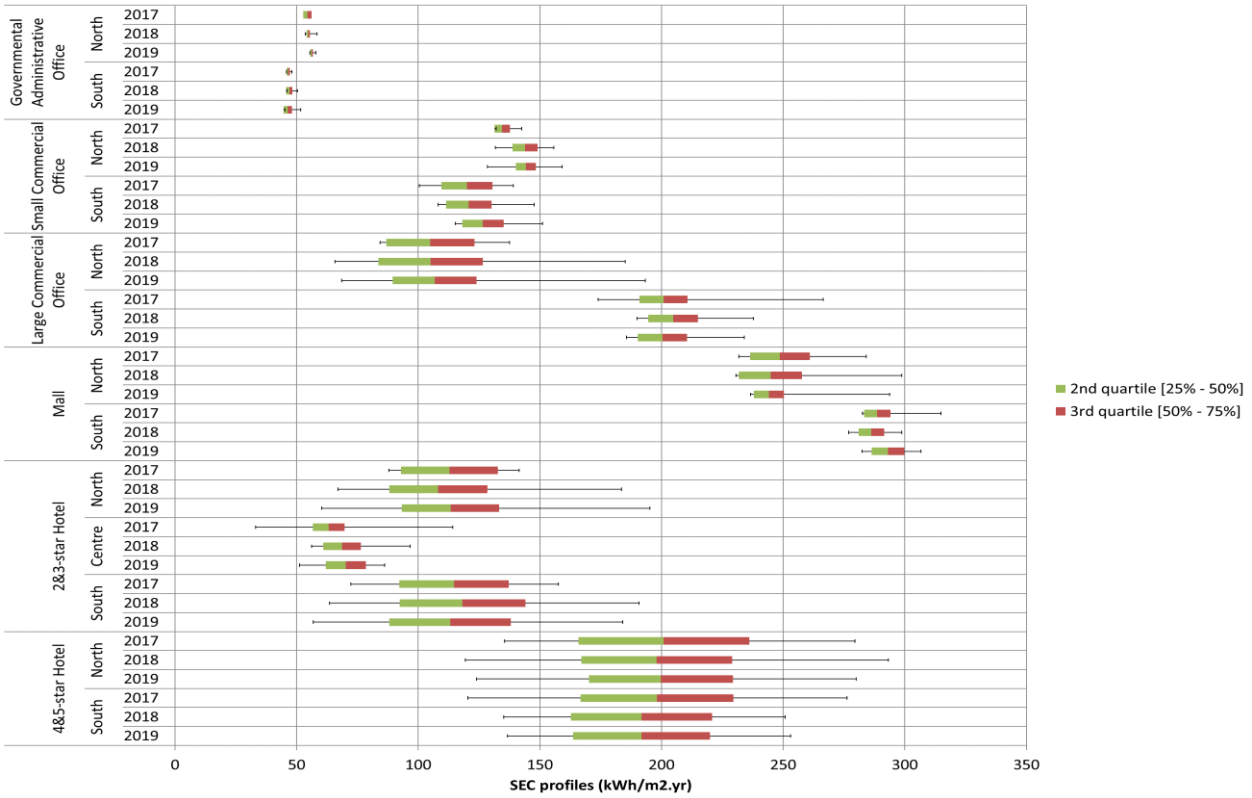
Besides, the proposed customised Energy Monitoring and Verification system (based on IPMVP-ISO 17741) should be promulgated to foster the deployment of EE renovation works and Energy Performance Contracts implementation by ESCOs.

Lead by example and collaborate with concerned stakeholders

Naturally, the MOC should not be the sole involved entity, it shall lead and facilitate the development of a strong communication and collaboration platform with all concerned stakeholders. Building developers, designers, builders, equipment and material manufacturers, building managers and users shall be involved, motivated, and empowered with related knowledge and tools to play their respective role to create the necessary synergies and operate a deep and needed market transformation toward EE and green buildings for a sustainable, green and low-carbon development of Viet Nam.

ANNEX 1: SEC profiles and Energy consumption benchmarking results

The findings are recapped in the table below, it features the statistical distribution of Specific Energy Consumption Profiles distribution in quartiles (i.e., their statistical distribution in 4 parts: 0-25%, 25%-50%, 50%-75% and 75%-100%), representing the Energy Consumption benchmarking for the 6 concerned typologies and 3 climate zones, expressed in kWh/m^2/year, for the years 2017-2018 and 2019.



Energy consumption Benchmarking per Building typology and Climate Zone in Viet Nam for three years (2017 – 2019)

ANNEX 2: Lists of demonstration buildings

The list of demonstration new buildings is as follows:

1. High rise residential and commercial building Y1, blocks B&C in HCMC (Capital Land Felix Vista) in HCMC
2. The Golden Lotus - office building, in HCMC.
3. Nam Cuong Anland 2 - High-rise residential building in Hanoi.
4. New administration and Educational building, College of Urban Works Construction in Hanoi.
5. Coninco office Building in Hanoi
6. DIC Hotel building in Vung Tau (design stage)
7. DIC Condotel building in Vung tau (design stage)
8. Daikin office building in HCMC (design stage)
9. The Holiday Halong Hotel (design stage)

The list of demonstration existing buildings is as follows:

1. Melia Hotel in Hanoi
2. Somerset Chancellor Court (Office and serviced apartment building) in HCMC
3. Nam Linh office building in HCMC
4. People's committee office building in District 8 in HCMC
5. People's committee office building in District 10 in HCMC
6. DIC office building in Vung Tau
7. Equatorial Hotel in HCMC
8. Ramana Hotel in HCMC
9. Majestic hotel in HCMC
10. Sofitel Metropole hotel in Hanoi
11. HTV building in HCMC
12. University of Food Industry in HCMC
13. Kinh Do hotel
14. CEO office

ANNEX 3– Key recommendations for New Buildings.

The EE and Green building development roadmap shall set clear targets in terms of numbers, percentage of new buildings or consolidated GFA for EE, Net Zero Energy or Green certified buildings.

Key recommendation 1	**Strengthen the regulatory system**		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
Strengthen Building EE Codes and related standards	- Strengthen QCVN09 compliance and define appropriate compliance check procedure. - Consider involving 3rd parties for compliance check to ease burden of DOCs/MOC - Promote the use of Renewal energy - Define penalties for non-compliance. - Define quality of workmanship standards	-Switch from current "best effort" EE regulation to Performance based one. - Mandate Testing and Commissioning at the end of construction phase - Mandate Building Energy Management System for all commercial buildings.	- Mandate Net zero energy Buildings for all new buildings. -Mandate renewable energy production at site for all new buildings to cover for as much of the needs.
Promote voluntary Green building codes/ rating tools	- Endorsed voluntary and already acknowledged Green Building rating tools (LOTUS, LEED, GREEN MARK, EDGE) and make official communication about it. - Allow incentives for certified projects	- Mandate a Green certification for all public buildings - Integrate more green aspects in standards and codes (water and waste management, green material usage, etc).	Mandate green certification for all new buildings.

Key recommendation 2	**Raise awareness and build capacity**		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*

Establish EE technical training and research centres	- Promulgate the establishment of centres of EE in buildings - Allocate human and technical resources - Define and implement vocational training for EE - Promote EE technologies, products and materials	- Involve /train the general public about EE in buildings - Develop online EE training modules - Mainstream EE and green design in university curriculum - Establish EE R&D units in partnership with academia and the private sector to improve equipment, materials, technologies, management of design and construction.	Continue R&D on mechanical and electrical equipment, materials, on EE simulation baseline parameters, etc.
Raise awareness of the public	Run information campaigns about roadmap and expected objectives update MOC website and databases on a permanent basis. Communicate yearly about achieved results. Develop further demonstration projects for visit of the public		
Key recommendation 3	Define incentive schemes for EE and Green Buildings		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
	- Consider non-financial and fiscal incentives as a first step - Encourage municipalities to define their own incentive scheme - Coordinate with international donors to promote existing schemes	- Plan financial incentives for EE and Green to accelerate the transformation	Provide energy incentives only for Net Zero Energy Building and positive energy buildings
Key initiative 4	Develop renewable energy sources		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*

	- Promote Solar PV rooftop and solar hot water	- Mandate the use of renewable energy for hot water in new residential buildings	- Gradually mandate solar PV rooftop and solar hot water for all typologies towards NZEB.

ANNEX 4 – Key recommendations for Existing buildings and operations

Monitor and reduce energy consumption in existing buildings

Key recommendation 1	**Monitor energy consumption in existing buildings**		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
Establish Energy consumption benchmarks	Communicate first results of defined SEC profiles and Energy Benchmarks for 2017-2018-2019. Communicate and mainstream the online energy consumption information disclosure system	Broaden encompassed typologies (including residential buildings) and climate zones. Mandate EE labelling public disclosure for building rental or purchase	Set minimum energy performance level for each typology and climate zone.
Implement EE labelling system for buildings	Run a voluntary EE labelling system for commercial buildings, and award the first EE certificates for 2020	Mandate EE labelling for commercial buildings Run a voluntary EE labelling for Residential buildings	Mandate EE labelling for all building types
Key recommendation 2	**Strengthen the regulatory system**		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
Accredit ESCOs and Energy Auditors	Define training and accreditation programme for Energy auditors	Upgrade / update accreditation system	Upgrade / update accreditation system
Define/Select a national Energy Monitoring, Reporting and Verification (MRV) system	-Select the most appropriate system for Viet Nam (such as the International Performance Monitoring and Verification	Review context and update/ upgrade official MRV system accordingly	

	Protocol (IPMVP) or the translation of ISO 17741) -Define related training programmes		
Promote Energy Management system	- Raise awareness about Energy Management System in commercial building. - Disseminate training materials about Energy Management systems	-Mandate Energy Management systems in commercial buildings- Run further trainings about energy management	-Mandate Energy Management systems in high-rise residential buildings
Key recommendation 3	**Promote existing building retrofitting**		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
Promote Energy audits	Consolidate data related to current Key Energy Users	Mandate Energy audit every 3 years and renovation plan for all commercial buildings	Mandate energy Audit and renovation plan for all large buildings every 3 years
Define incentive schemes	-Consider incentives schemes for building owners to facilitate retrofitting works implementations -Promote Energy Performance Contract implementation by ESCOs		
Raise general public awareness	Run communication campaigns about: - Information disclosure online platform - EE certification award - Energy consumption benchmarks	- Update / upgrade communication campaigns - Strengthen and widen activities of EE centres of excellence to raise further awareness	

ANNEX 5 - Key recommendations for Building materials and equipment

Key recommendation 1	**Establish EE and green standards for building materials**		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
Run and update online database	Keep on updating/ improving online database		
Establish building material testing standards and labelling	-Define priority order Establish and promulgate testing standards. -Start certifying / labelling building materials	- Certify / label all identified building materials - Mandate EE / green certifications for market access for locally and imported materials.	
Establish National testing facilities	-Identify qualified resources and needed equipment -Appoint official entities to test materials	Update / upgrade testing facilities and allocated resources	
Key recommendation 2	Establish EE and green standards for building equipment and appliances		
	Short term (0 to 5 years)	*Medium Term (5 to 10 years)*	*Long term (after 10 years)*
Run and update online database	Keep on updating/ improving online database		
Establish equipment testing standards and labelling	-Define priority order Establish and promulgate testing standards and minimum required energy performance -Start certifying / labelling equipment and appliances	- Certify / label all identified equipment - Mandate EE / green certifications for market access for locally and imported equipment - Ban inefficient equipment	

Develop National testing facilities	Identify qualified resources and needed equipment Appoint official entities to test equipment	Update / upgrade testing facilities and allocated resources