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Proposed Training Plan to Improve Building Energy Efficiency in Vietnam

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Proposed Training Plan to Improve Building Energy Efficiency in Vietnam

Executive Summary

Vietnam has experienced fast growth in energy consumption in the past decade, with annual growth rate of over 12 percent¹. This is accompanied by the fast increase in commercial energy use, driven by rapid industrialization, expansion of motorized transport, and increasing energy use in residential and commercial buildings. Meanwhile, Vietnam is experiencing rapid urbanization at a rate of 3.4 percent per year²; and the majority of the growth centered in and near major cities such as Hanoi and Ho Chi Minh City. This has resulted in a construction boom in Vietnam.

In response to the building sector's growth, the Government of Vietnam introduced a decree on energy efficiency in 2003 in an effort to define energy conservation, particularly in building construction, and this resulted in the development of building energy efficiency code in 2003. However, the 2003 energy efficiency building code, which was updated in 2005, was not widely implemented. The Government of Vietnam is currently updating and modifying the code for broad implementation. Given limited capacity in building energy efficiency in Vietnam, there is a need for significant efforts to train stakeholders and build capacity for the implementation of the energy efficiency building code.

This proposed training plan is based on the review of the 2011 Vietnamese Energy Efficiency Building Code (VEEBC) and international experience in developing and conducting training programs on building energy efficiency. The proposed training plan is aligned with the planned implementation set-up in Vietnam, based on the discussion with the Ministry of Construction and various stakeholders. It includes training plans and mechanisms for both short-term and long-term. Developing a discrete training gap analysis and plan could flesh out the ideas of the Ministry of Construction on training and ensure a strong foundation for future energy efficiency improvements.

Initial training, for example, may focus on an introduction to the Vietnam building energy code as well as efficient design and quality construction principles, to individuals who may later train others as well. Part of this initial training may also focus on experts who have been involved in drafting the code thus far (including staff from the Ministry of Construction and the Vietnam Association of Civil Engineering Environment). The objective of this part of the training would be to teach the experts how to draft, revise, and ultimately explain a building energy code. This will help in moving more rapidly toward adoption and implementation of the code, and in making revisions in the future. It is also essential to raise awareness among government officials (national, provincial, and local) and other stakeholders through introductory training of building energy codes to facilitate nation-wide adoption of VEEBC. Other than energy code development and adoption, the proposed training plan also includes trainings on building energy code implementation, energy management, building operation and maintenance, energy audits, energy simulation, and sustainable design.

¹ Source: World Bank. 2010. Vietnam: Expanding Opportunities for Energy Efficiency – Report 61153. Washington DC: The World Bank Group.

² Source: World Bank. 2011. Vietnam Urbanization Review – Technical Assistance Report 66916. Hanoi: The World Bank in Vietnam.

This analysis examines stakeholder groups and the topics on which they need training on which topics, as well the depth of training needed, and potential timing of training and mechanisms for training (e.g. training for building design and construction professionals offered as peer to peer training, training for energy code enforcement staff, and university-based courses for current students). Different stakeholder groups will have different motivations, levels of understanding, and areas of expertise or interest. As a result, training will be more effective if targeted and tailored to the needs of these different groups. For example, what works for code officials in terms of training may not be appropriate for architects, building designers, or HVAC engineers.

Energy efficiency training could be organized by several organizations with relevant capacities. The Ministry of Construction could provide training materials or organize online trainings; professional organizations such as and the Vietnam Association of Civil Engineering Environment and the Association of Architects may link building energy efficiency training to their existing certification or continuing education program; universities may integrate building energy codes components into their curriculum and/or issue certificates for students taking certain courses; private companies like HVAC manufactures may continue their existing training programs with additional components of building energy efficiency. The trainings offered by various organizations could be either free or fee-based. Traditionally, the national government provides free online training materials covering a few introductory or essential issues related to building energy codes; advanced trainings and professional trainings could be provided by professional organizations while charging course fee or certification fee (if certification is required).

The table below is the proposed training plan on building energy efficiency in Vietnam; it covers both the near-term and long-term needs. The first step we recommend is the introductory training for VEEBC. The introductory training is essential to raise awareness among stakeholders and roll out implementation, recognizing it will take time and effort to reach out to all stakeholders. We recommend that the Government of Vietnam speeds this process by targeting code officials, architects, and engineers in major provinces and cities (e.g. Hanoi, Ho Chi Minh City, and Da Nang) in the initial training and developing the train-the-trainer program, so that successful cases and training programs could be easily replicated in other provinces and cities. The second step is to help provinces and cities to build capacity to enforce VEEBC through training on compliance checks³. This could start with basic trainings on compliance checks such as how to conduct plan reviews and basic inspections and expand with more sophisticated training on an ongoing basis. As VEEBC is implemented, code officials or third-party inspectors (depending on the enforcement system that the Government of Vietnam is adopting) will obtain hands-on experience in compliance checks and be able to deal with checks with more technical details. In parallel with training on compliance checks, the Government of Vietnam, in collaboration with professional organizations and companies, could start VEEBC training for architects and engineers with technical details and specifications; similarly, this is an ongoing process as codes and building technologies will be constantly updated. The Ministry of Construction can be less involved in this process, because once VEEBC is mandatory, driven by the market, these professionals will be incentivized to take VEEBC training and they, with technical knowledge and experience, could grasp technical details of VEEBC rapidly. However, the Ministry may monitor and supervise this process to make sure that there are adequate and well-organized private courses. The remaining categories of training – training on post-

³ The draft VEEBC requires energy audits in VEECB-compliant buildings; if energy audits are mandatory in the final version of VEEBC, the training on compliance checks should also include energy audits training.

occupancy energy management, long-term educational training, and green building training – are not directly linked to the code implementation in the initial stage, but are important in terms of capacity building and improving building energy efficiency in Vietnam in the medium and long term.

To summarize, training and capacity building for VEEBC will take time, but are critical to achieving the desired results in energy efficiency; in order to facilitate VEEBC implementation and build capacity fast, the following steps are recommended in the near term:

1. Developing or finalizing materials for the introductory training;
2. Reaching out to code officials and key stakeholders in major provinces and cities, and organizing introductory trainings on VEEBC;
3. Starting the train-the-trainer program and replicating the introductory training to various stakeholders in more (or all) provinces;
4. Conducting training on compliance checks among code officials and inspectors in major provinces and cities;
5. Encouraging professional organizations to organize and host trainings on technical requirements associated with VEEBC; and
6. Expanding training on compliance checks and VEEBC technical specifications to more jurisdictions.

Purpose (listed by priorities)	Potential Trainer	Attendee	Topic
Level I: Introductory training			
Raise awareness of stakeholders with introductory trainings of VEEBC	VACEE	MOC, other Ministries, provincial and local officials, code officials and inspectors, developers, utilities, architects, engineers, universities, other professionals	Introductory Training on VEEBC Codes 101; enforcement structure; codes specifications (scope and application)
Level II: Compliance check			
Enable inspectors and/or code officials to conduct plan review and inspection and evaluate code compliance	MOC, VACEE	Code officials, third-party inspectors (if using third-party inspectors)	Compliance Check for VEEBC Codes 101; compliance check (plan review and pre-inspection, construction inspection provisions, air leakage, commissioning, onsite changes, fill out form/use software)
Level II: Technical specifications			
Train design professionals on specific technical issues and how to design in compliance with VEEBC	VACEE, VAA, universities, private companies	architects	VEEBC Technical Specifications (Design) Codes 101; codes specifications (envelope, scope and application); compliance check (onsite changes, fill out form/use software)
Train engineers on relevant technical issues and how to design in compliance with VEEBC	VACEE, universities	Engineers	VEEBC Technical Specifications (Engineering) Codes 101; codes specifications (HVAC, power and lighting, scope and application); energy simulation; OTTV calculation

Let builders be familiar with energy efficiency materials and construction, and ensure correct installation of EE technologies in buildings	Building Science and Technology Institute	Builders	VEEBC Technical Specifications (Construction) Codes 101; installation of energy efficiency materials and technologies
Level III: Training on post-occupancy energy management and audit			
Train professionals for energy management, operation, and maintenance in the existing buildings	Energy Conservation Centers at the provincial level, private organizations	Engineers, technicians, architects, facility, maintenance and energy managers	Energy management, Building operation and maintenance Building energy use, glazing, insulation, building envelope, cooling, HVAC, controls, indoor air quality, electrical system, energy auditing, building commissioning, maintenance and related codes
Be familiar with building energy use and energy audit; determine energy saving measures used in buildings	Energy Conservation Centers at the provincial level, private organizations	Energy auditors	Energy audit Principles of energy, energy and building shell, energy auditing, air leakage, insulation, windows and doors, cooling systems, indoor air quality, lighting and appliances, and water heating
Level IV: Long-term educational training			
Educate students and young professionals about building energy codes and how to perform according to the codes	Universities	university students, young engineers and architects	Building Energy Codes Training for Young Professionals Codes 101; codes specifications (envelope, HVAC, power and lighting, scope and application); simulation
Understand principles of energy simulation and how to use energy simulation to comply with energy codes and other green building standards	VACEE, universities	Engineers, university students	Energy Simulation Principles of building energy simulation, uncertainty in energy modeling, how to use simulation to show code compliance
Level V: Green building			
Gain concrete understanding of the research that supports the costs and benefits of green building and build enough knowledge to apply sustainable design in practice	VAA, VGBC	Architects, engineers, contractors, tenant and developers, project managers, building professionals, resource conservation specialists	Sustainable design Key practices and cases of sustainable building, LEED, Lotus and other relevant criteria or established guidelines, costs and benefits of incorporating sustainable building measures, financial incentives and technical assistance offered by governments, utilities, and other organizations, guidance for education and training of staff in sustainable building.

Note: VACEE is the Vietnam Association of Civil Engineering Environment; VAA is Vietnam Association of Architects; VGBC is the Vietnam Green Building Council.

Background

Vietnam has experienced fast growth in energy consumption in the past decade, with annual growth rate of over 12 percent. This is accompanied by the fast increase in commercial energy use, driven by rapid industrialization, expansion of motorized transport, and increasing energy use in residential and commercial buildings. Meanwhile, Vietnam is experiencing rapid urbanization at a rate of 3.4 percent per year; and the majority of the growth centered in and near major cities such as Hanoi and Ho Chi Minh City. This has resulted in a construction boom in Vietnam.

In response to the building sector's growth, the Government of Vietnam introduced a decree on energy efficiency in 2003 in an effort to define energy conservation, particularly in building construction. This government push towards energy efficiency in buildings led to the development of Vietnam's first building energy code in 2003, a result of collaborative work between an appointed Vietnamese Technical Advisory Group and two international consultants, as well as public comments. With only a few revisions to the 2003 code, in 2005, the Vietnam Energy Efficiency Building Code (VEEBC) was issued by the Minister of Construction under Decision No. 40/QD-BXD. Since its introduction, however, the 2005 code has remained virtually unused.

For this reason, the Ministry of Construction (MOC) is making revisions to the VEEBC 2005 in an effort to make it more useable, and ultimately, easier to implement⁴. The Vietnam Mission of the U.S. Agency for International Development (USAID) is supporting this initiative under the framework of the Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) program. USAID has asked Pacific Northwest National Laboratory (PNNL) to provide technical support to facilitate the revision and implementation of the latest version of VEEBC (herein referred to as VEEBC 2011). PNNL supports the U.S. Department of Energy's building energy codes program and has a wide range of expertise and experience assisting other countries with the implementation of their building energy codes.

PNNL has reviewed VEEBC 2011 and provided detailed comments to the code; the review comments were well received and appreciated by MOC, the Vietnam Association of Civil Engineering Environment (VACEE) – the main writer of VEEBC 2011, and other stakeholders. VACEE has also provided detailed written responses to PNNL's comments and made corresponding changes to VEEBC 2011. To facilitate this effort, USAID and PNNL have also co-hosted a workshop on building energy efficiency in Hanoi in June 2012 with engaged participants from MOC, VACEE, Hanoi Architectural University, International Finance Corporation (IFC), Vietnam Association of Architects, and other public and private organizations. The Government of Vietnam requested this workshop and a related review of Vietnam's draft new building energy efficiency code to help the country adopt more efficient buildings as it develops.

Following the workshop, MOC has highlighted training as its priority need in moving forward with building code implementation. Deputy Minister Nguyen Thanh Nghi prepared a letter to USAID just after the seminar suggesting additional support for training in code implementation and other related

⁴ The VEEBC has gone through internal reviews from domestic stakeholders by the end of 2011; Vietnamese Ministries, Provincial Departments of Construction, Departments of Science and Technology, Departments of Renewable Energy and other relevant local Departments, architects, engineers, builders, academic institutes, and other private sector stakeholders have provided comments and inputs to revise VEEBC. The domestic review was followed by review and technical support from international experts – primarily the International Finance Corporation and the U.S. Agency for International Development.

topics. In response to this, with the support from USAID, PNNL had another visit to Vietnam in September 2011, and discussed and analyzed the training needs for the implementation of VEEBC 2011.

Given limited capacity in building energy efficiency in Vietnam, stakeholders representing a cross section of interests in the energy codes would be involved in training and capacity building progress; they include:

- Regulators, including building code officials, provincial and city regulatory agencies, chief architects of the city
- National, provincial, and city governments, including the Ministry of Construction, Department of Construction at 63 provinces, and other relevant Ministries and Departments
- Designers, including architects, lighting and mechanical engineers
- Professional organizations, such as VACEE and Vietnam Association of Architects (VAA)
- Developers, builders, owners, and operators
- Academia, such as Hanoi Architectural University, Ho Chi Minh City University of Architecture, and Da Nang University of Architecture
- Building component and equipment manufacturers
- Utility companies

In terms of priorities, trainings for code officials, other regulators, and government officials are critical; regulators and government officials need to establish legal framework and mandate energy code and code officials are responsible for enforcing energy code and supervising code implementation at the provincial or local level. In addition, Vietnamese experts would benefit from training on developing and drafting a building energy code and the initial trainings on code development and analysis may focus on experts who have been involved in developing VEEBC such as staff from MOC and VACEE. Second, encouraging architects and engineers to learn technical requirements of VEEBC is also essential as these professionals need to know how to design buildings and deploy technologies in accordance with VEEBC. Third, trainings for developers and building owners are important in terms of raising market awareness and facilitating VEEBC implementation, but these trainings could be built up gradually as MOC rolls out mandatory implementation of VEEBC. Finally, as the market for building energy efficiency gradually develops, the training needs to penetrate into universities and other building-related sectors such as utilities and material and equipment manufacturers.

Different stakeholder groups will have different motivations, levels of understanding and areas of expertise or interest. As a result, training will be more effective if targeted and tailored to the needs of these different groups. For example, what works for code officials in terms of training may not be appropriate for architects, building designers, or HVAC engineers. The specific training needs and designs for different stakeholder groups will be discussed in detail below.

This report recommends a training plan based on requirements of VEEBC 2011, U.S. and global experience, and inputs from Vietnamese stakeholders. It prioritizes curriculum topics, identifies potential trainers, and recommends mechanisms that could help build capacity rapidly and sustainably; it also considers both near-term training for code implementation and longer term training of architecture and engineering students. Developing a discrete training plan could flesh out MOC's ideas on training and ensure that they build a strong foundation for future energy efficiency improvements.

Barriers for deploying building energy efficiency

Vietnam’s building energy efficiency code covers a robust yet feasible range of energy efficiency topics. It includes several innovative aspects, such as requiring periodic energy audits⁵ after the building is built. This also requires a wide range of knowledge to implement it. There is strong support across stakeholder groups for moving forward with a mandatory building energy code because of the energy, environmental, and cost benefits associated with it. However, capacity needs to be enhanced to properly implement the code. Capacity on energy efficiency broadly has grown in the last decade, as efficient designs, lighting, air conditioning and windows have become more prevalent. However, this is still the exception in new construction rather than the norm.

It is important to examine the existing institutions that could contribute to VEEBC implementation. Table 1 below discusses the roles of existing institutions in VEEBC implementation and training.

Table 1: Potential VEEBC Training Organizations and Their Roles

Organizations	Roles
Ministry of Construction	Develop and finalize VEEBC and its implementation plan; supervise implementation in provinces and cities
Departments of Construction	Enforce VEEBC at provinces and cities; conduct compliance checks through plan reviews and construction inspections (as well as energy audits if mandatory); issue construction and occupancy permits and supervise building constructions
Vietnam Association of Civil Engineering Environment	Draft VEEBC; provide VEEBC training to engineers and code officials; train the trainers
Vietnam Association of Architects	Organize trainings for architects
Vietnam Federation of Civil Engineering Associations	Provide information on infrastructure and urban planning and how VEEBC is linked with other regulations on urban planning
Energy Conservation Centers	Organize and provide trainings for local government officials at the province and local levels; conduct trainings on energy audits
Architecture/ Engineering Universities	Train students and young professionals on building energy efficiency and energy simulation
Building Science and Technology Institute	Provide information on energy-efficiency building materials that could be used for compliance checks; train building material testing labs
Construction companies (e.g. Vietnam National Construction Consultants Corporation)	Organize trainings for their architects and engineers to ensure that they are able to apply VEEBC
Building material or equipment manufacturers	Organize learning sessions for their technicians and help them to understand VEEBC; help clients comply with VEEBC requirements regarding building materials and equipment (e.g. HVAC system)
VGBC; Green Building Council	Supplement trainings on VEEBC by providing trainings on green building designs and technologies

⁵ Based on our understanding, when VEEBC is finalized, it is likely that energy audits during the operation stage will be voluntary.

Significant gaps exist in human capacity, infrastructure, and facilities to fully implement VEEBC 2011. Stakeholders in large lack awareness of building energy efficiency and do not have enough knowledge on building energy codes. In addition, Vietnam is short of a holistic training system for building design and construction. Professional organizations, such as VACEE and VAA, and academic institutes provide training to engineers and architects on building physics, design, and tools occasionally. MOC and provincial Departments of Construction also organize occasional training for code officials on building codes and quality control.

VEEBC 2011 requires Overall Thermal Transmission Value (OTTV) calculations. The OTTV approach has been used in many energy codes of the tropical countries, including those of Hong Kong, Singapore, Malaysia, Thailand and other ASEAN countries; it was also used in an older version of ASHRAE Standard 90 in the U.S. OTTV calculation has been used in Vietnam for about 30-40 years and was taught at the university level, but most architects and engineers in the field still need training or software assistance to do the OTTV calculations. Based on our understanding, VEEBC 2011 also requires the whole-building compliance⁶, but most stakeholders in the building sector, except for architects and engineers that have been working on large commercial buildings, are not using building energy simulation. Finally, energy audits are not widely performed in Vietnam and training and certificate associated with energy audits may be needed once VEEBC 2011 is enacted.

Training on developing and updating building energy codes

To rapidly finalize its building energy code for adoption, Vietnamese experts would benefit from training on analysis and drafting of a building energy code. A better understanding of the methodologies used in designing different provisions, and the logic behind ease of use, would allow the Vietnamese to more rapidly integrate analysis and review comments, and explain the code as implementation begins. It would also ensure that capacity exists to improve the code in the future. Part of this initial training may also focus on experts who have been involved in drafting the code thus far (including staff from MOC and VACEE). The objective of this would be to teach the experts how to draft, revise, and ultimately explain a building energy code. This will help in moving more rapidly toward adoption and implementation of the code, and in making revisions in the future. As VEEBC 2011 starts to be implemented, other stakeholders will gradually learn about building energy codes, which provides knowledge for them to actively participate in the code upgrade process in the future.

The development and upgrade of building energy codes weigh in many factors. For examples, in the code upgrade process in the U.S., building science and building energy efficiency are not the only considerations in approving proposed code changes. Market viability, industry fairness, construction costs, and impacts on other codes (e.g. fire, safety and structural codes) are all brought forth in the code development and revision process. The code upgrade is followed by a process to determinate if the proposed code will improve energy efficiency in the designated building type. U.S. Building Energy Codes Program and PNNL have developed 16 prototype commercial buildings to help make the determination.

⁶ In the draft VEEBC we reviewed, both whole-building and OTTV compliance approaches are required at the same time, and this may be modified as two compliance options in the final version of the code.

Training plan for VEEBC implementation

The training needs to target both near-term and long-term goals. The near-term training will focus on raise awareness and build the capacity to facilitate the implementation of VEEBC 2011 and often target implementers such as local officials, architects, and engineers, while the long-term training will mostly be conducted in the university to educate students and young professionals about building energy codes, energy simulation and how to perform according to the codes. A five-tier training program could be designed for different stakeholder groups with different foci, thus raising awareness, enabling inspection and providing more technical details for advanced audiences, conducting energy management and audits, designing green buildings, and building long-term capacity.

Initial training, for example, may be focused on an introduction to the Vietnam building energy code as well as efficient design and quality construction principles, to individuals who may later train others as well. It is also essential to raise awareness among government officials (national, provincial, and local) and other stakeholders through introductory training of building energy codes to facilitate nation-wide adoption of VEEBC. Other than energy code development and adoption, the proposed training plan also includes trainings on building energy code implementation, energy management, building operation and maintenance, energy audit, energy simulation and sustainable design.

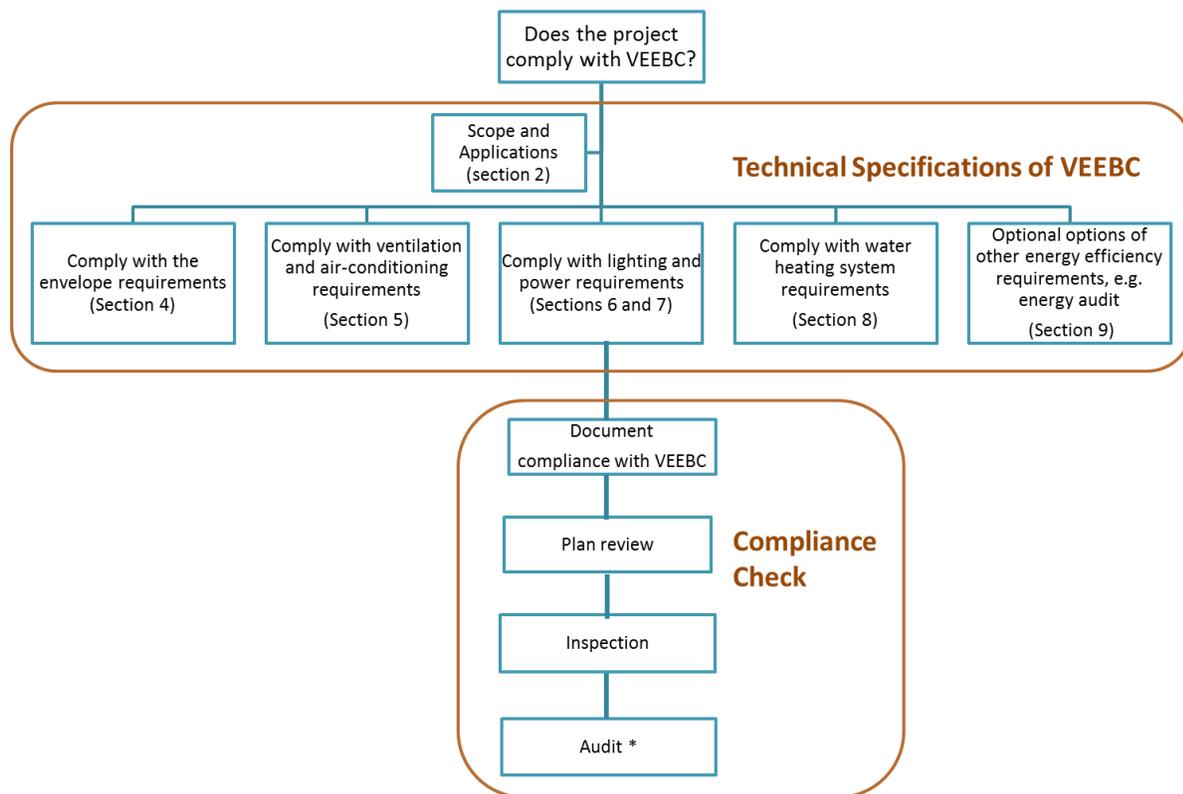
Level I: Introductory Training

The introductory training provides a basic introduction to the varied and complex issues associated with building energy codes and particularly VEEBC 2011. This training is designed to raise awareness and apply to broad audiences with an interest in building energy efficiency, including MOC and other Ministries, provincial and local officials, code officials and inspectors, architects, engineers, builders, developers, universities, and general public. This training provides a basic introduction to many aspects of building energy codes, including their:

- Benefits in terms of current energy, economic, and environmental challenges;
- Cost-effectiveness of implementing energy codes;
- Challenges in terms of adoption, implementation, compliance, and enforcement;
- Development processes led by MOC and VACEE;
- Adoption and incorporation into building design and construction by provinces and districts;
- Enforcement and compliance tools at the provincial and local level.

Level II: Technical Training for effective implementation

The technical training could be used to help the implementation of the building energy codes. The training should be different for different stakeholders, based on their respective needs. For architects, engineers, and builders, it is important to understand envelope, ventilation and air conditioning, power and lighting, and scope and application requirements of VEEBC 2011, and how this could be applied to and integrated with building design and constructions. For code officials at the provincial and local levels, the key concern is how to incorporate VEEBC into the existing permitting and inspection process and what are changes related to this. Therefore, the technical training should have two aspects: compliance check and field inspection for code officials and technical specifications of VEEBC for professionals (Figure 1).



* It is likely that energy audit is voluntary in the final version of VEEBC.

Figure 1: Components of Technical Trainings

Training on Compliance Check are intended to provide tools and specific training necessary for code officials to evaluate commercial buildings complying with VEEBC 2011. The training could include both classroom training and field inspection for energy code compliance. The code officials are recommended to complete the introductory training before taking the compliance check training. Based on the estimates of the Haiphong City Department of Construction, there would be about 15 to 20 people to be trained on compliance checking in each provincial or city government in the initial stage.

The compliance check training includes how to use compliance checklist or software and how to do plan review and field inspection. For example, the ASHRAE 90.1 compliance checklist requires data check and gathering at various stages: plan review, footing and foundation, framing/rough-in, plumbing rough-in, mechanical rough-in, rough-in electrical, insulation, and final compliance check.

The compliance check will occur in two stages: plan review and field inspection (and energy audit if it is mandatory). Plan review is conducted before the construction starts. For example, to review the HVAC system, the code officials will first identify the type of system (i.e. cool source and air distribution system), then determine the provisions that apply to that system, and finally review the mechanical plans and specifications to determine if the provisions have been addressed. Once the construction starts, code officials and inspectors will conduct field inspections throughout the construction as well as upon the

project's completion. For example, to inspect building envelope during the construction stage, code officials check the insulation U-factor, if fenestration and doors are tested and meet thermal requirements, if fenestration and doors meet maximum air leakage requirements, and if vestibules are installed per approved plans. To build capacity on plan review and construction inspection, code officials may need both classroom training and field training. Site visits to exemplary projects will provide opportunities to test conceptual understanding with the real thing.

In addition to code officials and inspectors, testing labs that certify building materials should also be trained on VEEBC and relevant testing protocols to make sure that the features that building materials claim are in fact correct. These lab reports and certificates need to be submitted together with other documentations for plan reviews and inspections. **Training on technical specifications** would help design professionals to understand provisions of VEEBC and enhance compliance from design to construction. It will provide an overview of the requirements of VEEBC 2011 and how this is related to architecture design, engineering system, and construction. As shown in Figure 1, VEEBC 2011 has mandatory requirements for building envelope, HVAC system, hot water service, power and lighting system, and scope and application. The training on technical specifications could be further specified or disaggregated by sub-categories. For example, for electric engineers, they need to attend detailed trainings on electrical system (i.e. power and lighting); for mechanical engineers, holistic training on HVAC and water heating service would be desired. The technical training could cover building physics, what provisions of the code are used, technical values and requirements (e.g. U-value for windows and walls), how to meet code requirements, materials to use, compliance approaches (i.e. OTTV option, whole-building performance, and maximum allowable capacity losses), exemptions, and rules. The technical training could also be varied by climate zone as the thermal requirements differ by climate zones.

The technical trainings for engineers and architects could be organized through architectural and engineering associations like VACEE as their regular training or continuing education programs. It could also be accompanied by visiting architectural and engineering offices or attending periodically architectural/engineering association meetings and providing short localized sessions (e.g., brownbag presentations) on certain elements of the energy code that may be problematic.

Level III: Training on Post-Occupancy Energy Management and Energy Audit

The Chapter 9 of VEEBC requires energy audits in the operation stage⁷ and the implementation process, content of the audits, and energy audit reports should comply with the *Technical Guidance on Energy Audits for Residential Buildings* that is enclosed with VEEBC.

Energy audits would help customers to determine how energy is being used in the building, options and measures that could help save energy, and cost benefit analysis associated with these measures. Energy audit training may cover the principles of energy auditing and inspection, including training in the

⁷ Section 9.6 of VEEBC requires that priority construction buildings (i.e. civil buildings such as administrative headquarters, office buildings, high-rise hotels, trade centers, high-quality apartment buildings, cultural works, hospitals, etc.) having the gross floor area greater than 2,500 m² or having the annual energy consumption level larger than 500 tons of oil equivalent must undergo energy audits once every three years. However, per the conversation with VACEE, the main writer of VEEBC, energy audits would be voluntary during the initial implementation of VEEBC.

principles of energy and building shell, energy auditing, air leakage, insulation, windows and doors, cooling systems, indoor air quality, lighting and appliances, and water heating. Potential trainees would include accredited energy auditors, engineers, architects, facility and energy managers, and private consultants who would conduct energy auditing in commercial buildings.

Training on energy management is not directly linked with VEEBC implementation, but it overlaps with and complements energy audit training. Energy management training may include an overview of building systems and energy use, energy conservation techniques, energy management in HVAC systems and controls, efficient lighting, and electrical system, energy management and operation related to codes, indoor air quality, and energy operation and maintenance. In particular, this would emphasize how energy management is related to codes, provide an overview of health, safety, energy, and environmental codes that impact facility operation and energy use, explain how to comply with the requirements of the most important health and safety codes (since this is the priority for building code enforcement at the provincial level) and how to use the energy and maintenance related codes to improve energy efficiency. Beyond the requirement of building energy code, energy audit and energy management could also be used by energy service companies to improve energy efficiency in existing buildings.

The Vietnamese Ministry of Industry and Trade (MOIT) oversees energy auditing, energy management, and energy-efficiency products. MOIT is also the key Ministry implementing the 2006 Law on Energy Efficiency and hosts an annual contest for energy efficiency (including buildings). The current Vietnamese regulation requires energy audits in commercial buildings using more than 500 tons of oil equivalent per year. The Energy Conservation Centers (ECC) at the provincial level, affiliated with MOIT and the Department of Industry and Trade (DOIT), have conducted energy audits in major public and commercial buildings. MOIT, DOITs, and ECCs also offer trainings on energy audits and energy management and MOIT has reserved budget for energy auditing training. For example, ECC at Haiphong City currently has 14 courses on energy audits and energy management.

Level IV: Long-Term Educational Training (through Academia)

Vietnam is building its capacity to improve building energy efficiency; this requires both short-term and long-term training mechanisms. Training for compliance checks and technical requirements of VEEBC would help roll out implementation of the building code and other energy efficiency programs in the near term; however, the training mechanism needs to be sustainable. In the long-term, training on building energy efficiency needs to be conducted in the universities and academic institutes, so young architectural and engineering students and professionals could learn principles of building energy efficiency, energy-efficiency design, building energy simulation, and energy management in the classroom and prepare to apply energy-efficiency design in the practice. In addition, as VEEBC will be mandatory in the future, it is necessary for universities to offer relevant courses and let architectural and engineering students understand the requirements of VEEBC and how to comply with VEEBC in the construction project. The courses and trainings could be divided into three levels: 1) principles and practices of building energy efficiency which can include an introduction to building energy codes and other relevant regulations; 2) building energy simulation, including OTTV calculations, energy simulation using different tools, and other exercises; and 3) energy-efficiency and sustainable designs as well as emerging energy-efficiency technologies.

Universities in Vietnam recently started to offer energy efficiency related programs. For example, The Institute of Tropical Architecture in Hanoi Architectural University organizes an annual green building week; the first day of the green building week consists of workshops for professionals and policy makers and the second day of the workshop is designed to provide free lectures on energy-efficiency design (e.g. basic principles, emerging technologies, recent policy development, and case studies) for students. The Institute of Tropical Architecture is also considering adding courses on energy-efficiency design and green buildings to the regular curriculum, which requires the approval from the Ministry of Education.

Level V: Green Building

Green building training programs will help attendees understand the concept of sustainable buildings, beyond codes programs, other green building programs such as LEED and LOTUS, and take advantage of financial incentives and technical assistance associated with green buildings (if applicable).

This training will include key practices and cases of sustainable building, establish competencies in applying LEED, Lotus and other relevant criteria or established guidelines, analyze the costs and benefits of incorporating sustainable building measures, learn about financial incentives and technical assistance offered by governments, utilities, and other organizations, work with different stakeholders to improve building's performance, understand project development process of the sustainable building, and learn about guidance for education and training of staff in sustainable building. Course content may include energy efficiency and integrated lighting design, green material selection, indoor environmental quality and health, water conservation and quality protection, and building operation and maintenance.

The green building training could be conducted through organizations, such as the Vietnam Green Building Council⁸ or the Vietnam Council for Green Buildings under MOC. The trainings could also be conducted by accredited professionals through different organizations, and trainers should be familiar with Green buildings and have professional and hands-on experience on green building projects; for example, professional with LEED AP certificate could be the potential trainer.

The green building training may also have two layers: introductory training to raise awareness among stakeholders and technical training to enable trainees to perform work in a green building project. Depending on the needs, green building trainings may be introduced to a broad range of stakeholders, including architects and engineers, contractors, tenant and developer representatives, project managers, other building industry professionals, and resource conservation specialists.

Training Approaches

Train-the-trainer is often used in the codes training to build capacity rapidly and effectively. With initial training on building energy codes and latest techniques, the seasoned practitioners could deliver trainings to others. The initial trainers could be experienced people or institutes. For example, in the U.S., the International Code Council has trained and certified Code Ambassadors in some states to support and mentor jurisdictions to improve energy code compliances. Similarly, in the process of implementing the Energy Conservation Building Code in India, three institutes, the Malaviya National Institute of Technology in Rajasthan, CEPT in Gujarat, and Indian Institute of Information Technology in Hyderabad, were built as local hubs for conducting training and facilitating implementation, and the three states these

⁸ The Vietnam Green Building Council is offering green building workshops and trainings occasionally.

trainers reside in built capacity faster and started out energy code enforcement more effectively than other states. In Vietnam, to effectively build capacity in a short period, it would be beneficial to identify experienced and knowledgeable trainers at each province and train these trainers first. And based on our understating, MOC is considering using architectural universities in major cities (e.g. Hanoi and Ho Chi Minh City) as training hubs. Later on, the trained trainers could organize VEEBC trainings at the provincial and local levels. Provincial Department of Construction could also set up an apprentice program in which someone who wants to be an inspector or code official “shadows” an inspector or code official to learn how to do this. In addition, Vietnam has 63 provinces with different levels of development; the initial training could be further constrained and focuses on three regions: Hanoi in the North, Da Nang in the Middle, and Ho Chi Minh City in the South.

Vietnamese stakeholders all recognize that there is a great need to develop training materials, yet it may take some time to fully build the training infrastructure. Materials from other countries could be referred as a starting point to develop training material, but ultimately these materials need to be localized to Vietnam at national as well as local scales. The Vietnamese organizations could do a dry run to test the newly developed materials to guarantee the quality of these materials. The idea is to get some trainers together to discuss frequency, cost-effectiveness, materials, and modules to cover. In the dry run, trainers will also discuss purpose of each slide and provide feedback and comments, but the trainers normally do not explain the slides as they do in the actual training. It generally double actual training time but would receive useful comments.

There are several approaches of organizing the training; the effectiveness of different approaches depends on the local situation. The classroom training and presentations are the most common approach and various stakeholders expressed that the in-classroom training would be most effective in Vietnam. For certain training such as compliance check, the classroom training could be supplemented by the field training or video training. The field training provides hands-on experience on different technical aspects of the buildings by letting code officials and inspectors actually get into the building under construction to make the judgment. If the field training is not available, photos and videos could be used to demonstrate good and bad cases.

A webinar is another good way to conduct training; however, the webinar is not most effective to deliver technical information. It is mostly appropriate to be used in the introductory training and generate awareness among different stakeholder groups. The webinar could also help train more people with less costs. The webinar could be followed by the classroom training, so when people come to the training, they are already aware of the issue and the in-person training could focus on technical information. In addition, in the U.S. experience, it has been found that webinars are helpful for software training as it allows trainees to experience the user-interface of the software and to use the software during the training. Long training programs are normally divided into different webinars, usually 60-90 minutes each, and training videos could be recorded and posted on the website.

Other common tools that could complement codes training include:

- User guides
- Tip sheets on specific compliance topics (installing insulation, certain calculations, etc.)
- Hotlines and help desks
- Articles, presentations and other web-based materials

Providing technical support and building a feedback loop are essential for a rigorous training program. It is important to set up the ability to have questions answered by both industry and organizations in charge of code enforcement. This can be a university or someone who is deeply knowledgeable on the code and on how it will be implemented. This could also help the training developers to gather information of problem areas in the code that can be the focus of further educational efforts.

Institutional Set-ups and Financing Mechanisms

After completing its review process, MOC is expecting to issue VEEBC in the first half of 2013, accompanied by a series of capacity building activities. The Department of Construction in each province would incorporate VEEBC into its construction approval process along with the enforcement of other building codes⁹ (e.g. fire and structure codes). The sections below explain how different organizations contribute to VEEBC implementation.

At the Ministerial Level

MOC, as a catalyst and facilitator, supports the development, revision, and implementation of VEEBC and provides technical and financial support to provinces to implement and enforce the energy code. MOC, in collaboration with technical organizations and international experts, may develop or obtain core tools, materials, and training to support the provinces in implementing VEEBC once it is formally issued. These core materials are designed to be customized for province and local conditions, and for the broad spectrum of stakeholders that are involved in the code adoption, implementation, and enforcement process. MOC would also develop or sponsor training and “train-the-trainer” program by using and building on existing stakeholder networks and programs such as training programs run by VACEE and VAA.

MOC is expecting to issue VEEBC in the first half of 2013, and start capacity building activities as soon as possible. Based on communication with MOC, its priorities include:

- 1) Organize training for the Department of Construction in all 63 provinces. MOC has a budget set for training. The training for DOCs will include two parts: introductory training on building energy codes and VEEBC as well as training on compliance check and inspection. It would be beneficial to build on and expand the existing system for quality control and inspection of the construction project.
- 2) Build capacity and raise awareness among stakeholders, including designers, consultants, developers, and universities. The trainings for stakeholders are also divided into two categories: introductory training for all stakeholders and training on technical specifications for architects and engineers. Given limited capacity in Vietnam, technical support from USAID and other international experts on training would be helpful in capacity building and knowledge sharing.
- 3) Develop supporting tools and materials for training, including technical guidelines, tools for OTTV calculation, and checklist for compliance check.

⁹ Decree No. 64/2012/ND-CP on construction permits was issued in September 2012 and regulates the procedures for obtaining construction permits; however, Decree No. 64 does not include VEEBC in the building permitting process.

- 4) Extend the training on energy audits, maintenance and operation, and modifications after construction. VEEBC and other building regulations require energy audit and commissioning, and most of these requirements are not mandatory now.

The development of VEEBC is a coordinated effort and the draft code was reviewed by all Ministries. The implementation of VEEBC and code training also require coordination among different Ministries. MOIT oversees the programs for energy auditing, energy management, and energy-efficiency products; and ECCs affiliated with MOIT at the provincial level implement the 2006 Law on Energy Efficiency and conduct energy audits. The Ministry of Education could work with universities to develop courses on building energy efficiency. The Ministry of Transportation is supervising the development of infrastructure, and building energy efficiency is part of the municipal energy planning. However, the ministerial coordination to promote building energy efficiency may need attention and work from the Prime Minister to ensure smooth division of roles and communication.

MOC would lead in the development and most training materials and help to organize trainings for Ministries, provincial government departments, and local code officials. MOC and MOIT have budgets for training, and therefore, the initial training for code officials and Departments on introduction to VEEBC and compliance check (organized by MOC) and energy auditing training (organized by MOIT) would be free to trainees.

Meanwhile, the ministries, professional organizations, and private stakeholders agree that developing training materials is urgently needed. The national government, in collaboration with professional organizations, could also lead in the development of training materials and offer free materials for stakeholders. The Table 1 below shows training materials and information offered by governments of different countries. The training materials also need to be updated continuously based on feedback from ongoing dialogue with provinces and stakeholders and from training workshops, hotline, and frequently asked questions.

Table 2: Building codes: information, training and tools

	Free info?	Free codes?	Free compliance software?	Government training?
Australia	Yes	No	No	Yes
Canada	Yes	No	Yes	Yes
China	Yes	No	No	Yes
India	Yes	Yes	Yes	Yes
Japan	Yes	Yes	Yes	Yes
Korea	Yes	Yes	Limited	Yes
U.S.	Yes	Mixed	Yes	Yes

At the Provincial Level

The provinces need to work with ministries and stakeholders to assess training needs. Provinces and ministries also need to collaborate in designing mechanisms to develop and update training materials to better respond to the evolving needs by providing information and questions obtained from plan review and compliance check.

The Department of Construction and other provincial departments responsible for code adoption, implementation, and enforcement (such as the Department of Information and Trade, and the Chief Architect of the City) will be a prime resource to help enforce codes as well as provide feedback for trainings. Their existing networks and programs will be critical in forging links and establishing partnerships with other primary actors, such as the primary users of codes – designers (e.g. architects, engineers, and lighting designers), builders and contractors, and building owners. Energy code enforcement at the provincial level also requires coordination; the Department of Construction and the Department of Information and Trade need to coordinate on several issues such as energy audits.

Code officials from all 63 provinces need to be trained. It is estimated that in the initial trainings, around 15-20 people in each province need to be trained initially. The training could be divided into a few steps, starting with pilot trainings in the major cities and provinces (i.e. Hanoi, Ho Chi Minh City, and Da Nang) and expanding to small provinces with less construction. Pilot province and stakeholder materials and processes could be packaged and later transferred to other provinces. In addition, new information on training and energy-efficiency technologies will continue to be reviewed and used where appropriate.

Where possible, existing infrastructure will be used as a platform for launching training programs on VEEBC and for tailoring, customizing, and disseminating the materials to the appropriate stakeholders. Delivery of the materials will be achieved through provincial and local stakeholders at the provincial and local level. Figure 2 illustrates this strategy.

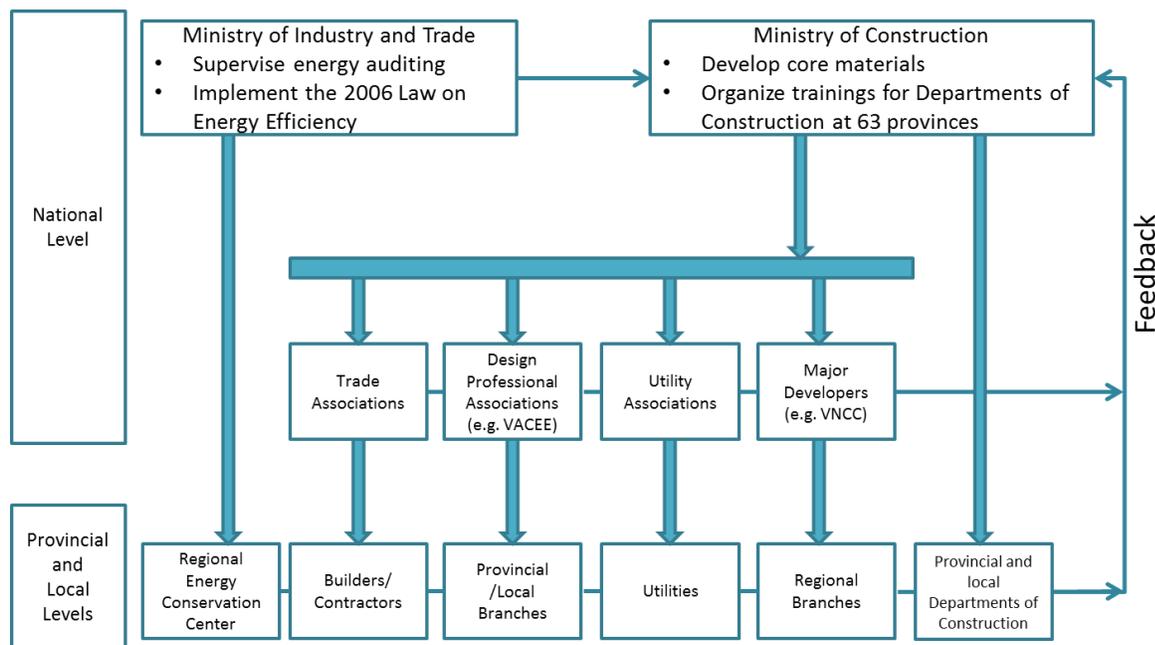


Figure 2: Building energy codes training at the national and provincial levels

Professional Organizations and Industries

In addition to the introductory training and compliance training (for code officials) offered by the national and provincial governments; the technical trainings for architects, engineers, builders, and other stakeholders could be hosted by professional organizations or big companies like the Vietnam National Construction Consultants Corporation (VNCC) through their existing infrastructure and networks.

The main professional organizations with relevant expertise include VACEE, VAA, and the Vietnam Federation of Civil Engineering Associations (VFCEA); and their target audiences vary based on their capacities and strengths. All of these organizations have extensive networks throughout Vietnam with a huge membership base among architects and engineers. VACEE is the main writer of VEEBC. It is familiar with the technical requirements in the code. Our understanding is that VACEE is also finalizing software for OTTV calculation, and thus VACEE has strong capacity to develop training materials and conduct technical trainings. Most practicing architects are members of VAA, and VFCEA has wide experience in urban planning; their networks could be used in code training to reach out to targeted audiences.

VNCC is a state-owned company supported by MOC, and it has over 3,000 staff working on building and infrastructure projects. VNCC has a small budget for training and provides occasional training to its staff on new building design, emerging technologies, and green buildings. From VNCC's perspective, there are two key elements of the industrial training: 1) introductory training for all stakeholders with specific information on the cost-effectiveness of the code and 2) technical training focusing on tools and solutions. The technical trainings need to be segmented by stakeholder groups, and the chief architects need to receive trainings related to all building components.

To make the training sustainable and market-based, professional and industrial stakeholders emphasized that VEEBC needs to be mandatory, and it could also be accompanied by other mechanism such as certificates associated with VEEBC training.

Conclusions

VEEBC has been developed through a stakeholder process and extensively reviewed by domestic and international experts, which makes the codes rigorous in many aspects and practical for implementation. As Vietnam is experiencing fast urbanization and construction boom, implementing building energy codes and improving building energy efficiency are crucial. Meanwhile, there is a great need to build capacity in Vietnam at the national, provincial, and local levels to facilitate enforcement of VEEBC and improve energy efficiency in Vietnamese buildings. Training on building energy codes and energy efficiency would be most effective if segmented by stakeholder groups to reach targeted audiences. In addition, it needs to serve both immediate needs in the near term and long-term demands for building energy efficiency. Introductory training on VEEBC could be started as soon as VEEBC is finalized, followed by trainings on compliance checking and technical requirements. The trainings need to raise awareness of stakeholders on building energy codes as well as deliver technical information. It needs to be cost-effectiveness and user-friendly and conducted in a practical, accurate, and understandable manner.

MOC, DOC, MOIT, VACEE, universities and other stakeholders all recognize that there is a great need to develop training materials, yet it may take decades to fully build the training infrastructure. Materials from other countries could be referred to as a starting point to develop training materials, but ultimately these materials need to reflect the code requirements and Vietnamese circumstances. In addition, since building energy efficiency, by its nature, involves multiple stakeholders, the training on building energy codes and energy efficiency also needs to be conducted in a coordinated way through multiple ministries, departments, and organizations.

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Appendix A: Resources for Developing Training Program

Below provides a brief list of available resources for training in the U.S. and other selected countries.

- <http://www.energycodes.gov>
 - Provides a holistic picture of the U.S. Building Energy Codes program, including detailed information on energy codes development, determination, adoption, implementation, and enforcement
 - Includes a variety of training materials, ranging from introductory code training to detailed training on code compliance software
- <http://www.energycodesocean.org/>
 - Gathers information from several countries on building energy code development and adoption, compliance and enforcement, and energy cost and savings
- <http://www.aia.org>
 - Develops over a thousand training courses for architects on building designs as well as energy efficiency
- <http://eco3.org/ecbc/>
 - Provides an overview of the Energy Conservation Building Code in India
 - Includes nine training modules associated with the Indian energy code
- <http://www.vgbc.org.vn>
 - Provides information on green buildings in Vietnam