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PROMOTION OF NON-FIRED BRICKS PRODUCTION AND UTILIZATION IN VIETNAM

Final Report

INTEGRATED PRODUCT MARKET STRATEGY FOR NON-FIRED BRICKS IN VIETNAM

CARRY OUT BY

EXPERT CONSULTANT TEAM

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ACCORDING TO DECISION NO. 1686/QD-TTG

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ACRONYMS

Acronym	Meaning
AAC	Autoclaved Aerated Concrete Bricks
CCB	Cement Concrete Block
CDC	Construction Design Joint Stock Company
FCB	Fired Clay Brick
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GOV	Government of Vietnam
MOC	Ministry of Construction
MOST	Ministry of Science and Technology
NFB	Non-fired Brick
NFBM	Non-fired Building Material
PMU	Project Management Unit
R&D	Research and Development
SBU	Standard Brick Unit
UNDP	United Nations Development Programme
VABM	Vietnam Association for Building Materials
VAT	Value Added Tax
VCA	Vietnam Concrete Association
VIBM	Vietnam Institute for Building Materials

REPORT No. 4: INTEGRATED PRODUCT MARKET STRATEGY FOR NFB IN VIETNAM

EXECUTIVE SUMMARY:

The project “Promotion of Non-fired Bricks production and utilization in Vietnam” was initiated in September 2014 through the Prime Minister with Decision No.1686/QD-TTG and is funded by the GEF/UNDP and co-financed by the Vietnamese agencies/institutions. After the Midterm review of the project, it was apparent that many challenges were hindering the ultimate goal for NFB to gain 30%-40% of the market share by 2020. The habit of using fired clay bricks (FCBs) is still popular in all provinces and is greatly affecting the popularity of newer materials such as non-fired bricks. Non-fired Brick (NFB) products are not well known in the market areas. The awareness of investors, designers, contractors, and consumers about Non-fired building Materials (NFBMs) is incomplete. Although significant growth has occurred with many NFBM’s, engineers and designers are faced with uncertainties in the design process when using NFBMs. These contribute to issues such as horizontal permeability and low bonding issues. Also, skilled workers are required for the construction of NFBs and specialty mortars and tools are needed in the application process. Many developers are unaware of these requirements and untrained masons are applying the NFBs incorrectly. The knowledge about design and construction using NFBs is very limited, affecting the quality of construction work and thus causing hesitation in the usage of NFBs. The price for raw materials needed in NFB production is higher, so the price of the NFB, therefore, appears high compared to that of the FCB. The reality is that, on a cost per area basis, many hard cost savings can be accrued by using a NFB vs FCB, but the consumers are unaware of these advantages. Many small concrete brick production lines also produce products that fail to meet Vietnamese standards, affecting the confidence of users and the quality of the NFB. The policies on incentives for NFB production and investment are not detailed enough to enable businesses and owners to access and benefit from them. For example, investors or building owners are not educated on NFB and are concerned about the quality, so they chose to use an FCB and risk high fines instead of using a product that they are not familiar with. There have also been a lack of policies and incentive mechanisms for using NFBs in construction works.

To address these concerns, an integrated product market strategy for non-fired bricks was developed. The focus on increasing the NFB market share was divided into 3 NFB products currently being produced in Vietnam; CCB, AAC, and Acotec panels. The project partners consist of MOST (Ministry of Science and Technology, UNDP, VIBM (Vietnam Institute for Building Materials), supported by a

Project Management Unit (PMU) and Consultants. This team undertook a study in order to uncover the most efficient policies and help develop market strategies to guide both government and business enterprises to contribute to growing the NFB market share in Vietnam to meet the goals set forth of gaining 40-45% market share for NFB products by 2030.

The study, through market research, field studies, and international experiences, has helped provide insights and recommendations to Vietnam in order to move towards the target goal regarding Non-fired brick market share.

An important lesson learned from this study, is that the government must take the lead in creating an enabling environment for supporting the transformation of the market for NFBs, at the initial stages of market development. To help grow the NFB market, the following is recommended from a governmental perspective:

- Continue to phase out Fired Clay Brick plants that are emitting high GHG emissions and using good quality soil for brick manufacturing.
- Enforce fines for mining clay.
- Increase penalties for producers making non-compliant NFB products and investors not using NFB on construction works with state budget.
- Value Added Tax (VAT) reduction and increase other fiscal incentives for NFB production and use.
- Monitor the implementation of the NFB related clauses of the following policies such as: Approval of the National Green Growth Strategy (Decision 1393/QD-TTg), Approval of the National Action Plan on Green Growth in Vietnam for the Period of 2014-2020 (Decision 403/QD-TTg), National technical regulation on NFB efficiency in construction works using energy (QCVN 09:2017/BXD), Declaring the action plan for the construction industry planning and implementing the National Action Plan for the 2030 recommendation program for sustainable development (Decision 1659/QD-BXD).
- Integrate key principles of the Energy Efficiency Building Code into the Green Growth Action Plans.
- Energy performance standards and product standards for GHG emissions (for brick production and equipment) should be enforced.
- Set up new institutional capacity within the government on Green Building design and construction of Government constructions. .
- Enforce government control for regular examinations at production plants and examinations at jobsites.
- Include standards of TCVN requirements of specialty tools, mortars, and accessories needed for NFB products.
- Include policies to encourage the use of fly ash and other industrial waste.
- Supporting enterprises invested in technological innovation by establishing a support fund in technological development.

Technological advancements and specialized training are key components that are still hindering the growth of non-fired building materials. Recommendations for improvement in these areas include:

- Updating architectural programs to include NFB in building design and construction guidelines.
- Allocating government funds to schools and university programs in architecture, engineering, masonry, and construction design to incorporate NFB related curriculum and training.
- Conduct trainings and follow-up trainings.
- Recommend that contractors hire skilled masons.
- Invest in large-scale production facilities using industrial waste and facilities with automated technology.
- Set goals for all existing factories to use automated equipment, especially in raw material mixing stage.
- Monitor dust at NFB manufacturing plants.
- Invest in scientific research and improved R&D for: bonding agents and glues for panel system use, optimized mix designs for NFB with fly ash and water repellent admixtures, and diversification of NFB products.
- Encourage producers to sell NFB products with specialty tools as a bundled package.
- Establish a support fund for technological development.
- Promote the role of the government to help support business enterprises by providing information on technology before investing.

Communication strategy and awareness campaigns can help to change the mindset of consumers and help spread information on NFBs. Recommendations to increase consumer awareness are:

- Encourage industry collaboration and networking.
- Create marketing guidelines for promoting NFB products, including improved product positioning, online marketing, developing Green Building mottos, etc. The producer should be the main influencer of NFB.
- Hold regular stakeholders meetings.
- Creating a Masons' or Skilled Workers' Association for the construction sector within the labor union.

Sectoral Targets for the period of 2021-2030

Increase investments for production and use of non-fired building materials so that NFB market share reaches 35-40% by 2025; 40-45% by 2030.

- Increase research and development for NFB products such as decorative, thin, and hollow products. These types of products with high added value account for 80% of the total market.
- Continue to maximize the use of industrial waste (ash, coal slag, metallurgical slag, ...) to produce NFBs.

Research and development, product and material optimization, new innovative products, advancement in production facilities, and more will require substantial support from all levels of government along with the private sector. The evolution of non-fired building materials will help build consumer trust in the products and strengthen market growth in Vietnam.

1. INTRODUCTION

Vietnam's population is growing rapidly, especially within the two large cities of Ho Chi Minh and Hanoi. Although there has been a decrease of GDP from 7.1 percent in 2018 to 6.6 percent in 2019, mainly due to slower export growth and weaker agricultural production growth, Vietnam is still projected to continue to grow fast.[1]

Because of this growth, the country will see a rapid increase in urbanization, increasing the demand for living spaces and larger buildings. The demand for building bricks will rise and it is forecasted that more than 35 billion SBUs will be required in 2025. The problem is, the traditional brick-making industry is extremely damaging to the environment. Apart from the loss in valuable top soil, traditional brick kilns making Fired Clay Bricks have higher levels of air pollution, emit more GHG emissions, cause poor working conditions and more.

The Government of Vietnam recognizes the challenges posed by FCB and has made progress in changing over to Non-Fired Bricks. The benefits of a NFB includes reducing pressures due to clay mining, reducing air pollution and GHG emissions, and other positive impacts.

In hopes to converting the building materials market to a more sustainable environment, the Government of Vietnam set forth a Development Programme for NFB. The Prime Minister's Decision 115/2001/QD-TTg, dated August 1, 2001 set initial targets for NFB production. On September 19, 2014, the Prime Minister issued Decision No. 1686/QD-TTg on the approval of project "Promotion of Non-Fired Brick production and utilization in Vietnam."

The objective of the project, "Promotion of Non-fired Bricks production and utilization in Vietnam," is to reduce greenhouse gas emissions by displacing the use of fossil fuels and the mining of good quality soil for brick-making through the increased production, sale and utilization of NFBs.

As part of the project, a study was commissioned on "The Integrated Product Market Strategy for Non-fired Bricks Project," which focusses on identifying the existing status and measures to develop the market for NFB. The study focusses

[1] "World Bank. 2019. World Bank East Asia and Pacific Economic Update, October 2019: Weathering Growing Risks." Washington, DC. https://openknowledge.worldbank.org/handle/10986/32482

on the following non-fired building materials: CCB (Cement Concrete Block), AAC (Autoclaved Aerate Concrete) and Acotec Panels. The results obtained through the research of market reviews, field studies, and international experiences was used to develop a market strategy to accelerate the growth of non-fired building products in Vietnam.

Through the market review and field studies, data was collected from different organizations. Interviews were conducted with: MOC, VIBM, VABM, VCA, and CDC, to collect their thoughts on the NFB market. Evaluations were done for the urban markets of Hanoi and Ho Chi Minh, as well as the rural markets surrounding the Mountain and Delta areas of Vietnam, in order to understand challenges and learn from successes there.

In addition, a study of International experiences was also conducted. The countries studied were: Canada, China, Korea, Italy, and Thailand. These studies offered insight into the global experiences in sustainable building developments where positive practices of using NFBs can shed light on the market strategies that can be implemented in Vietnam.

The Market study conducted for Vietnam in the urban and rural areas exposed insights into how each market is dealing with NFB and FCB production.

2. OVERVIEW OF CURRENT SITUATION AND TRENDS

The Market study conducted for Vietnam exposed insights into the production of NFB and FCB in urban and rural areas. For instance, all FCB production facilities in Ho Chi Minh have been abolished by the Ho Chi Minh City People's Committee through the implementation of Decision No. 2491/QD-UBND on May 21, 2011, which approved the planning of construction materials development by 2020. The implementation strategy of the non-fired construction material development program, however, is still inadequate. Non-fired building materials are still not widely used because most people are accustomed to using fired clay bricks and the price of NFB products appears high compared to FCBs. The raw material costs of NFBs are high in the city. Also, when NFBs are put into construction, there are some disadvantages that the engineers cannot overcome such as: horizontal permeability and low bonding with mortar. The use of such materials requires skilled workers, specialized tools, and auxiliary items. Producers using the "turnkey" business model are having the most success and

running at 100% capacity. This is due to the fact that quality and performance is controlled from production to installation completion. The facilities producing non-fired building materials have not benefitted from the incentive policies because the investors/owners of the new buildings have not paid attention to the ways in which the use of new materials in construction helps reduce overall construction expenses. They have simply focused on the SBU (standard brick unit) price difference between NFB and FCB without considering the hard cost savings.

The main advantage of non-fired bricks in Ho Chi Minh, is the fact that the state policy encourages the use of NFB in projects with good budget capital. In Ho Chi Minh, the design capacity for NFB in the province is 139 million SBU/year.

The Hanoi market is also characterized by unfulfilled strong competition from FCB and from the home based NFB production facilities that risk making poor quality concrete bricks. Larger production facilities in the urban areas are mainly providing products for state budget capital construction projects. In Hanoi, there are 18 fired clay brick production facilities in which 01 enterprise still manufactures fired brick in round kilns. The remaining 17 enterprises use tunnel kilns to manufacture bricks. Besides the 18 FCB enterprises, there are many FCB manufacturers at smaller scale (household scale) using improved manual kilns-with an exhaust treatment system, or round kilns. At present, there are a total of 199 FCB kilns including tunnel kilns, round kilns, and improved manual kilns. According to the Department of Construction, the Hanoi area is still producing about 384 million SBU/year of FCB. The design capacity for NFB is 236.20 million SBU/year with 09 enterprises for the Hanoi market area. The challenges faced in the market are due to the lack of demand for NFB since the consumers are lacking product knowledge.

In the rural areas of the Mountain and Delta regions, raw materials play a big part in brick production since the materials needed for cement production are highly available.

There are a significant number of production facilities on an industrial scale and even more NFB production facilities are manual and household based. The firms benefit from the abundant raw materials and cheap, local labor. The enterprises mainly sell products to projects with state budget capital or, in some cases, sell into the urban areas. Unfortunately, there are challenges in the consumption of products. Residential areas still consume fewer NFBs, leading to low revenues and profits for the NFB producer. Also, many establishments do not have standards of conformity, so the market faces many difficulties with quality control and consumer concern.

The rural areas of Can Tho, HauGiang, Thai Nguyen, and Cao Bang combined house 35 FCB production facilities, 40 NFB enterprise facilities (larger production plants) and 102 NFB manual or household facilities. The design capacity for the rural areas is much higher for the NFB at 559.46 million SBU/year vs. 475.50 million SBU/year design capacity for FCB. The main product category is solid brick with a size of 80 x 80 x 180 mm with majority of the commodities being assessed according to existing standards and conformity. Provinces like HauGiang, however, are facing difficulties because there are few state budget construction projects.

The demand for non-fired building materials from now to 2030 is expected to come, mainly, from construction works with state budgets, followed by the commercial housing construction sector. The output of NFB consumed in the period of 2016-2018, which includes information such as new builds for single family homes and population size, indicates a growth trend of NFB consumption and GDP. Using these figures and the statistics of investment in capital construction, we can forecast the demand of NFB's in the period to 2030 as shown in Table 1:

Table 1. Forecast demand of NFB (unit: billions of SBU)

No.	Forecast methodology	Year 2020	Year 2025	Year 2030
1	By the area of new buildings	7.908	15.410	22.911
2	By the scale of population	7.451	13.354	19.257
3	By the growth trend	7.450	13.297	19.145
4	By GDP	5.786	9.715	13.644
5	By capital in construction	5.501	8.780	12.058
	Average	**6.819**	**12.111**	**17.403**

The demand for NFB from now to 2030 is expected to come, mostly, from individual housing construction, commercial buildings, architectural and religious construction.

The output for fired clay brick (FCB) consumed in the period of 2001-2018 also includes information such as, new builds for single family homes, and population size. Through the growth trend of NFB consumption, GDP, and statistics of

investment in capital construction, we can forecast the demand of FCBs in the period to 2030 as shown in Table 2:

Table 2: Forecast demand of FCB (unit: billions of SBU)

No.	Forecast methodology	Year 2020	Year 2025	Year 2030
1	By the area of new buildings	18.237	18.009	17.781
2	By the scale of population	22.189	24.767	27.346
3	By the growth trend	22.090	24.626	27.161
4	By GDP	20.947	22.967	24.986
5	By capital in construction	20.206	21.923	23.639
	Summary forecast	**20.734**	**22.458**	**24.183**

The forecast results of the NFB demand vs. FCB demand shows us that the market of the NFB in 2020 will reach about 25% and will increase to 35% by 2025, reaching 40% in 2030.

2.1 CCB

Cement Concrete Block (CCB) are Concrete block or brick consisting of a mixture of cement, aggregates, sand, water, and other raw materials; it is usually formed in a mold with a vibrating press machine. The block or brick is naturally cured in an outdoor environment. Popular sizes of these bricks are: 210x100x60mm, 390x100mm, or 200x130mm.

Production of Concrete Bricks in Capacity are Defined as:

> 20 million SBU/year = Large capacity of NFB plants
10-20 million SBU/year = Medium to Large capacity of NFB plants
< 10 million SBU/year = Low capacity of NFB plants
< 6million SBU/ year = Super Low capacity of NFB plants

Market Size:

The market size for CCB accounts for up to 90% of the NFB market. The CCB products are sold to mostly low and high-rise apartment developments.

Performance:

The product performance of the CCB depends greatly on the manufacturing process, as well as how they are used in the construction. The larger producers of CCB that follow standards and conformity have few quality issues with their product. The smaller operations producing CCB products, however, do not follow the standard guidelines of production and more quality issues can, therefore, arise. Raw materials can also cause quality concerns. For instance, the sand used in the south is creating a softer brick and more cracks are being noticed.

CCB products are desirable because of their quick, natural curing process, the fact that they take less time to lay than FCB and thus save time and money, their higher threshold of thermal insulation, the fact that their raw materials are abundant and recycled raw materials can be incorporated into the product to help with moisture issues and, of course, the fact that the government currently offers investment incentives. In addition to these factors, production of CCB yields high efficiency products and the investment costs for startup facilities are low. The CCBs can also be produced in a larger size than a standard Fired Clay Brick; because of all these advantages, they are gaining popularity and becoming the trend in many areas.

Weaknesses:

Despite accounting for a large percentage of the market size for NFB, the market for CCB is slower to make gains. Smaller production plants operating out of homes can only sell to private clients rather than state enterprises because they lack proper documentation and lab tests; they also lack storage silos for fly ash and risk compromising standard quality.

Public awareness, too, is still an issue. Some designers, architects, and investors are still unfamiliar with the product. In addition to this issue, builders/masons are often simply farmers instead of skilled tradesmen, so they do not follow the proper procedures or fully understand the product itself. CCB quality is also dependent upon the availability of raw materials and transportation to further distances can be difficult and increase cost.

The Hanoi market supply of Cement Concrete Brick (CCB) products are produced in either a large production plant or a smaller operation being managed from the owner's home.

Of the smaller production sites, there are only two operating today. At one time, there were five, but the others went out of business because of low profitability (only 20% of cost). CCB products from the smaller operations are sold by word of mouth to local single families or private clients. The smaller household production plants are not offering coaching, training, or technical guidelines to end users.

The larger CCB producers are much more advanced in terms of technology, training, and quality control. Khang Minh Brick, a local producer of CCB in Ha Nam province with distance of 60 km from Hanoi, established their business in 2009 because of the government sector to promote NFB. Since then, Khang Minh Brick has increased its business to 6 production lines using technology from both China and Vietnam. They are experiencing a slowdown in the market, however, and only running at 70% capacity, which produces 105 million bricks.

Main Barriers:

The porous nature of concrete leads to a permeable product. Water permeability is a big concern for the CCB products. Because of the advanced technology and resources available to the larger producers, however, they are able to use innovative admixtures and equipment such as a high-tech vibrating press machine which improves capacity and

compaction ability of the machine. This creates high-efficiency production. A low permeable product will help keep the moisture from wicking into the CCB product and protecting the surface from becoming damp. Curing time is also an important role for the strength development and durability of concrete. The larger producers are curing their bricks (via natural curing) for 20 days before the bricks are loaded onto a truck for shipment. This is very different than the four-day cure time we are seeing in the smaller CCB plants. The larger CCB producers feel the government system is not following up on production standards at the smaller production plants and they are risking the quality and reputation of the Cement Concrete Bricks.

Producers and contractors are constantly looking for ways to improve the application of CCBs. For instance, Khang Minh is working on a new brick design using fly ash that can satisfy the water issue demands of the market. They have already changed the structure of the brick by going from a two-core hole to a four-core hole structure for better impermeability. Though the larger CCB producers are making strides to develop a better brick, they feel the legal system has not been strong enough to keep new fired clay brick producers out of the market. FCB continues to be very competitive.

CCB products are sold mostly to low-rise and high-rise apartment and villa projects. Coaching and training are provided by the larger producers for the end users and technical guidelines are available for contractors. This helps to alleviate improper applications, eliminate the risk of cracking, and address any other quality The training and guideline tools offered by the larger producers have helped gain the confidence of the end users. This was reiterated by a contractor on a jobsite meeting at the Hado apartment development project who stated, “I like the quality and consistency of the CCB products.” The contractor also noted that CCB is of great benefit to the contractor because he can choose which size works best to allow for a net savings on the area space for apartments. The larger brick units take less time to lay than a fired clay brick; this saves the contractor time and money.

April to July is the slowest season in the rural area (Hanoi) because of the heat and harvesting season. Vietnamese farmers, not skilled tradesmen, are acting as builders and masons. Unfortunately, they cannot work at the production plant during harvesting season. Also, as farmers they do not always follow the correct procedures for CCB design control and innovation.

Production performance is better and with far fewer issues in the North where there are more raw material resources available. Sand and gravel

that is mined from the river basins are also abundant. This is not true of the Southern areas.

CCB	FCB (2-hole)
Size: 27x15x11 cm	Size: 4x7x16 cm
Price: 1,800 VND	Price: 900-950 VND
*Requires less mortar & fewer bricks	

2.2 AAC

Autoclaved Aerated Concrete (AAC) is made from a mixture of cement, lime, gypsum, ground sand or fly ash, and an aeration agent together with other raw materials. The AAC block comes in different sizes (600mm length x 200mm height x100, 150, or 200mm thickness)**.** The AAC reinforced panels can have a length up to 5000mm. The AAC products are lightweight and provide low thermal conductivity. The curing process is usually through a low heat autoclaved curing chamber.

Market Size:

AAC products (bricks and panels) account for approximately 5.4% of the NFB market with 0.285 billion SBUs sold yearly. The target markets for AAC products are large development markets or those seeking to cut construction time and costs with an ecofriendly product. Typical applications include high-rise apartments and fence/wall applications.

Performance:

AAC products are running at 80% of design capacity and producing 200,000 m^3/ year. The producers are monitoring their production lines to improve the stability and quality of the products. Consumers can see the advantage of this new technology and the trend is increasing as more projects are going up in the cities.

AAC went a few years with no standards in place and faced quality issues because of this, but the issues have since been resolved with technical

guidelines issued by the MOC.[2] AAC performs well; it offers good thermal insulation and is comparatively lightweight. It is easily used for structural partition walls and the quick installation requires fewer laborers. AAC products help to improve sound transmission for noise reduction, is moisture resistant, and cures quickly (one week). Ten percent of the capacity for AAC is already being shipped to Taiwan and Singapore. Vingroup, who has manufacturing technology from Finland, has a total of six lines (300,000 m^3/ year/line), four lines in Ha Noi, two lines in Ho Chi Minh City, and plans to expand to 10 lines soon.

The producer offers training to end users to develop product knowledge and produce skilled technicians. In addition, the producer offers a two-year guarantee, during which they provide technical advice and send technicians to fix any issues that arise. These practices effectively gain the trust of customers. A showroom within the production office also aids in the sale of AAC since customers can see the product for themselves and get help in the selection process.

Viglacera, a top performing company in the NFB manufacturing business, is producing Autoclaved Aerated Concrete in Vietnam. The company was founded in December 2010 and in 2019, they upgraded capacity from 100,000 m^3/year to 200,000 m^3/year. They are running at 80% capacity.

The AAC products offer improved sound transmission and the larger sizes save on construction time and labor costs. AAC blocks can be handled in larger sizes at the job sites without the need for lifting tools; however, the AAC panels require simple lifting tools. The increase in soundproofing is due to the air pockets contained inside of the products. The sound insulation value is 7 decibels greater compared to other building materials of the same weight. The AAC products are mostly being used on high-rise apartment developments and fence/wall applications. The lightweight value of the AAC is a good selling feature for the large development projects and is becoming more popular. The density of the AAC brick products is around 600 kg/m^3. Fired clay brick densities are around 1500 kg/m^3, saving nearly 40%. Despite its low weight, AAC is strong and can be used in load-bearing walls, roofs, and floors. Some panels can be made with steel structures in which the steel is locally produced and galvanized at the plant to prevent rusting.

Raw materials, which include sand and fly ash, are abundant in Vietnam. Lime is mainly produced in North Vietnam since there are ample limestone

[2] TCVN 2011 / TCVN 7959-2017, “Lightweight Concrete—Autoclaved Aerated Concrete Products—Specifications currently sets the standard for production. The products are cured by autoclaved technological system at a high pressure (~12 atm) and low temperature (‘190 degrees Celsius) for 6-8 hours.

mines. Lime is mined for general building purposes and is not specified for AAC. Although lime does not meet the specifications for AAC products to date, lime is considered a valued alternate material to use in place of cement. All raw materials are tested upon delivery. Curing for the AAC products is achieved through a low heat autoclaved technology system from Germany. Viglacera is looking to expand their business by purchasing another retrofit facility. The producer believes consumers can see the advantages of the new technology with NFB products and foresees better developments in the future.

Housinco Group has developed the Housinco Premium project, which is using AAC products. The contractor stated that he likes working with AAC bricks because he can complete a floor in six days. It would take him 15 days to complete using an FCB. The requirement for using the AAC bricks came from the investor (Viglacera) because they require a lightweight brick. AAC products were specified at the beginning design phase of this development. The Housinco project is 27 floors high and will consist of offices and apartments. The contractor sees the AAC bricks and panels gaining interest with developers since it helps reduce the net area size for apartments and improves sound transmissions when used as structural partition walls. The producer offers training to the end users as the construction method is still new and fired clay brick practices remain more familiar. The construction design has been learned from experience and the contractor has developed a guideline that includes using a special mortar for waterproofing and a grid system that is nailed to the product at every 3rd layer of AAC brick, to prevent movement cracking. The special mortar, glue, and other supplies are purchased from another local ready-mix supplier. There have not been any quality issues since the new practices have been in place and the contractor also offers a two-year product guarantee. The growing trend is believed to be in green buildings as the developer has two more buildings in the design phase that will replicate the Housinco Premium Project and the same NFB products will be used.

WEAKNESSES:

There are, of course, some disadvantages to AAC. The transportation costs and difficulty of travel for the larger AAC panel products can be challenging due to narrow streets. Since the panels are larger in size and thus heavier, the weight (140-180 kg/panel) can be a challenge as it is quite hefty for the typical Vietnamese worker and will require lifting tools. Also, the size of the product eliminates purchases from smaller job sites

and can exceed elevator-loading capacity.[3] Aside from these issues, cracking of the panels require attention and repair for up to two years after the build when the structure is more stable. Consumer awareness concerning this process is troublesome for the AAC panel products since the cracking can be perceived as product failure although it could be due to a combination of factors, including the lack of proper construction design or techniques, shrinkage cracking due to moisture evaporation in the panel, improper mortar fill, lack of reinforcement materials used in critical locations, and the natural ground settlement process.

Main Barriers:

Raw material costs are driving the selling price in some markets for AAC products. The North has a more competitive advantage because of the locally available raw materials, such as lime. The transportation cost of lime, from the North to South, is 600,000/m^3. Transportation costs are higher to deliver the heavier panels and less product is delivered on site due to the weight of the trucks, therefore another increase in cost is incurred. Delivery to smaller jobsites in the city is a challenge with the larger sized panels since access is limited.

Most AAC panels are selected to be used in a project from the design phase. Because this is a long and tedious procedure, the processing time from design to production could be as long as two years.

2.2 ACOTEC PANELS

Acotec Panels are made with raw materials such as water, sand, cement, and aggregates. The panels are formed by an extruder or mold and then cut according to the recommended size. The panels are then stacked and left to cure by natural elements for 15-24 hours. The standard sizes of the Acotec Panels are 68-120mm thickness x 300-600 mm width x 2500-3300mm length.

Market Size:

Acotec panels account for about 4.6% of the NFB market and have nearly 0.240 billion SBUs sold per year. Acotec panels are mostly sold to high rise structures.

[3] Loading capacity > 2 tons and width of elevator > 3.5 m

Performance:

Acotec is a hollow core panel without reinforcement steel that is used for interior walls in buildings. It is referred to as “the Acotec panel” in Vietnam. These Acotec panels are being developed in Hanoi, Ho Chi Minh City, Ba Ria-Vung Tau, and Nha Trang. The operating capacity for Hanoi is at 100%. Acotec panel production is increasing in terms of interest and use. The panels are quickly becoming the trend for this market.

Those on larger job sites seeking a product made to fit their exact specifications and/or those enticed by the fast curing process and “turnkey” services the producer offers are driving the trend.

The Acotec panels follow the standards for specifications of product, construction, and acceptance under the TCVN Standards 11524:2016. (Government laws already in place are effective for limiting the use of FCBs).

Xuan Mai Concrete,[4] located in Hanoi, produces two types of Acotec panels in their market and are working at 100% capacity. XMC was the first Acotec panel producer in the North and is leading the group. These panels are lightweight (ranging from 140-180 kg/m^3) and can be easily used as structural partition walls. The biggest market for Acotec panels is high-rise structures. It has been difficult to promote on smaller job sites due to the size of the panels and limited space on the job site areas. The Acotec panels follow the standards for specifications of product, construction, and acceptance under the TCVN standard 11524:2016. The producer believes his products promote well against fired clay brick not only because the price is competitive at 375,000VND (which includes product, transportation, and installation), but also because the installation process is faster and the contractor is saving time and labor which saves the builder money. The builder is noticing the efficiency of the panels, which includes more net area space for the apartments and improved sound transmissions. The builder also likes the application process because it is clean and with little waste (no broken brick, messy mortar, or scaffolding). The product is increasing in popularity and demand.

Xuan Mai Concrete uses technology from Finland and is currently producing 1,200,000 m^3/year with four lines and plans to increase production to 2,000,000 m^3/year. The producer has hopes of increasing his volume to 10 million within the next few years. The curing time for the panels takes only one week and is a natural curing process. Quality

[4] Xuan Mai Concrete intends to increase their investment from 1,200,000m^2/ year to 2,000,000 m^2/ year at their production facility. Xuan Mai estimates the total market for Acotec panels to be 10 millionm^2.The search for a new facility is already underway

control is managed with the supplier of the raw materials to ensure that the product surface is sufficient and all products meet quality standards. The raw materials used (sand, stone, gypsum, cement, chemical additions, etc.) are abundant and are tested upon delivery. The standardized labs at the plant test products for compressive strength, tensile testing, etc.

Weaknesses:

Testing new glues and bonding agents for the joints of the walls and framework needs to be enforced because cracking has been an issue that appears at the joints between the adjoining wall panels. As we see with the AAC panels, the peoples' perception of the crack is product failure; however, causes for cracking or defects could be from improper mixing of the grout and water, insufficient grout at the joints, incorrect grout being used, vibration during construction, ground settlement and more. Drying shrinkage of panels can lead to cracking in weak connection points such as between panels, and the position adjacent to the panels that are in contact with the columns and beams of the building. The moisture content within the AAC panels can become very high with elevated humidity conditions. This promotes the occurrence of cracks due to the panels drying out too rapidly and causing shrinkage cracks.

Main Barriers:

Because of the negative impacts of consumer perception, specialized products and tools need to be established and provided as a solution to help with the cracking (rift) of paint at joints of walls or any other cracking concerns. Transportation is limited because of small streets. Acotec panels are limited to only being supplied at larger jobsite because of their size. Elevator restrictions are a big problem for Acotec panels as well. The elevator dimensions are smaller than the size of some panels, making it difficult to lift the panels to all floors of the buildings. Acotec panel dimensions should be designed to conform to elevator dimensions ahead of schedule.

3. INTERNATIONAL EXPERIENCES AND RECOMMENDATIONS WITH LESSONS LEARNED FOR VIETNAM

Globally, we face the challenge of achieving sustainable development for all human beings while preserving the environment. Through collaboration with other countries, we can glean lessons learned and implement solutions in Vietnam to help expedite the growth of NFB products. The countries chosen to study for international experiences were: Canada, China, Korea, Italy, and

Thailand. Assessing issues and solutions in these countries will result in gaining knowledge from experiences learned and to reduce the impact of hazardous building materials in the built environment, thus enabling Vietnam to make educated decisions and avoid the difficulties other have experienced.

The government is the main promoter in supporting the transformation of building materials into sustainable building materials. Policy makers and green construction supporters help to promote the most appropriate construction materials for different types of projects. This can be defined in each country studied. When it comes to promotion and material selection for green buildings in Canada, climate policy and low carbon designs are the focus, which ensures concrete becomes the building material of choice. In 2019, Canada's federal government committed to the Carbon-Pricing Plan, which puts a direct tax on emissions. Pricing carbon pollution will be the most efficient way to help reduce greenhouse gas emissions because the worst GHG emitters receive a direct penalty.

In China, lessons can be learned from the "Twelfth Five-Year Plan" which focused on reconstruction control for the clay brick industry. From 2013 to 2015, 486 clay production facilities were eliminated, removing 14 billion bricks from the market. China has also decreased illegal production with an amended regulation that enforces increased penalties for the illegal acts of manufacturing and selling clay bricks with a fine of 200 Yuan per cubic meter. To follow through with the roadmap of eliminating clay brick kilns, the "Thirteenth Five-Year Plan" is in place (2016-2020) to change development by promoting technological progress and green building materials, optimizing industrial structure, and deepening the "ban" on hazardous production.

The Chinese government is influential in supporting research and development; this is achieved by encouraging enterprises to produce high quality green building materials while also implementing stricter tax policies, fines, and punishments on traditional enterprises and manufacturers that are not abiding by the rules.

The Korean government is helping to develop and encourage sustainable building products via building certification criteria. The certification criteria can help to encourage the future needs of green buildings and construction, improve incentive grant programs for certified green buildings, modify green product technology, and more. In effort to reduce energy consumption in the building sector, the Green Building Plan includes mandatory regulations that raise standards and criteria for green home designs, promote environmentally friendly product certifications, and support the use of renewable energy. This clearly indicates that for the NFB market to grow, Vietnam must consider sustainability as a whole.

Thailand's government also plays a crucial role in developing green building materials through the Energy Efficiency Development Plan – EDP (2011-2030) which promotes technological development and innovation, enforces mandatory requirements (rules, regulations and standards) through building design inspections, and a mandatory "building efficiency" labeling process for new government buildings. Consumer awareness of sustainable living and behavioral change is formed through the EDP.

To encourage green businesses, the Italian government passed a law that provides contractors who register with the community as "certified EMAS (Eco-Management and Audit System)" with a reduction in building permit costs and savings on new government contracts. The strategy for green communities was creating by national agencies within the government to develop new technologies and encourage energy efficiency and sustainable developments. Several influences are turning construction companies' attention towards the different aspects of sustainability in Italy. Governmental regulations and national laws are pushing for the construction of "low energy" or "green" buildings. Construction companies are also encouraged to consider the interests of all "stakeholders" during the development of a project.

Industry collaboration from the supply chain is necessary for adopting sustainable products and practices. The supply chain (raw material suppliers, producers, product distributors, masons, contractors, and designers) can help to identify market challenges and develop the best solutions. From Canada, we can learn that with the help of associations such as the CCMPA (Canadian Concrete Masonry Producers Association), consumers become more aware of "doing the responsible thing" and their choices for building green reflect their good feelings about it.

The CCMPA has helped promote the awareness of the value of concrete masonry by focusing on its advantages such as: durability, energy efficiency, termite resistance, fire resistance, design versatility, and others. The CCMPA members strive to produce innovative products to lower their carbon footprint. For example: incorporating materials such as PLC (Portland lime cement), recycled product, and local raw materials into their mix designs, as well as practicing carbon capture techniques.

Industry collaboration with China enables green building material producers to help optimize the industry structure by encouraging other enterprises to use low carbon technology and urging green development and sustainable building materials.

ICT (Information Communication and Sharing Technology) is an adopted practice throughout the building sector in Italy. It has helped in developing long-term

relationships with the supply chain partners and is a fundamental tool in encouraging a sustainability strategy to grow a product market.

The ICT also encourages reviewing subcontractor audits with job site technical support, having a relationship with the raw material providers, and ensuring that raw materials have been through frequent testing and optimization while choosing local sources, if possible.

The shortage of skilled laborers is a global concern, therefore, the focus on improving specialized training in the construction sector is imperative. Not only is the government the main advocate for pushing green building designs, but it can also promote national campaigns for training skilled laborers. In Canada, the government leads consultations, explores partnerships, and provides advice to help minister employment in the construction sector. The government also helps in the development and labor workforce for skilled trades, including masons.

In Korea, the authorities have invested money to attract more skilled workers by improving training. This makes the construction sector more attractive to architecture students, but improved professional training also attracts blue-collar workers. Updating the architecture programs in universities to include a clearer and deeper knowledge of universal green building design is highly beneficial.

The EDP in Thailand ensures that end users can learn about building with energy efficiency and building design inspections. The EDP is promoted at institutions for skilled labor training and development. Thailand has developed online handbooks for sustainable building materials, such as the AAC panels. These handbooks provide guidelines on design techniques for plastering, mesh, and other important details to help avoid common user errors.

4. RECOMMENDATIONS OF NFB MARKET STRATEGY FOR VIETNAM

Government influence and policy enforcement will help the move towards quality and consistency of non-fired building products. Innovative equipment can also lead to developing new non-fired products. Enforcing energy efficiency and sustainability at the production process by using advanced technology will help lower production costs and improve competitiveness with NFBs. The government also has the ability to solve the negative impacts hindering the growth of NFBs and can change the mindset of the consumers and gain their confidence of using a product that they are not used to.

Government and Policy Enforcement

The government should ensure the gradual phasing out of inefficient Fired Clay Brick production technologies. These facilities are high GHG emitters and an action plan for promoting green development can be enforced by converting these production facilities to be replaced with large section tunnel kiln, electronic automatic batching technology, energy saving technology, etc.

- Continue the roadmap to eliminate manual brick kilns – taking a lesson learned from China with their Twelfth Five-Year Plan and how they followed up on continuation of the ban of FCB and promoted green buildings with the Thirteenth Five-Year Plan. For FCB plants that will continue to exist, make sure that improved tunnel kiln production plans are in place. Ensure that all brick facilities that are high GHG emitters are replaced with energy saving and automatic batching technology. The government needs to ensure that both FCB and NFB producers and users are following governmental standards and guidelines. The operation of brick kilns that cause pollution, kill crops, and affect the environment adversely should be terminated as per the regions policy and regulatory framework with Decision 1469/QD-TTg of the Prime Minister in 2014.
- Enforce land use fines for mining clay. China offers a valuable lesson learned: in order to develop NFB, they banned FCB and increased tax on the use of clay. After five years with this strict program in place, there was a 42% decrease in FCB. Vietnam has policy in place to stop FCB production, but needs a stronger enforcement for this law.

Some of the stakeholders, like CDC (Consulting and Construction Design) notes the difficulty in promoting NFB to investors; investors are not confident in the NFB due to the quality concerns of permeability and cracks. Investors still believe that the FCB is a better product and they are willing to endure fines and penalties (which can be up to 15 million VND) for using the FCB because the investor will receive a larger fine for quality issues if something goes wrong with the NFB.

- State policy encourages the use of NFB in projects with good budget capital, and according to Circular 12/2017/TT-BXD on using NFBs for construction works using state budgets, the works must use 100% NFBs. Higher fines and penalties need to be issued for construction works that are ignoring the policy standards. A gap in legal documentation is occurring because the user is still deciding what products to use and the legal documents are being ignored. The builders/owners need to have the technical guidelines and capacity to

satisfy building process and regulations. In order to convince investors to use NFB, the suggestion is made that these guidelines and data sheets are available to designers and owners. The producers should also use case studies and successes of other projects to prove credibility of NFBs. Skilled laborers should be mandatory on jobsites whom guarantee their work, and ensure the proper tools are provided for quality products (i.e. mortars, grids, glues, etc.).

- The rural areas have implemented higher resource taxes and VATs. In Cao Bang province, the state levies resource tax of VND 119,000/m^3. Initially, the resource tax was at VND 18,000/m^3. These policy and regulatory frameworks also apply in Mekong Delta. Also, the government levies 10% VAT in all NFB and FCB production facilities. The enterprises have been requesting that the authorities should consider reducing the taxes by at least half. Therefore, it is anticipated that the new VAT will be 5% when the reduction consideration is made. Also, the government should continue to improve and supplement incentive tax mechanisms and policies such as: import tax on equipment and spare parts, corporate income tax, reduction on building permit cost, reduction in raw material cost, and other incentives to help improve the competitiveness for the NFB market.
- Supervise and Audit the implementation of policies regarding green building design and construction such as: DECISION 1393/QD-TTg Approval of the National Green Growth Strategy, DECISION 403/QD-TTg Approval of the National Action Plan on green growth in Vietnam for the Period of 2014-2020, QCVN 09:2017/BXD National technical regulation on efficiency in construction works using energy, DECISION 1659/QD-BXD Declaring the action plan for the construction industry planning and implementing the National Action Plan for the 2030 recommendation program for sustainable development.
- A more integrated policy and regulatory framework is needed on green building design and construction. At present there are several stand alone policies such as standards on AAC blocks, light weight concrete panels, etc. and energy efficiency building code QCVN09. Due to various reasons, including a lack of integrated approaches, the implementation of these have not been effective .

Environmentally friendly building products and designs should be a reinforced criterion to help promote green growth in the building sector and will therefore increase awareness of NFBs.

- Government should encourage the notion that energy audits should be required for buildings and materials. The only energy building code in place is QCVN 09:2013/BXD “Energy Efficiency Building Code (EEBC)” which regulates conductivity coefficient of external walls in buildings

shall be less than 1.8 W/m^{2}K; however, this regulation is rarely enforced in practice. Energy efficiency should lead to more sustainable practices which will encourage green growth in the building sector. Mandatory energy performance standards and standards for GHG emissions for brick production and equipment should be enforced.

- Develop a government institution that specialises in Green Buildings, including sustainable building products like NFBs, focusing on R&D, as well as physical implementation of green building projects in government construction. A green building focus on design with technical regulations, energy efficiency, green building materials, solar energy, renewable energy, and green roofs will help the market become more consistent and use its resources for sustainable developments.

The quality concerns with NFB seems to lie with the smaller production plants in the rural areas and these areas represent 65% of the NFB product market. The urban areas or big city producers are not having as many quality concerns. Producers making non-compliant, under strength masonry units and supplying to project sites is a serious issue in the global market. The lessons learned, where quality issues are a concern, is that increasing stringency in building codes and enforcing penalties to enterprises that are not complying within standards will help rid NFB products of a negative reputation.

- The region's policy and regulatory policy states that the manufacturer of products has to adhere to the certified conformity standards. This should be applied to all producers. The household-based producers are not making products certified to standards; it is causing quality concerns. Products that are made at household plants are being shipped out after only four days of curing (the larger production facilities give the CCB products 20 days to cure before shipping). According to the Cement organization, the highest strength benefits for a hollow cement block occur during the first three days of curing. The most valuable effects of the curing process are secured at around 10-14 days. Product quality is increased with longer curing times. Therefore, all producers of NFB should conform to the current TCVN standards and develop QA/QC procedures and conformity certifications or penalties should be given to those who ignore the requirements. Government needs to strengthen the management of NFB production plants with regular examinations that the product and use of product are strictly abiding by regulations. Also, mandatory job site technical support will help manage NFB purchases and strengthen standards by allowing for design codes to follow standards for use of NFB in construction and encourage that mandatory regulations are being followed.

- Include in the standards of TCVN, the requirements of the special mortars, glues, and grids that needs to be used for NFBs.
- Incorporate policies to encourage the use of fly ash. Decision No. 452/QD-TTg, dated April 12, 2017, of the Prime Minister approved the promotion on the treatment and use of ash, slag, and gypsum from thermal power plants, chemical plants, and fertilizer plants as raw materials for construction materials production and in construction works. Since this decision, many standards, technical instructions and norms for the use of ash in construction materials such as NFBMs have been issued.

The amount of thermal power ash in Vietnam in the period between 2020-2030 is expected to generate 25.4 to 38.3 million tons/year. Optimization of building material choice selections with raw material products available in the market (ash, slag, calcium silicate, etc.) should be developed. Research and Development should ensure improved quality and sustainability for NFB with an added cost savings. The government should continue the development of NFB specification guidelines and include standards for fly ash brick, calcium silicate brick, silica brick, and other non-fired building products.

Training

Since skilled laborers are a global concern, focus should rest on improving the training modules in place and conduct specialized training throughout the construction sector. Knowledge is power.

- Focusing training with online webinars and training videos. Architectural programs should be updated to include a deeper knowledge of green building practices, the benefits of non-fired building materials, and design applications. Continue with workshops and training courses that are in place with updated information on lessons learned from building designs (i.e. special mortars, grids, etc.). Involve designers, owners, and contractors in all training programs by having special presentations prepared at their office. Invite them to plant demonstrations and prove the stability and sustainability of NFBs. The strategy to increase knowledge in the workforce with NFBs will help to reduce quality issues and build confidence with its consumer.
- Allocate funds from the government to universities or other educational programs regarding sustainability in building construction. Include masonry classes where the end users can learn more about NFBs. These classes should provide a broad introduction to design planning

for sustainability, structural design with design load requirements, building envelope designs, and eco-friendly building products.

- Require follow up training on seminars quarterly. If the owner or investor is making the final decision, then the issue becomes reaching the owner. Sufficient training of the product installation and technology will help fill in any gaps hindering product growth.
- Contractors should hire a skilled mason to be available for NFB jobsites. The skilled mason is central to the success of training new talent. Being in real work conditions at the jobsite, in the elements, is essential in truly teaching someone new skills. Having skilled masons that are part of the labor union will ensure that a unionized mason is on site at all NFB projects.

The strategy to increase knowledge in the workforce with NFBs will help to reduce quality issues and build confidence with its consumer.

Investments

- Develop investment in production and use of NFBs to replace FCB to reach 35-40% by 2025 and 40-45% by 2030. This can be achieved by investing in the production of large scale NFBs and with products using industrial waste materials (ash, coal slag, metallurgical slag, etc.), lightweight products, and investing in products that meet the requirements of industrialization and modernization of the construction industry.

Production Technology

- Set a development goal for 50% of all factories to use automated technology in production lines. Uses of advanced technology include applications such as automation for brick stacking and other modernized equipment functions.

Utilization of Natural Resources

- Maximize industrial waste materials (ash, coal slag, metallurgical slag, etc.) as raw materials for production of NFBs, thus saving mineral resources.

Environment

- Require production facilities to have a waste treatment system that meets environmental regulations and standards. The equipment system should be prepared for monitoring and reporting emissions and dust concentration at each factory.

Science and Technology

- MOST can help encourage Institutes, universities, and enterprises in the construction materials sector to invest in scientific research to: develop advanced technology applications in production in order to diversify product categories, improve product quality, and increase labor productivity by applying mechanization and automation. This will result in reducing raw material consumption with the increase of the use of waste as a raw material and fuel and improve environmental protection and occupational safety.
- MOST can also establish a Technology Development Support Fund to support enterprises invested in technological innovation by using advanced production and quality management measures to lower cost and improve competitiveness. This fund should work to strengthen the connection between manufacturing enterprises with domestic and foreign research institutes to propose and carry out research on key programs and structures for the development of NFB production industry.
- Promote the role of state management of science and technology by providing information on technology to support businesses before they decide to invest. This role will act as a bridge between businesses, universities, institutes, and research centers in Vietnam and help organize the application of science and technology while meeting the needs of technological innovation for enterprises.
- Support the research and development of NFB mix designs using fly ash and water repellent admixtures to help with moisture wicking problems and water mitigation issues.

Products

NFB products conforming to the standards will help eliminate quality issues such as the possibility of cracking. NFBs should be designed and constructed in accordance with the technical specifications for design, construction, and acceptance for each type of product. All NFB products should comply to the current TCVN standards before using them in construction works.

- R&D for bonding agents and glues for panel system use. Since cracking is still a concern for non-fired panel systems, producers need to find a solution. More test should be performed on elastic putty, flexible grouts, etc. Jobsite supervision should ensure:
  - That moisture control is maintained within the panels and the plastic packaging is not removed until installation to help avoid wall shrinkage.
  - Confirm that gaps between the wall is a maximum of 2mm and sealed with elastic putty to allow for flexible movement.
  - That the proper grout is being used, confirm proper mixing of grout and water, and sufficient grout is used at joints.
  - That glue/foam is used to fill between the panels, beams, and columns.
  - Provide a layer of fiber mesh over the joints as an additional precaution against cracks at critical positions.
  - Vibration is kept at a minimum in the surrounding areas.
- Require that the NFB producers also sell specialty mortars, glues, robust fasteners, and other accessories that are needed for NFB building applications. The product should be sold in a bundled package with requirements and tools needed for construction use.
- Offer diversity for large sized NFB products, components, wall panels, decorative, and lightweight materials, etc. Offer panel sizes that will conform to standard elevator dimensions to eliminate elevator restrictions on larger jobsites. Offer smaller panel sizes that can easily be delivered to any jobsite. Produce four-core hole brick products instead of two-core holes to allow for more impermeability.

The proven system requires the producer and contractor to work as a team. This collaboration works best because quality is enforced and guaranteed. Producers offering a “turnkey” service are operating at 100% capacity because this type of service helps reduce the risk of error by unskilled masons. The producer can bundle the NFB products, transportation, and labor cost to the general contractor. Vin

group, as an example, has increased quality and effectiveness with Acotec panels and they are having better construction designs to date. Construction methods have become more flexible in design and allowing for more NFB products gives more choices to the consumer, therefore making it easier to use. The NFB offers flexibility because it can be used on exteriors, interiors, and comes in different thicknesses. The diversity of larger sized NFB products, components, wall panels, and lightweight material is a huge benefit to the end user because of the reduction of construction time and lower construction cost. With supply chain collaboration such benefits will become well defined.

Consumer Awareness

Communication needs to be top priority. Changing habits for using FCB and creating awareness to stakeholders by making them understand the use and value of non-fired building products is key in driving the market share for NFB. The more communication is made public through the construction sector, the more knowledge is shared and the increased opportunity for others to learn and become aware of NFBs.

- Promote more industry collaboration within the supply chain. Integrating all sectors in the industry to network, attend association meetings, become key speakers, and communicate the awareness of green buildings in the communities to the public. Establishing an industry voice with associations that are dedicated to campaign for non-fired brick. For example, “Breathe easier today with concrete brick.”
- The level of control for planning development needs to come from the producer to push NFB to the supply chain and into the market. Joint product design and open communication involving the entire supply chain is an influential method to further grow the NFB market.
- Marketing of NFB should be done on the Internet and through industry associations, conferences, magazines, and industry peers. For instance, if a marketing promotion is about thermal mass, then concrete block has an enormous impact because of the selling feature that the mass properties help reduce energy consumption by keeping building cooler in the summer. Because Vietnam has intense heat in the summer, this would be of great importance to the homeowner, thus should be marketed to the homeowners with this idea in mind.
- Use the media to product position NFB against FCB showing the target audience the benefits of using non-fired building materials against fired clay brick and use examples from local construction sites. Example: “Because we used AAC panels instead of FCB at this Smart City Development, we were able to save xxx tons of CO2—meaning: we

could take xx cars off the road for two years!" This type of industry voice will help to create client demand for a green market because it makes it personal. Continue to broadcast and spread the knowledge on contents related to the production and use of NFB to the supply chain (investors, contractors, designers, etc.).

- Enhance NFB sales by providing an online E-market.. Remote areas and cities with limited raw material resources could also benefit from purchasing products online.
- To create public awareness, it is imperative that companies develop a green building motto to symbolize their commitment to sustainability, such as: "The Green Brick Solution," or "Live Green-Build Green." This helps to create client demand for a green market by promoting wellbeing and living for building occupants and signifies the importance of sustainability. Owners/developers should focus on green building communities and enforcing that NFB products are used in these communities.
- Establish joint monthly meetings with stake holders and policy makers as an information sharing and problem-solving sessions to discuss specific problems and handling techniques encountered at project sites.
- Create an association for masons within the labor union so they can meet on a regular basis and discuss lessons learned. Make it mandatory that a representative from the mason's union be present at the jobsites. Having these types of organizations could help prevent losing skilled masonry laborers to other trades and help:
    - Adopt sustainable concrete masonry products and practices
    - Jointly help to identify market challenges and develop the best solutions
    - Support education and training of future industry professionals
    - Increase the market share of concrete masonry
    - Ensure positive industry reputation in the eyes of the consumers

During the Twelfth Five-Year plan, about 14 billion bricks were taken out of the market and more than 600 cities in China completely banned solid bricks in the urban areas. The growth rate of green buildings in China is accelerating because green is becoming the trend. This trend will continue as awareness of environmental issues become more deeply embedded in the public consciousness. Vietnam can learn from China as the ban of FCB in China helped strengthen the NFB market. Even if the Vietnamese government should lack the physical and financial resources to support the abolishment of manual brick production, it can help FCB producers to switch production and manufacture NFB products.

Consumers are now increasing their demand for a healthy living environment and the real estate developers are more aware of environmental protections. Because

the government has been discouraging the use of clay bricks and encouraging a sustainable product, the people are more aware of the harm of clay brick and the market for NFBs is increasing. With the government strategy for energy efficiency and green building development, consumer awareness will broaden about non-fired building materials.

5. CONCLUSIONS

The NFB market in Vietnam is at a stage where a more focused effort led by the Government could remove few remaining obstacles to larger private sector investments in NFB's and more rapid growth of the market. There are a few challenges that need to be tackled so as to increase confidence in consumers and investors. Hence, the immediate need is for the government to address these challenges through further development and effective implementation of the policy and regulatory framework to supply and use NFBs and to phase out FCB's, more spending on R&D and product diversification of NFBs, increased public procurement and demonstration of NFB's, advocacy, training, advisory support, and awareness raising. In this effort, it is important to strengthen existing institutional capacity and develop new ones, and to establish effective modes of Public Private Partnerships and collaboration with Industry, labour, financial institutions and various stakeholders. As these efforts progress, the perceived risk for private investments in NFBs is expected to decrease which will help decrease the cost of financing and financial institutions are expected to offer more financing options to this sector for large as well as small and medium sized investors.