

# LOTUS Homes V1

Technical Manual  
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# Preface

## VGBC Background Information

The Vietnam Green Building Council (VGBC) is a project of the Green Cities Fund, Inc. (GCF), an international non-profit organization based in Oakland, California, USA. The VGBC's aim is to be the focal point for academia, government and the private sector in order to promote a more sustainable and adaptive built environment in the context of climate change.

The VGBC has been officially recognized by the Ministry of Construction of the Socialist Republic of Vietnam (March 2009) and also took part in the establishment of the WGBC Asia Pacific Network (September 2009).

The VGBC has set the following objectives:

Raise awareness and advocate for the development of green buildings:

- Enhance awareness of green building practice through workshops and online resources
- Support the government in defining green building development policies and codes
- Strengthen ties with academia, government and private sector partners

Build capacity:

- Develop and implement training curricula for academia and government
- Define and implement an official Green Consultant training and examination program (LOTUS Accredited Professional)

Define green building metrics for Vietnam:

- Develop a set of green building rating systems (LOTUS)
- Create a Green Database (products and services)
- Continue long-term research on climate change resilience for the built environment

## LOTUS General Information

LOTUS includes a set of market-based green building rating systems developed by the Vietnam Green Building Council specifically for the Vietnamese built environment.

LOTUS Rating Systems share the same goal with existing international green building rating systems (LEED, Green Star, BREEAM, GBI, Green Mark, Greenship, etc.) and aim at establishing standards and benchmarks to guide the local construction industry towards more efficient use of natural resources and more environmentally friendly practices.

LOTUS Rating Systems have been developed through long-term research, with the expert advice of specialists giving particular consideration to Vietnam's economic and natural characteristics and existing Vietnamese standards and policy.

The LOTUS Rating Systems currently include:

- LOTUS Non-Residential (LOTUS NR)
- LOTUS Multi-family Residential (LOTUS MFR)
- LOTUS Building in Operation (LOTUS BIO)
- LOTUS Homes
- LOTUS Small Buildings (LOTUS SB)
- LOTUS Interiors
- LOTUS Small Interiors (LOTUS SI)

## LOTUS Accreditation for Professional Practitioners

One of the key roles of VGBC is to educate and update practitioners about “green building” design and implementation issues. The core of VGBC's educational offering is the LOTUS Accredited Professional Training Course which allows candidates to undertake an exam in order to achieve the qualification of **LOTUS Accredited Professional (LOTUS AP)**.

LOTUS APs are practitioners within the construction industry who have comprehensive knowledge of the LOTUS Certification System philosophy, structure and practical application within the lifecycle of a building project. LOTUS APs are listed on the VGBC website.

# LOTUS Homes Rating System

## Scope and Eligibility

LOTUS Homes is used for single family dwellings. These are formally described as individual residential houses under QCVN 03:2012/BXD & Circular 12/2012/TT-BXD, dated on 28.12.2012. The following types of development are covered by this description:

- Villas: detached villa, semi-detached villa, deluxe villa and resort villa
- Terraced house: Townhouse, terraced house with garden
- Traditional rural house

LOTUS Homes can also be used for:

- Individual villas built in developments such as resorts.
- Refurbishment projects

For such projects, a close liaison with VGBC or a LOTUS AP will be necessary to ensure that certification is achievable.

Apartment buildings and Hostels, as defined under QCVN 03:2012/BXD & Circular 12/2012/TT-BXD, are not eligible for certification under LOTUS Homes.

## Categories

LOTUS Homes is composed of 6 **Categories** (plus “Innovation”), each containing a varying number of **Credits**. Against each credit, specific criteria have been set carrying individual scoring points.

**Energy (E)** - To monitor and reduce the energy consumption of a building through, for example, passive design, the use of natural ventilation and the installation of energy-efficient equipment (HVAC, lighting, water heater, etc.).

**Water (W)** - To reduce the water consumption of a building through the use of water-efficient fixtures, rain water harvesting, water reuse/recycling and associated water saving measures.

**Materials (M)** - To encourage use of sustainable materials and reduce use of high-embodied-energy materials, for example through the use of re-used and/or recycled materials.

**Local Environment (LE)** - To protect the ecology of the site of the building and surrounding area, to encourage recycling practices, and to integrate adaptation and mitigation strategies.

**Health and Comfort (H)** - To ensure high indoor environmental quality, through the optimization of indoor air quality, daylighting, and thermal comfort.

**Community and Management (CM)** - To increase the awareness of how buildings affect the community and to ensure that, throughout the project, all targets set up are competently and effectively managed.

In addition to the above categories, an **“Innovation” (Inn)** category rewards exceptional performance or initiatives which are not specifically addressed by LOTUS. This category awards additional “bonus” points.

## Prerequisites

Unlike other LOTUS rating systems, LOTUS Homes does not encompass any prerequisite.

## Credits

LOTUS is a point-based system where projects obtain points for complying with criteria set in the LOTUS Credits. Credits are built on the following structure: Intent, Requirements, Overview, Approach & Implementation, Calculations (optional) and Submissions. For a project to be compliant with a credit, the intent of the credit has to be met, the requirements have to be achieved and the required submission documents have to be provided.

## Options and strategies

Some credits can be satisfied through different options or strategies. A project can select only one option with its assigned points. A project can implement any or all strategies and accumulate points for the credit (while being restricted by the maximum number of points).

## Best practice credits

LOTUS Homes include some best practice credits rewarding bonus points for achieving best practice in design and construction. Best practice credits often require extra calculations or sophisticated documentation. These credits may be aspirational and not easily achievable for most projects, so, projects that do not achieve these credits will not lose points and the overall certification level will not be affected. Best practice credits are listed in the Appendix A.

## Performance and Prescriptive paths

Some credits, options or strategies in LOTUS Homes can be achieved with either a Prescriptive path or a Performance path.

The Prescriptive path requires specific solutions and is a "black-and-white" approach. The Performance path provides flexibility so that a design team may design a solution taking into account project requirements. A project may choose a Performance path for one credit and a Prescriptive path for another.

All the Performance paths are listed in Appendix B.

## Weighting

The current weighting of categories within LOTUS Homes (Table 1) has been carefully considered through analysis of other green building rating systems and in response to the environmental issues specific to the construction practices, development and the changing climate of Vietnam.

Table 1: LOTUS Homes Weighting

Categories	Weight (%)	Points	Bonus Points
Energy	30%	24	5
Water	10%	8	4
Materials	17.5%	14	0
Health & Comfort	13.75%	11	3
Local Environment	20%	16	1
Community & Management	8.75%	7	3
Innovation	0%	0	4
<b>Total</b>	<b>100 %</b>	<b>80</b>	<b>20</b>

## Certification Levels

There will be 80 points available in LOTUS Homes, plus up to 20 bonus points available with the best practice credits and the Innovation category. The thresholds for Certification Levels have been kept similar to the other LOTUS rating systems.

The first certification level for LOTUS Homes has been benchmarked at 40% (LOTUS Certified) of the total amount of points excluding bonus points. This value reflects a good first level of performance and the minimum required for certification.

The following thresholds correspond to 55% (LOTUS Silver), 65% (LOTUS Gold) and 75% (LOTUS Platinum) of the total number of points as shown in Figure 1.

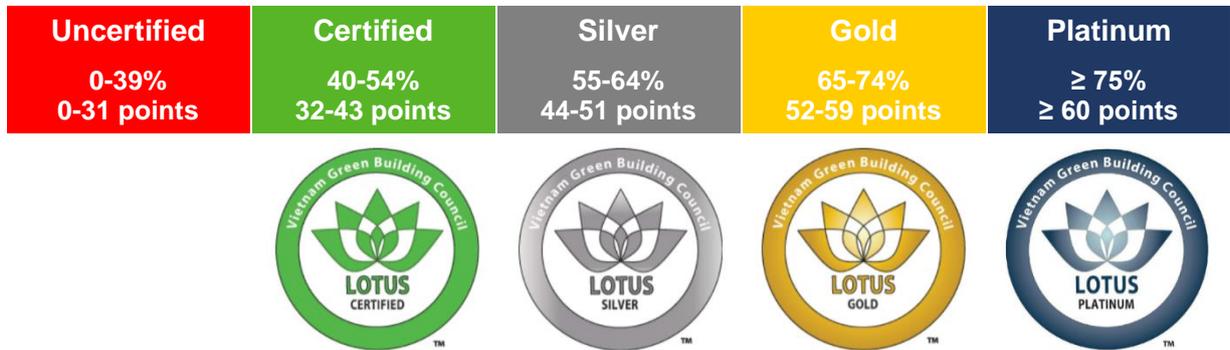


Figure 1: Certification System & Performance levels

# LOTUS Homes Certification Process

## Introduction

LOTUS Certification is a formal process to independently validate that a project has achieved the environmental performance specified in LOTUS Rating Systems. Documentation-based submissions are provided to the **Assessment Organization** as evidence of this achievement.

The VGBC recommends that LOTUS Certification is planned at the earliest possible stage of the project, ideally before the design stage even begins. This allows designers to make changes that will improve the project's overall performance and help to achieve a better LOTUS Certification level.

## LOTUS Timeline

LOTUS Homes Certification happens in the following steps:

- Application and Registration
- Pre-assessment stage (optional)
- Certification stage

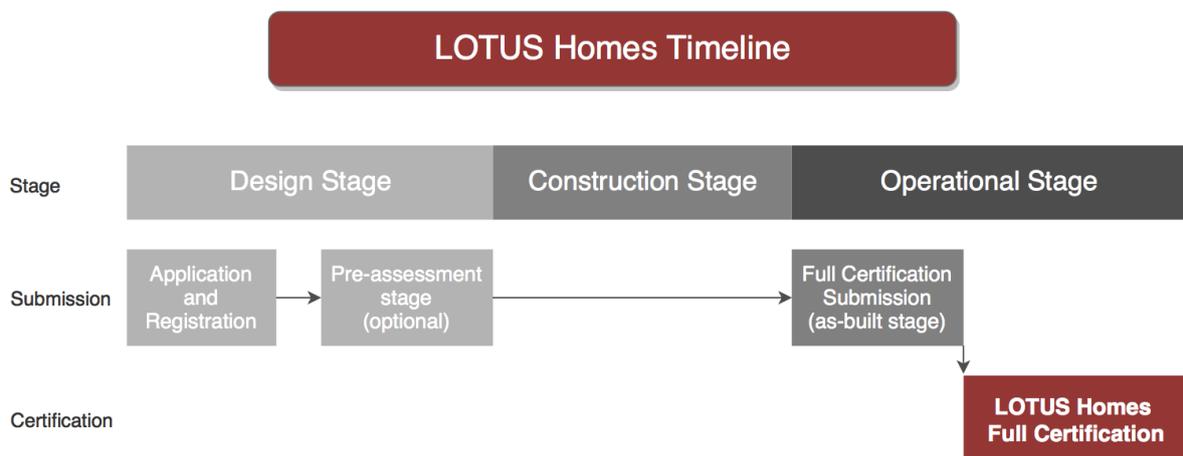


Figure 2: LOTUS Homes Timeline

# LOTUS Homes Credit list

Note: Best practice credits are included in Appendix A and are not listed below.

Credit	Title	Points
<b>ENERGY</b>		<b>24 points</b>
E-1	Passive Design	5
E-2	Building Envelope	4
E-3	Home Cooling	6
E-4	Artificial Lighting	3
E-5	Water heating	2
E-6	Energy Efficient Appliances	3
E-7	Energy Monitors	1
<b>WATER</b>		<b>8 points</b>
W-1	Water Efficient Fixtures	5
W-2	Water Efficient Landscaping	2
W-3	Drinking Water	1
<b>MATERIALS</b>		<b>14 points</b>
M-1	Building Structure Materials	3
M-2	Non-structural Walls	3
M-3	Windows and Doors	2
M-4	Flooring Materials	2
M-5	Roofing Materials	2
M-6	Furniture	2
<b>HEALTH &amp; COMFORT</b>		<b>11 points</b>
H-1	Fresh Air Supply	2
H-2	Ventilation in Wet Areas	1
H-3	Low-VOC Emissions	4
H-4	Daylighting	3
H-5	Acoustic Comfort	1

<b>LOCAL ENVIRONMENT</b>		<b>16 points</b>
LE-1	Site Selection	5
LE-2	Site Design	2
LE-3	Vegetation	2
LE-4	Heat Island Effect	2
LE-5	Flood Risk Mitigation	1
LE-6	Stormwater Runoff	2
LE-7	Refrigerants	1
LE-8	Waste Management	1
<b>COMMUNITY &amp; MANAGEMENT</b>		<b>7 points</b>
CM-1	Design Management	1
CM-2	Construction Management	5
CM-3	Operational Management	1
<b>INNOVATION</b>		<b>4 bonus points</b>
Inn-1	Exceptional Performance Enhancement	4
Inn-2	Innovative techniques/initiative	

# Energy

As urbanization is speeding all over the world, buildings have been described as a hidden culprit, responsible for 20% to 40% of global energy consumption and more than 30% of global greenhouse gas emission.

For developing countries like Vietnam, while fast economic growth and urbanization rates are improving living conditions, they are also leading to an increasing energy demand. It is expected that between 2010 and 2025 there will be a 10% increase in energy demand each year and that by 2025 the demand will be triple the current demand and that 8 times the amount of electricity will be required to cope with the fast urbanization and construction rate.

Moreover, as Vietnam's energy is mainly generated from non-renewable fossil fuels which are the main sources of greenhouse gas emissions, increased energy demand also means worsening global warming.

However, since buildings, especially in urban areas, consume the majority of the energy produced annually in Vietnam, there is potential for mitigating climate change and energy insecurity through integrating energy efficiency measures into buildings. With energy efficient designs, buildings can potentially reduce their energy consumption up to 50%, thus climate change improvement can be realized.

With this target in mind, LOTUS Homes rewards efforts taken to reduce the building energy consumption through passive design, optimized thermal performance, incorporation of natural ventilation and energy efficient technologies, as well as utilizing sustainable energy sources.

Energy		24 points
Item	Criteria	Points
E-1	Passive Design	5 points
	Strategy A: East and west facade	
	East and west facades area is lower than 40% of the total facade area	1
	East and west facades area is lower than 20% of the total facade area	2
	Strategy B: Window-to-wall ratio (WWR)	
	WWR of the east and west facades is lower than 30%	1
	WWR of the east and west facades is lower than 15%	2
	Strategy C: Shading Devices	
	1 point for meeting each of the following requirements: <ul style="list-style-type: none"> <li>- Install appropriate shading devices on 90% of the glazing area on the north and south facades</li> <li>- Install appropriate shading devices on 90% of the glazing area on the east and west facades</li> </ul>	2
E-2	Building Envelope	4 points
	Strategy A: Heat transfer through walls	
	All the external walls are made with any or any combination of the following: AAC blocks, a layer of insulation material with a thickness of at least 40mm, lightweight hollow blocks or equivalent.	1
	Strategy B: Heat transfer through roofs	
	All the roofs are made with any or any combination of the following: An air layer of at least 40mm, a layer of insulation material with a thickness of at least 40mm, a fixed sunshade, a green roof or equivalent.	1
	Strategy C: Solar radiation through windows	
	All the glazing systems installed are any or any combination of the following: solar control glasses or low solar heat gain low-E double glazing windows	1
	Strategy D: Solar radiation on solid surfaces	
	Limit solar radiation on 95% of the solid surfaces	1

Item	Criteria	Points
E-3	Home cooling	6 points
	Strategy A: Natural cooling	
	Strategy A1: Stack Ventilation Install a vent column or an effective rooftop turbine vent to create stack ventilation	1
	Strategy A2: Minimized use of air-conditioning For 3 points, only bedrooms are equipped with air-conditioning systems For 6 points, no air-conditioning system is installed in the building	6
	Strategy B: Mechanical cooling with air-conditioning system	
	Strategy B1: Variable speed compressors All air-conditioners are equipped with variable speed compressors	1
	Strategy B2: Energy efficient air-conditioners For 1 point, all air-conditioners have at least 3 stars in the energy labelling program of VNEEP For 2 points, all air-conditioners have at least 4 stars in the energy labelling program of VNEEP For 3 points, all air-conditioners have 5 stars in the energy labelling program of VNEEP	3
E-4	Artificial Lighting	3 points
	Average luminous efficacy is higher than 60 lm/W	1
	Average luminous efficacy is higher than 70 lm/W	2
	Average luminous efficacy is higher than 80 lm/W	3
E-5	Water Heating	2 points
	Option A: Solar water heating	
	Solar thermal system produces the domestic hot water	2
	Option B: Heat pump water heating	
	Heat pump water heater produces the domestic hot water	2
E-6	Energy Efficient Appliances	3 points
	40% of appliances and equipment installed have an energy efficiency label	1
	1 point for every additional 20% of appliances and equipment installed that have an energy efficiency label (up to 80%)	3
E-7	Energy Monitor	1 point
	Install a home energy monitor to record electricity consumption	1

## E-1 Passive Design

### Intent

To incorporate design techniques that take advantage of the natural climate and site to minimize mechanical cooling in the building, while ensuring comfort for all occupants

### Requirements

Criteria	5 points
Strategy A: East and west facade	
East and west facades area is lower than 40% of the total facade area	1
East and west facades area is lower than 20% of the total facade area	2
Strategy B: Window-to-wall ratio (WWR)	
WWR of the east and west facades is lower than 30%	1
WWR of the east and west facades is lower than 15%	2
Strategy C: Shading devices	
1 point for meeting each of the following requirements: <ul style="list-style-type: none"><li>- Install appropriate shading devices on 90% of the glazing area on the north and south facades</li><li>- Install appropriate shading devices on 90% of the glazing area on the east and west facades</li></ul>	2

## E-2 Building Envelope

### Intent

To ensure proper application of materials and techniques to the construction of the building envelope to optimize the thermal performance of the building.

### Requirements

Projects can follow the requirements below or follow the performance path in Appendix B.

Criteria	4 points
Strategy A: Heat transfer through walls	
All the external walls are made with any or any combination of the following: AAC blocks, a layer of insulation material with a thickness of at least 40mm, lightweight hollow blocks or equivalent.	1
Strategy B: Heat transfer through roofs	
All the roofs are made with any or any combination of the following: An air layer of at least 40mm, a layer of insulation material with a thickness of at least 40mm, a fixed sunshade, a green roof or equivalent.	1
Strategy C: Solar radiation through windows	
All the glazing systems installed are any or any combination of the following: solar control glasses or low solar heat gain low-E double glazing windows	1
Strategy D: Solar radiation on solid surfaces	
Limit solar radiation on 95% of the solid surfaces	1

## E-3 Home Cooling

### Intent

To reduce the need for HVAC systems and increase natural air flow and to encourage the installation of energy efficient HVAC systems.

### Requirements

Projects can follow the requirements below or follow the performance path in Appendix B.

Note: Under credit E-3, it is possible to follow the prescriptive path for one strategy and follow the performance path for the other strategy.

Criteria	6 points
Strategy A: Natural cooling	
Strategy A1: Stack Ventilation Install a vent column or an effective rooftop turbine vent to create stack ventilation	1
Strategy A2: Minimized use of air-conditioning For 3 points, only bedrooms should be equipped with air-conditioning systems For 6 points, no air-conditioning system should be installed in the building	6
Strategy B: Mechanical cooling with air-conditioning system	
Strategy B1: Variable speed compressors All air-conditioners are equipped with variable speed compressors (inverters)	1
Strategy B2: Energy efficient air-conditioners For 1 point, all air-conditioners should have at least 3 stars in the energy labelling program of VNEEP For 2 points, all air-conditioners should have at least 4 stars in the energy labelling program of VNEEP For 3 points, all air-conditioners should have 5 stars in the energy labelling program of VNEEP	3

## E-4 Artificial Lighting

### Intent

To reduce energy consumption associated with the use of interior artificial lighting systems.

### Requirements

Projects can follow the requirements below or select the performance path in Appendix B.

Criteria	3 points
Average luminous efficacy is higher than 60 lm/W	1
Average luminous efficacy is higher than 70 lm/W	2
Average luminous efficacy is higher than 80 lm/W	3

## E-5 Water Heating

### Intent

To reduce the energy consumption of domestic water heating.

### Requirements

Criteria	2 points
Option A: Solar water heating	
A solar thermal system produces the domestic hot water	2
Option B: Heat pump water heating	
A heat pump water heater produces the domestic hot water	2

## E-6 Energy Efficient Appliances

### Intent

To reduce the energy consumption of equipment and appliances

### Requirements

Criteria	3 points
40% of appliances and equipment installed have an energy efficiency label	1
1 point for every additional 20% of appliances and equipment installed that have an energy efficiency label (up to 80%)	3

## E-7 Energy Monitor

### Intent

To have access to energy use information and encourage energy conservation.

### Requirements

Criteria	1 point
Install a home energy monitor to record electricity consumption	1

# Water

Water scarcity - including poor availability and quality- is a growing risk threatening both food and energy security of many countries in Southeast Asia. Several river basins in the country are expected to face acute stress or shortage by 2025, and groundwater sources are rapidly declining.

In Vietnam, even though the country was considered one with high water availability with intensive river systems, the government has announced that Vietnam is a country with poor clean water resource, which has only enough water to provide 4000m<sup>3</sup>/year/person, compared to the global average of 7000m<sup>3</sup>/year/person. Moreover, seasonal shortages have already worsened, especially around major metropolitan areas such as the Red river delta or big rice-producing areas like the Mekong delta due to high demand, water pollution and climate change impacts. Since these two river deltas are the country's premier rice-growing regions, water shortage threatens the nation's food security.

As clean water becomes less readily available within Vietnam, the cost of this service is bound to increase in near future. Therefore, a water-efficient building not only ensures consistency in operation and production but also saves building owners money in operational costs. Furthermore, such building improvements will also help reduce the load on many of the antiquated sewage systems in urban areas of Vietnam.

Understanding the circumstance, LOTUS prioritizes the reduction of water consumption and emphasizes this in the requirements of the Water Category. Credits within this category encourage water-efficient equipment and water-efficient landscaping.

Water		8 Points
Item	Criteria	Points
W-1	Water Efficient Fixtures	5 points
	Install the following fixtures: <ul style="list-style-type: none"> <li>- 1 point for installing dual flush low flow WCs</li> <li>- 2 points for installing low flow shower heads</li> <li>- 1 point for installing low flow kitchen and bathroom taps</li> <li>- 1 point for low-water clothes washers</li> </ul>	5
W-2	Water Efficient Landscaping	2 points
	Strategy A: Plant Selection	
	Select plants to minimise water demand for irrigation	1
	Strategy B: Water Efficient Irrigation System	
	Install a water efficient irrigation system	1
W-3	Drinking Water	1 point
	Install a drinking water filtration system supplying at least one faucet in the house	1

## W-1 Water Efficient Fixtures

### Intent

To reduce the consumption of water in buildings by means of water efficient fixtures

### Requirements

Projects can follow the requirements below or select the performance path in Appendix B.

Criteria	5 points
Install the following fixtures: <ul style="list-style-type: none"><li>- 1 point for installing dual flush low-flow WCs</li><li>- 2 points for installing low-flow shower heads</li><li>- 1 point for installing low-flow kitchen and bathroom taps</li><li>- 1 point for low-water clothes washers</li></ul>	5

## W-2 Water Efficient Landscaping

### Intent

To reduce potable water consumption on landscaping

### Requirements

Projects can follow the requirements below or select the performance path in Appendix B.

Criteria	2 points
Strategy A: Plant Selection	
Select plants to minimise water demand for irrigation	1
Strategy B: Water Efficient Irrigation System	
Install a water efficient irrigation system	1

## W-3 Drinking Water

### Intent

To reduce consumption of bottled drinking water and to improve drinking water quality.

### Requirements

Criteria	1 point
Install a drinking water filtration system supplying at least one faucet in the house	1

# Materials

During the lifecycle of any construction material, its extraction, processing, transportation, use and disposal can have negative effects on the environment. Especially, the acquisition of virgin material destroys natural habitats, pollutes air and water, and depletes energy and natural resources. Therefore, to mitigate the negative impacts of construction on the natural environment, usage of materials produced from virgin sources must be limited.

With the fast urbanization rate reaching 28% (Vietnam Ministry of Construction), construction sites are rising in all corners of Vietnam. Along with this, the demand of construction materials is expected to rise by 10% annually (Vietnam Association of Building Materials). However, this growth will not be sustainable as the production of those construction materials mostly relies on the exploitation of virgin materials. Moreover, since materials exploitation in Vietnam is usually small-scaled and processing technologies are often outdated, natural resources are being wasted and serious damages are being done to the environment.

By setting a common goal of construction materials conservation, the Materials Category of LOTUS encourages strategies and materials which are not only re-used or recycled, but also sustainable and accessible. By responsibly specifying materials and construction processes, the impact of any project on the natural environment can be significantly reduced.

The Material Category of LOTUS includes two main goals which are to reduce the amount of virgin natural resources used, and to promote the use of low-energy sustainable materials. To achieve the goals, credits within this category encourage onsite reuse of building materials and structure, consumption of recycled materials, materials from sustainable sources and unbaked materials.

Materials		14 points
Item	Criteria	Points
M-1	<b>Building Structure Materials</b>	<b>3 points</b>
	40% of the structure materials are sustainable	1
	1 point for every additional 20% of the structure materials that are sustainable (up to 80%)	3
M-2	<b>Non-structural Walls</b>	<b>3 points</b>
	40% of the non-structural walls are sustainable	1
	1 point for every additional 20% of the non-structural walls that are sustainable (up to 80%)	3
M-3	<b>Windows and Doors</b>	<b>2 points</b>
	40% of windows and doors are made up of sustainable materials	1
	80% of windows and doors are made up of sustainable materials	2
M-4	<b>Flooring Materials</b>	<b>2 points</b>
	40% of the flooring materials are sustainable	1
	80% of the flooring materials are sustainable	2
M-5	<b>Roofing Materials</b>	<b>2 points</b>
	40% of the roofing materials are sustainable	1
	80% of the roofing materials are sustainable	2
M-6	<b>Furniture</b>	<b>2 points</b>
	25% of all furniture items are sustainable	1
	50% of all furniture items are sustainable	2

## M-1 Building Structure Materials

### Intent

To encourage and recognise developments that use sustainable materials for building structure.

### Requirements

Criteria	3 Points
40% of the structure materials are sustainable	1
60% of the structure materials are sustainable	2
80% of the structure materials are sustainable	3

## M-2 Non-structural Walls

### Intent

To encourage and recognise developments that use sustainable materials for non-structural walls.

### Requirements

Criteria	3 Points
40% of the non-structural walls are sustainable	1
60% of the non-structural walls are sustainable	2
80% of the non-structural walls are sustainable	3

## M-3 Windows and Doors

### Intent

To encourage and recognise developments that use sustainable materials for windows and doors.

### Requirements

Criteria	2 Points
40% of windows and doors are made up of sustainable materials	1
80% of windows and doors are made up of sustainable materials	2

## M-4 Flooring Materials

### Intent

To encourage and recognise developments that use sustainable flooring materials.

### Requirements

Criteria	2 Points
40% of the flooring materials are sustainable	1
80% of the flooring materials are sustainable	2

## M-5 Roofing Materials

### Intent

To encourage and recognise developments that use sustainable roofing materials.

### Requirements

Criteria	2 Points
40% of the roofing materials are sustainable	1
80% of the roofing materials are sustainable	2

## M-6 Furniture

### Intent

To encourage and recognise developments that use sustainable materials for fitted furniture.

### Requirements

Criteria	2 Points
25% of all furniture items are sustainable	1
50% of all furniture items are sustainable	2

## Health & Comfort

The World Health Organization reported in its Air Quality Guidelines (2<sup>nd</sup> Edition) that most of an individual's exposure to air pollutants comes from inhalation of indoor air. Besides air quality, the amount of noise and light pollution can also affect occupants as well as the surrounding communities. As the population of Vietnam is increasingly urbanized, it is estimated by the Ministry of Construction that urban population will increase by 45% within the next 20 years. This urban migration results in an increasing number of people spending an increasing amount of their time within the built environment. As a result, building occupants quality of life depends greatly on the indoor environment quality (IEQ).

Ensuring occupants' health and comfort is done most effectively by maintaining and increasing the building's IEQ. Improving the IEQ results in reduced cases of asthma, allergies, respiratory disease and other occupant ailments described as "sick building syndrome".

All credits within the Health & Comfort Category of LOTUS Homes targets the overall improvement of the indoor environment in buildings. The improvements aim exactly at four different aspects of the indoor environment. First and most important aspect is the quality of indoor air. The building has to ensure fresh, clean air free of toxic chemicals for occupants. Moreover, a healthy indoor environment in a building has to be comfortable visually, acoustically and thermally for most of the occupants of the building.

Health & Comfort		11 Points
Item	Criteria	Points
H-1	<b>Fresh Air Supply</b>	<b>2 points</b>
	Provide sufficient fresh air supply to a minimum of 90% of the total net habitable area of the building	2
H-2	<b>Ventilation in Wet Areas</b>	<b>1 point</b>
	Ventilate wet areas with a local exhaust system or openable windows	1
H-3	<b>Low-VOC Emissions</b>	<b>4 points</b>
	Strategy A: Paints and coatings	
	Specify and install low-VOC emission paints and coatings	1
	Strategy B: Adhesives and sealants	
	Specify and install low-VOC emission adhesives and sealants	1
	Strategy C: Floorings	
	Specify and install low-VOC emission floorings	1
	Strategy D: Wood furniture	
	Specify and install low-formaldehyde emission wood furniture	1
	Strategy E: Ceilings, partitions and insulation	
	Specify and install low-VOC emission ceiling, partition and insulation products	1
H-4	<b>Daylighting</b>	<b>3 points</b>
	50% of all the habitable spaces have a daylit zone area of more than 75% of their floor area	1
	70% of all the habitable spaces have a daylit zone area of more than 75% of their floor area	2
	90% of all the habitable spaces have a daylit zone area of more than 75% of their floor area	3
H-5	<b>Acoustic Comfort</b>	<b>1 point</b>
	Design all walls and floors to comply with the requirements of TCXDVN 277:2002 on airborne and impact sound insulation for all classes	1

## H-1 Fresh Air Supply

### Intent

To ensure the provision of enough fresh air to maintain good indoor air quality during occupancy.

### Requirements

Criteria	2 Points
Provide sufficient fresh air supply to a minimum of 90% of the total net habitable area of the building.	2

## H-2 Ventilation in Wet Areas

### Intent

To reduce moisture and odours from wet areas.

### Requirements

Criteria	1 Point
Ventilate wet areas with a local exhaust system or openable windows	1

## H-3 Low-VOC Emissions Products

### Intent

To minimize the negative impacts of volatile organic compounds (VOCs) & formaldehydes from building materials on occupant's health.

### Requirements

Criteria	4 Points
Strategy A: Paints and coatings	
Specify and install low-VOC emission paints and coatings	1
Strategy B: Adhesives and sealants	
Specify and install low-VOC emission adhesives and sealants	1
Strategy C: Floorings	
Specify and install low-VOC emission floorings	1
Strategy D: Wood furniture	
Specify and install low-formaldehyde emission wood furniture	1
Strategy E: Ceilings, partitions and insulation	
Specify and install low-VOC emission ceiling, partition and insulation products	1

## H-4 Daylighting

### Intent

To encourage building designs which maximize the use of daylight.

### Requirements

Projects can follow the requirements below or select the performance path in Appendix B.

Criteria	3 Points
50% of all the habitable spaces have a daylit zone area of more than 75% of their floor area	1
70% of all the habitable spaces have a daylit zone area of more than 75% of their floor area	2
90% of all the habitable spaces have a daylit zone area of more than 75% of their floor area	3

## H-5 Acoustic Comfort

### Intent

To provide a comfortable acoustic environment for occupants.

### Requirements

Criteria	1 Point
Design all walls and floors to comply with the requirements of TCXDVN 277:2002 on airborne and impact sound insulation for all classes	1

## Local Environment

In the 21st century, local environments in Vietnam are under the threat of many factors. The fast but difficult to manage rate of Vietnam's urbanization is quickly turning virgin land into construction sites and habitats are disappearing together with the species living within them. The impacts of climate change can now be seen in the form of stronger and more frequent storms, frequent flooding and drought, sea level rise, and other extreme weather phenomena. Vietnam's urban areas generate over 8 million tonnes of solid waste per year, of which only about 70% is collected and treated. This means almost 2.5 million tonnes of untreated solid waste is released into the environment each year.

Therefore, to reduce these threats on the environment, construction projects should be following strategies to protect the natural ecosystems (selecting sites with low-ecological value and increasing vegetation with local species), to minimize waste and pollution (using cleaner refrigerants and diverting waste from landfills and nature), to improve building's resistance towards flooding and to alleviate its own impacts on climate change (increasing the perviousness of the site and limiting the heat island effect).

All credits within the Local Environment of LOTUS Homes consider these strategies that will contribute to protect the ecology of the site of the building and surrounding area, to encourage recycling practices, and to integrate adaptation and mitigation measures.

Local Environment		16 Points
Item	Criteria	Points
LE-1	Site Selection	5 points
	Strategy A: Land with low-ecological value	
	Do not situate building on a site with high-eco value	1
	Strategy B: Infill or redevelopment site	
	Locate building on an infill or a redevelopment site	1
	Strategy C: Mass transit Transport	
	Locate development within 800m of mass transit services	1
	Locate development within 400m of mass transit services	2
	Strategy D: Community Connectivity	
	There are at least 5 different types of basic services within a 0.5 km radius of the site	1
LE-2	Site Design	2 points
	Strategy A: Site Analysis	
	Provide a Site Analysis considering local environmental conditions such as sunlight, prevailing winds, topography and existing vegetation.	1
	Strategy B: Undeveloped Site Area	
	At least 20% of the site area is undeveloped	1
LE-3	Vegetation	2 points
	Strategy A: Vegetated Area in outdoor garden	
	15% of the total site area is vegetated with native or adapted vegetation	1
	30% of the total site area is vegetated with native or adapted vegetation	2
	Strategy B: Pot Plants	
	Provide 1 pot plant unit for every 10 m <sup>2</sup> of GFA, balconies and rooftop area	1
	Provide 1 pot plant unit for every 5 m <sup>2</sup> of GFA, balconies and rooftop area	2
LE -4	Heat Island Effect	2 points
	30% of the paved and roof area limits the heat island effect	1
	50% of the paved and roof area limits the heat island effect	2
LE -5	Stormwater Runoff	2 points
	Average perviousness of the site is at least 30%	1
	Average perviousness of the site is at least 50%	2

LE -6	Flood Mitigation	1 point
	Prepare a local flood risk identification statement for the site - AND - Implement flood risk mitigation strategies if required	1
LE-7	Refrigerants	1 point
	No R-22 refrigerant is used in the building - AND - Refrigerators/freezers use natural refrigerants	1
LE-8	Waste Management	1 point
	Provide a storage place with different bins for recyclables, organic wastes and garbage	1

## LE-1 Site Selection

### Intent

To encourage development to occur in suitable locations that will reduce harm on the natural environment and promote the health and wellbeing of occupants

### Requirements

Criteria	5 points
Strategy A: Land with low-ecological value	
Do not situate building on a site with high-eco value	1
Strategy B: Infill or redevelopment site	
Locate building on an infill or a redevelopment site	1
Strategy C: Mass transit Transport	
Locate building within 800m of mass transit services	1
Locate building within 400m of mass transit services	2
Strategy D: Community Connectivity	
There are at least 5 different types of basic services within a 0.5 km radius of the site	1

## LE-2 Site Design

### Intent

To analyse and consider the site layout in order to preserve existing vegetation and minimise building footprint.

### Requirements

Criteria	2 points
Strategy A: Site Analysis	
Provide a Site Analysis considering local environmental conditions such as sunlight, prevailing winds, topography and existing vegetation.	1
Strategy B: Undeveloped Site Area	
At least 20% of the site area is undeveloped	1

## LE-3 Vegetation

### Intent

To encourage the introduction and preservation of plants on site.

### Requirements

Criteria	2 points
Strategy A: Vegetated Area in outdoor garden	
15% of the total site area is vegetated with native or adapted vegetation	1
30% of the total site area is vegetated with native or adapted vegetation	2
Strategy B: Pot Plants	
Provide 1 pot plant unit for every 10 m <sup>2</sup> of GFA, balconies and rooftop area	1
Provide 1 pot plant unit for every 5 m <sup>2</sup> of GFA, balconies and rooftop area	2

## LE-4 Heat Island Effect

### Intent

To reduce the urban heat island effect from the proposed development.

### Requirements

Criteria	2 points
30% of the paved and roof area limits the heat island effect	1
50% of the paved and roof area limits the heat island effect	2

## LE-5 Stormwater Runoff

### Intent

To improve perviousness of site surfaces, thus reduce temporary load to municipal drainage system and improve groundwater recharge

### Requirements

Credit	2 points
Average perviousness of the site is at least 30%	1
Average perviousness of the site is at least 50%	2

## LE-6 Flood Risk Mitigation

### Intent

To encourage flood resistant designs and building features to adapt to climate change

### Requirements

Criteria	1 point
Prepare a local flood risk identification statement for the site - AND - Implement flood risk mitigation strategies if required	1

## LE-7 Refrigerants

### Intent

To encourage the selection and use of refrigerants that do not increase global warming nor damage the ozone layer.

### Requirements

Credit	1 point
No R22 refrigerant is used in the building - AND - Refrigerators/freezers use natural refrigerants	1

## LE-8 Waste Management

### Intent

To implement waste sorting and facilitate the recycling and reuse of waste

### Requirements

Credit	1 point
Provide a storage place with different bins for recyclables, organic wastes and garbage	1

## Community & Management

To attain the standards expected of a LOTUS Homes certified building, high levels of communication and coordination between all parties involved is vital. It is extremely important that the entire project team works together towards adopting all appropriate environmental principals at the project inception. It is also vital that this information is passed on to buildings users so that the building's design features are understood and used, ensuring the intended performance goals are met throughout the life of the building.

The concept of an "eco-charrette", is a crucial pre-design step, during which the project team made up of a minimum of the developer/client, the architect and the consultant engineers (if any), together define a strategy and a performance level for the project. This process ensures a complete commitment from the whole design team, before the design work has started, allowing for a full understanding of the aims throughout every step of design development and construction.

During the construction phase, it is necessary to limit the impacts of construction works (noise, dust, stormwater pollution, waste generation, etc.) that disturb the environment as well as the local community.

At completion of construction, producing a building operation and maintenance manual (O&M manual) including the necessary information for the operation and maintenance of the building is an important measure to ensure a good performance of the building during operation.

Community & Management		7 Points
Item	Criteria	Points
CM-1	Design Management	1 point
	Perform an Eco-Charrette	1
CM-2	Construction Management	5 points
	Strategy A: Stormwater pollution prevention, erosion control and sediment control	
	Implement best management practices for stormwater pollution prevention, erosion and sediment control.	1
	Strategy B: Demolition and construction waste	
	Implement strategies to minimize demolition and construction waste	1
	Strategy C: Construction noise	
	Implement adequate mitigation measures to limit construction noise	1
	Strategy D: Neighborhood Impact Plan	
	Implement adequate measures to reduce construction impacts on neighboring properties	1
	Strategy E: Construction Worker Management	
	Implement a Construction Worker Management Plan	1
CM-3	Operational Management	1 point
	Provide a Building Operation & Maintenance Manual	1

## CM-1 Design Management

### Intent

To ensure all sustainable design aspects are identified and planned for at the earliest stage of the project.

### Requirements

Criteria	1 point
Perform an Eco-Charrette	1

## CM-2 Construction Management

### Intent

To improve the construction practices on development sites to minimize the impact of construction on the local environment and surrounding land users.

### Requirements

Criteria	5 points
Strategy A: Stormwater pollution prevention, erosion and sediment control	
Implement best management practices for stormwater pollution prevention, erosion and sediment control.	1
Strategy B: Demolition and construction waste	
Implement strategies to minimize demolition and construction waste	1
Strategy C: Construction noise	
Implement adequate mitigation measures to limit construction noise	1
Strategy D: Neighborhood Impact Plan	
Implement adequate measures to reduce construction impacts on neighboring properties	1
Strategy E: Construction Worker Management	
Implement a Construction Worker Management Plan	1

## CM-3 Operational Management

### Intent

To ensure that the completed development is managed in a sustainable manner.

### Requirements

Criteria	1 point
Provide a Building Operation & Maintenance Manual	1

## Innovation

The purpose of this category is to reward innovative techniques/initiatives, as well as exceptional performance enhancement.

There are up to 4 points available over the 2 credits, but these points are not specifically assessed to one or the other credit.

Innovation		4 bonus Points
Item	Criteria	Points
Inn-1	Exceptional Performance Enhancement	4
	Exceed significantly the credit requirements of LOTUS credits	
Inn-2	Innovative techniques / initiatives	
	Implement innovative techniques/initiatives that are outside the scope of LOTUS	

## Inn-1 Exceptional Performance Enhancement

### Intent

To encourage exceptional performance and recognize projects that achieves environmental benefits in excess of the current LOTUS Rating System benchmarks.

### Requirements

Criteria	4 Points
Exceed significantly the credit requirements of LOTUS credits	1-4

## Inn-2 Innovative Techniques/Initiatives

### Intent

To promote techniques and/or initiatives that are out of the scope of the current LOTUS Rating System.

### Requirements

Criteria	4 Points
Implement innovative and environmentally friendly solutions that are not considered in the scope of LOTUS Homes	1-4

## Appendix A: Best Practice Credits

### Best Practice Credit List

Credit	Title	Bonus Points
<b>ENERGY</b>		<b>5 bonus points</b>
E-BPC-1	OTTV reduction	1 bonus
E-BPC-2	Renewable Energy	3 bonus
E-BPC-3	Home Energy Controls	1 bonus
<b>WATER</b>		<b>4 bonus points</b>
W-BPC-1	Rainwater harvesting	1 bonus
W-BPC-2	Water recycling/reuse	2 bonus
W-BPC-3	Swimming Pool Water Efficiency	1 bonus
<b>HEALTH &amp; COMFORT</b>		<b>3 bonus points</b>
H-BPC-1	Indoor Air Pollution Prevention	1 bonus
H-BPC-2	Lighting Comfort	1 bonus
H-BPC-3	Sound	1 bonus
<b>LOCAL ENVIRONMENT</b>		<b>1 bonus points</b>
LE-BPC	Composting	1 bonus
<b>COMMUNITY &amp; MANAGEMENT</b>		<b>3 bonus points</b>
CM-BPC-1	LOTUS AP	1 bonus
CM-BPC-2	Public Awareness Campaign	1 bonus
CM-BPC-3	Comprehensive Construction Management Plan	1 bonus

## E-BPC-1 OTTV Calculation

### Intent

To optimize the thermal performance of the building.

### Requirements

Criteria	1 point
Building's average OTTV surpasses VBEEC requirements by 40%	1

## E-BPC-2 Renewable Energy

### Intent

To promote the use of renewable sources of energy and encourage their use in the built environment

### Requirements

Criteria	3 points
Install a renewable electricity generation system with a power output of more than 1 kW	1
Install a renewable electricity generation system with a power output of more than 2 kW	2
Install a renewable electricity generation system with a power output of more than 3 kW	3

## E-BPC-3 Home Energy Controls

### Intent

To encourage the use of energy control solutions to save energy

### Requirements

Criteria	1 point
Install at least 2 different types of energy control solutions in the house	1

## W-BPC-1 Rainwater Harvesting

### Intent

To encourage rainwater harvesting as a means to reduce domestic water consumption

### Requirements

Criteria	1 point
Install a rainwater harvesting system to catch rainwater falling on the roof	1

## W-BPC-2 Domestic Water reuse

### Intent

To encourage water recycling and reuse as a means to reduce domestic water consumption

### Requirements

Criteria	2 points
Strategy A: Reuse water for irrigation	
Use reused water to meet the water demand for irrigation	1
Strategy B: Reuse water for WC flushing	
Use reused water to meet the water demand for WC flushing	1

## W-BPC-3 Swimming Pool Water Efficiency

### Intent

To reduce water consumption of swimming pools.

### Requirements

Criteria	1 point
Implement strategies to reduce water use for swimming pools	1

## H-BPC-1 Indoor Air Pollution Prevention

### Intent

To regulate indoor air quality via CO<sub>2</sub> monitoring and to prevent the leakage of combustion gases into the house

### Requirements

Criteria	1 Point
Option A: CO <sub>2</sub> monitoring	
Specify and install a CO <sub>2</sub> monitoring system	1
Option B: Basic Combustion Venting Measures	
Implement basic combustion venting measures	1

## H-BPC-2 Lighting Comfort

### Intent

To encourage the provision of high-quality lighting that provides good comfort to occupants.

### Requirements

Criteria	1 point
95% of the habitable spaces meet recommended illuminance levels	1

## H-BPC-3 Acoustic Comfort

### Intent

To provide a comfortable acoustic environment for occupants.

### Requirements

Criteria	1 Point
Average reverberation time (T60) in the habitable spaces of the project should be lower than 0.6 seconds	1

## LE-BPC-1 Composting

### Intent

To reduce the amount of waste sent to landfills and to improve soil quality

### Requirements

Credit	1 point
Install a compost bin to compost organic wastes	1

## CM-BPC-1 LOTUS AP

### Intent

To encourage the involvement of a qualified individual to manage these aspects through the design process and maintained during the construction stage.

### Requirements

Criteria	1 point
Involve a LOTUS AP in the project team from design to completion of construction	1

## CM-BPC-2 Comprehensive Construction Management Plan

### Intent

To improve the construction practices on development sites to improve the impact of construction on the local environment and surrounding land users.

### Requirements

Criteria	1 point
Prepare and implement a Construction Management Plan covering all the strategies in credit CM-2 Construction Management	1

## CM-BPC-3 Public Awareness Campaign

### Intent

To promote general public awareness on sustainability and green buildings

### Requirements

Criteria	1 point
Conduct at least two activities to promote general public awareness	1

## Appendix B: Performance paths

### E-2 Building Envelope

#### Intent

To ensure proper application of materials and techniques to the construction of the building envelope to optimize the thermal performance of the building.

#### Requirements

Criteria	4 points
Strategy A: U-values of walls and roof	
Average U-value of the walls and roof are 20% lower than VBEEC requirements.	1
Average U-value of the walls and roof are 40% lower than VBEEC requirements.	2
Strategy B: SHGC values of glazing	
SHGC values of glazing are 10% lower than VBEEC requirements.	1
SHGC values of glazing are 20% lower than VBEEC requirements.	2
Strategy C: Solar radiation on opaque surfaces	
Implement strategies to reduce the solar radiation absorbed by opaque surfaces	1

## E-3 Home Cooling

### Intent

To reduce the need for HVAC systems and increase natural air flow and to encourage the installation of energy efficient HVAC systems.

### Requirements

Criteria	6 points
Strategy A: Natural cooling	
Strategy A1: Stack Ventilation Install a vent column or an effective rooftop turbine vent to create stack ventilation	1
Strategy A2: Cross ventilation 1 point for every 20% of the area in living rooms and bedrooms which are designed with effective cross ventilation (up to 80%)	4
Strategy B: Mechanical cooling with air-conditioning system	
Strategy B1: Variable speed compressors All air-conditioners are equipped with variable speed compressors (inverters)	1
Strategy B2: COP Improvement 1 point for every 10% improvement of the average COP of all the air-conditioners in comparison to VBEEC requirements (up to 30%)	3

## E-4 Artificial Lighting

### Intent

To reduce energy consumption associated with the use of interior artificial lighting systems.

### Requirements

Criteria	3 points
Installed light power density of the project is lower than 8 W/m <sup>2</sup>	1
Installed light power density of the project is lower than 7 W/m <sup>2</sup>	2
Installed light power density of the project is lower than 6 W/m <sup>2</sup>	3

## W-1 Water Efficient Fixtures

### Intent

To reduce the consumption of water in buildings by means of water efficient fixtures.

### Requirements

Criteria	5 points
Reduce domestic water consumption through fixtures by 20% in comparison to a baseline model	1
1 point for every additional 5% reduction of the domestic water consumption through fixtures (Up to 40%)	5

## W-2 Water Efficient Landscaping

### Intent

To reduce potable water consumption on landscaping

### Requirements

Criteria	2 points
Reduce the amount of domestic water used for landscaping by 50% compared to benchmark consumption	1
Reduce the amount of domestic water used for landscaping by 80% compared to benchmark consumption	2

## H-4 Daylighting

### Intent

To encourage building designs which maximize the use of daylight.

### Requirements

Criteria	3 Points
50% of the net habitable area achieves a daylight factor of 1% or greater	1
70% of the net habitable area achieves a daylight factor of 1% or greater	2
90% of the net habitable area achieves a daylight factor of 1% or greater	3