



TREES – NC Version 1.1

Thai's Rating of  
Energy and Environmental Sustainability  
for New Construction and Major Renovation

By

Thai Green Building Institute (TGBI)

Supported by



The Engineering Institute of Thailand under Royal Patronage and  
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<i>IE 1</i>	Reducing impact from pollution		5
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<i>Credit</i>	<i>Details</i>	<i>Page</i>	<i>NC Point (required)</i>
	<i>IE 1.3</i> Prevent pollution from outside to inside of the building.	49	1
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<i>IE 4</i>	Use natural light in the building Regularly occupied spaces shall be designed to achieve enough natural light.	57	4
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<i>EP</i>	<b>Section 7 Environmental Protection</b>	<b>59</b>	<b>5 (2)</b>
<i>EP P1</i>	Reduce pollution from construction Plan to prevent pollution and disturbance from construction.	60	Prerequisite
<i>EP P2</i>	Waste management Provide recycling collection area.	61	Prerequisite
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## INTRODUCTION

Energy crisis and environmental crisis are increasingly serious. Energy resources such as coal, natural gas, and oil are limited but the demand to produce energy from these resources is increasing endlessly resulting in high energy price. While the development of renewable energy is not fast enough to respond to energy demand in the near future, energy production still relies on resources that have negative environmental impacts. Burning coal and oil results in large quantity of Green House Gas which creates Green House Effect that is a threat to human beings. Accessibility to any energy resource also trespass both Terrestrial ecosystems and Marine ecosystem continuously. Fuel transportation such as pumping oil across the ocean floor or fuel extraction activities are risk to the leakage that will destroy ecosystems massively. Energy crisis is in fact closely related to environmental crisis.

Buildings are the main cause of energy and environmental problems due to the fact that they consume a lot of electricity for air conditioning, ventilation, lighting, and electrical equipment, to maintain building occupants' activities, well-being and productivity. Quality of life is important and affect social and economic system. Therefore, energy is needed to maintain the acceptable quality of life level in buildings. Balancing between energy and environment conservation and well-being of the building occupants shall be made properly. Buildings also have other environmental impacts such as built-up land occupying, partly contribute to flooding and heat island effect, water consuming, raw materials extracting for building construction, pollution and waste releasing from construction sites and building operation, etc. Sustainable building design practice shall be able to help solving these problems using appropriate building designs and technologies while still maintaining building occupant good quality of life and productivity.

Thai Green Building Institute (TGBI) launched TREES (Thai's Rating of Energy and Environmental Sustainability) as a rating system that would help guiding construction industry to design and construct architecture that is environmental friendly and can increase occupant well-being and productivity comprehensively. TGBI expects that buildings using this rating system would consume less energy, reduce environmental impacts and reduce pollution while increase quality of life of the building occupants.

## TREES-NC

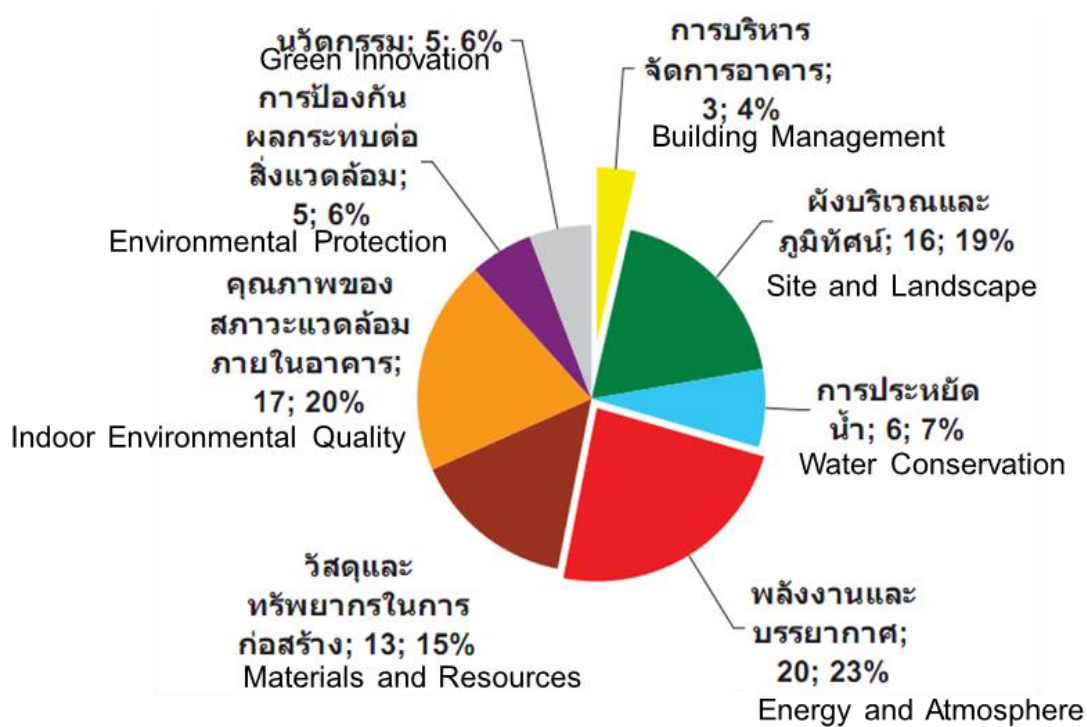
TREES rating systems are designed suitably for various building types, both new buildings and existing buildings, and mainly focus on new construction building, or major renovation. The building that will suitable to register with this rating system shall be a whole new design and construction project, or project with major renovation such as changing all building envelope and systems but the structure is not changed. Building with expansion or partly renovation may join TREES but may not get the credits in some topics that may affect to the expected award levels.

TREES-NC topics can be separated to prerequisite topics and credit topics. The registered project must pass all requirements in 9 prerequisite topics. If the project does not pass only one of the prerequisite

topics, the project will fail. For credit topics, there are points in each topic depending on the priority. The rating system total points are 85. If the project passes all 9 prerequisite topics and gets points from credit topics, the total score will be used to judge the award level. For TREES-NC, there are 4 award levels.

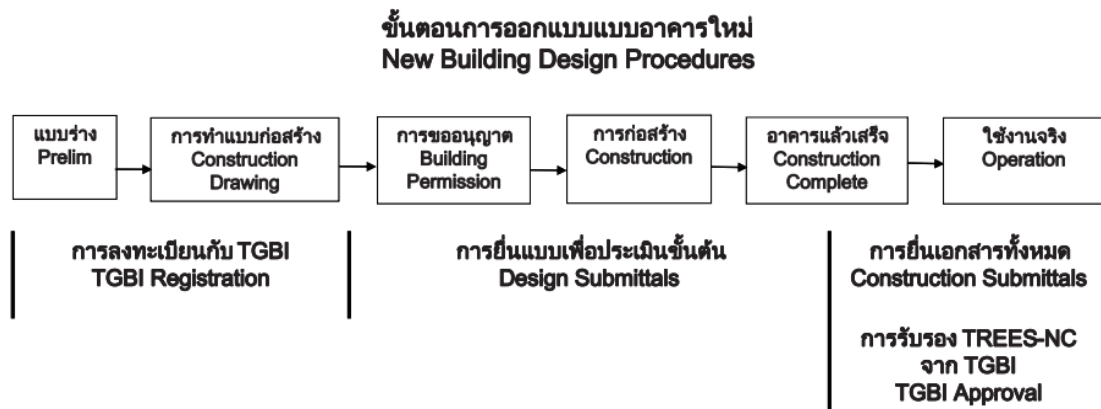
PLATINUM	more than 60 points
GOLD	46-60 points
SILVER	38-45 points
CERTIFIED	30-37 points
All level must pass prerequisite topics	9 prerequisite topics.

TREES-NC has 8 assessment sections: 1) Building Management, 2) Site and Landscape, 3) Water Conservation, 4) Energy and Atmosphere, 5) Materials and Resources, 6) Indoor Environmental Quality, 7) Environmental Protection, 8) Green Innovation. The score proportions are as follows:



TREES-NC assessment process is divided into 3 main periods, starting with registering the project with TGBI, then submitting the documents in design stage when the drawings are completed and finally submitting the documents in construction stage when the construction is completed. These processes are parallel with design and construction process of the project in general. The projects can also submit all documents (design and construction) at one time when the construction is completed. The complete building shall have enough information for TREES-NC certification. To confirm that the buildings maintain their green

status, building management evaluation is required and the rating system for operating buildings will be presented by TGBI in the near future.



The following table summarises submittal document period in each topic. There are 30 points for design submittal and 21 points for construction submittal. For Green Innovation Section, the project can decide when the appropriate time period to submit documents is. The projects can also submit all document at the end of construction.

Section	Design Submittals	Construction Submittals
Section 1 Building Management		BM P1, BM1, BM2, BM3, BM4
Section 2 Site and Landscape	SL P1, SL P2, SL1, SL2, SL3.1, SL3.2, SL3.3, SL4, SL5.1, SL5.2, SL5.3	
Section 3 Water Conservation	WC1	
Section 4 Energy and Atmosphere	EA P2, EA1, EA2, EA4	EA P1, EA3.1, EA 3.2
Section 5 Materials and Resources		MR1, MR2, MR3, MR4, MR5, MR6.1, MR6.2
Section 6 Indoor Environmental Quality	IE P1, IE P2 (choice 2 and3), IE1.1, IE1.2, IE1.3, IE1.4, IE1.5, IE3, IE4, IE5	IE P2 (choice 1), IE2.1, IE2.2, IE2.3, IE2.4
Section 7 Environmental Protection	EP P2, EP 2, EP 3, EP5	EP P1, EP1, EP4
Section 8 Green Innovations.	GI1-5	

TGBI specified the preliminary criteria of the project characteristic and qualification as follows:

1. The building shall be legal. If the building is illegal in any case, TGBI reserves the right to withdraw award.

2. The building shall be permanent and shall not have the objective to be relocate because TREES has many criteria involved with site and landscape.

3. The project shall have clear boundary. For group of the building such as industrial estate or university that does not have clear boundary, the project boundary shall be identified properly.

4. The total of the building usable area shall not less than 100 m<sup>2</sup>.

5. The minimum regular building occupants is 1 person.

6. Building usable area shall not less than 5% of the land area.

7. TREES-NC is not designed for 3 floors or less small residential buildings.



## Section 1 Building Management

Green building cannot be success without cooperation from every sector: Owners, Architects, Interior designers, Landscape architects, Engineers, Contractors, and other involved sectors including cooperation from the communities around the project. To show intentions and standpoints toward environmental friendly building construction which will not produce pollution to the surrounding context are a good communication to social to create understanding with every sector, and smoothness in building construction and operation. Successful green buildings also need building operation guidelines for building occupants, appropriate management plan and building maintenance plan throughout the buildings' life. Assessment in this section comprises the followings:

Topic	Detail	Point
BM P1	Green building preparation	Prerequisite
BM 1	Promoting green building	1
BM 2	Building manual and building operation and maintenance training	1
BM 3	Monitoring and evaluating green building activities during design stage, construction stage, and after completion stage	1

The outcome from this section will help the green building ongoing activities continue smoothly which would affect Owner and Building occupants in the scope of economy, health, and well-being in the building.

**BM P1 Green building preparation****NC (Prerequisite)****Intent**

For systematic and smooth green building design and construction process, which the project teams and persons in charge could efficiently maintain and fulfil the green building rating requirements throughout the project.

**Requirement**

Have working, monitoring, and evaluating action plans for green building design, construction, planning, and management complying with TREES. The requirement is only plans, not outcomes. The action plan shall comprise 1) Name list of the project team and head of the project: Owners, Architects or Engineers (who designs the building, or who are supervisor or contractor), Building inspector, Building manager, and/or TREES-A and Commissioning agents. 2) Activities specified to the person in charge that correspond to each attempted TREES credit. 3) Activities details including techniques and methodologies that will be used in brief. 4) Schedules of each activity (when the activity will be launched and how long of each activity).

**Implementation**

Set up the working group and the action plan that conforms to TREES-NC. The plan shall start from the beginning period of the project concept formulation, and have chief executive or appointed representative as a project leader.

**BM 1 Promoting green building****NC (1 Point)****Intent**

Green building shall be promoted efficiently.

**Requirement**

1. Install billboard in front of the construction site. Specify project green building intention to join TREES officially. Logo and TGBI's full name shall be presented clearly with specific rating system selected for the project (TREES-NC in this case). The billboard shall have 2 languages: Thai and English.

2. Provide building information and the project green building features up until present (in design stage or when completion). This information will be promoted for general public benefit. At least two forms of green building promoting from the following list shall be implemented:

- Brochure using recycle paper or others sustainable material for at least 500 copies printed, and shall be distributed in seminar that involved with building design, construction, or operation.
  - Website presents concept and details of the project's green building design and construction features.
  - Provide project green building features promotion offsite for at least 3 places.
  - Green features permanent exhibition in the building.
  - Install billboard at various locations in the building comprehensively to provide knowledge regarding the project green building features to building occupants or visitors.
  - Building visit: invite at least 3 organizations from government sector or private sector (50 people each) to visit building.
  - Presenting the project exceptional green features in academic journal or academic conference (national or international) for at least 1 article.
  - Other methods which are concrete, and can be proven and shown the quantitative outcomes.
- The other methods shall be presented to TGBI for approval.

**Implementation**

Plan to promote the project using various accepted channels and have billboard in front of the project site during construction.

<b>BM 2 Building manual and building operation and maintenance training</b>
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<b>NC (1 Point)</b>
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Building manual for appropriate building operating and management in written format with staff training are required.

**Requirement5**

Have building system operation and maintenance manual and conduct training of green building systems operating and maintaining for involved staffs. Building manual shall consist of systems at least the following:

- 1) Air conditioned and ventilation systems
- 2) Electrical and lighting systems
- 3) Sanitary systems
- 4) Hot water systems (for hotel and hospital)
- 5) Service systems
- 6) Renewable energy systems (if any)

Other systems can be added as appropriate of each project.

**Implementation**

Provide building manual and training for necessary building systems for the involved staffs. This section shall be considered with the section EA P1: Fundamental commissioning. Some of the details may be used with the section BM 1 Promoting green building.

<b>BM 3</b>	<b>Monitoring and evaluating green building activities during design stage, construction stage, and after completion stage</b>	<b>NC (1 Point)</b>
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**Intent**

To strengthen the systematic green building design and construction process further from BM P1 and manage green building design and construction knowledge for future TREES development.

**Requirement**

Green building project team shall extend the action plan from BM P1 by introducing the topic 5) Evaluation, identify success, limitation, comment and suggestion in design stage, construction stage, and after completion stage. Consequently, the green building project team can monitor the working process efficiently and can learn TREES systematically.

**Implementation**

Extend the scope of work of the green building project team in monitoring and evaluating activities systematically. Summarize the progress of activities in each period and collect the documents from the progress meeting for the topics that are successful or fail. The team shall summarize the success methods and fail methods for self-learning and produce database for TGBI in the future.

## Section 2 Site and Landscape

Site selection for appropriate construction and development is the importance first step of new projects. Design process without considering to environment may destroy environmental balance that is required a long period of time for restoration. In general, environmental balance affects environment, economics, and social including affects to the project, communities, and the city.

Score in Site and Landscape Section emphasizes the consideration and avoidance to environmental impact reduction by various strategies such as project layout design and planning, design and construction for landscape and outdoor area, select materials and plant materials that are appropriate with the site and consider the long term sustainability of the project.

This section comprises 7 topics: 2 prerequisite topics and 5 credit topics, the total score is 16 points. The project must pass the prerequisite topics. Then, the credit topics can be considered for this section. The prerequisite topics focus on natural resource protection and valuable ecosystems that may be destroyed from site selection without considering to the environment and may increasing risk from natural disaster which damages to life and property. The credit topics cover to site selection, reduce impact from transportation, increase green area and ecological open space, plant selection, and reduce flood problem and heat island effects as follows:

Topic	Detail	Point
SL P1	Avoid inappropriate construction site	Prerequisite
SL P2	Reduce negative impact to green field areas	Prerequisite
SL 1	Locate project on the developed land	1
SL 2	Reduce using private cars	4
SL 3	Sustainable site planning	3
SL 3.1	Ecological Open Space not less than 25% of the building footprint or 20% of the land area.	1
SL 3.2	Plant 1 big tree per 100 m <sup>2</sup> of open space (do not relocate natural big trees other sites).	1
SL 3.3	Use local or native plants appropriately	1
SL 4	Infiltration of storm water and flooding prevention.	4
SL 5	Reduce Heat Island Effects in the urban area from project development	4
SL 5.1	Green roof or vertical garden	2
SL 5.2	Hardscape area received direct solar radiation not more than 50% of the total hardscape area.	1
SL 5.3	Place big native trees at the Western, Eastern, and Southern sides of the building. Native plants can shade the building efficiently and not make damage to the building	1

**SL P1 Avoid inappropriate construction site****NC (Prerequisite)****Intent**

To avoid the development on inappropriate sites and reduce the environmental impact from locating the building on the site. Building or land development shall be located on low ecological value area or as specified in city planning regulation.

**Requirement**

Do not develop buildings, hardscape, roads, or car parking areas on the land that meet any criterion as follows:

1. Natural habitat of wildlife that are preservation or risk to extinction, or sanctuary or conservation area or wildlife sanctuary area according to Thai's laws including the protected area, water source area, or has various ecosystems, or valuable area which is required for conservation.
2. Undeveloped area within 15 m from natural water resource that are habitat of aquatic animals and animal reproduction.
3. The area used as forestry plantations before developing the project except the Developers trade the land of equal or greater size for the existing area as the new forestry plantation site.
4. Avoid construction at the high ecological valuable area or with city planning conflict such as low area which prone to flooding, area of natural water way, catchment (watershed / drainage / basin) area that receive water from surroundings, retention area, wetland, area with slope more than 30%.

**Implementation**

During the site selection process, give preference to sites that do not include sensitive elements or restrictive land by law and city planning regulation before deciding to develop the project. Design the building with minimum development footprint as specified to reduce destruction of existing ecosystems or habitat. Site of the building and appropriate development area shall be considered the possibility to reach the credit requirement in the section SL3 Sustainable site planning and SL4 Infiltration of storm water and preventing flooding problem.

**SL P2 Reduce negative impact to green field areas****NC (Prerequisite)****Intent**

Reduce impact from development to green area or the area that the ecosystems are rich. Recover green area in the developing project to increase ecological value and quality of life of the building occupants.

**Requirement****Alternative 1**

In case of the Previously Developed Area or has low ecological value, have *Ecological Open Space* area for at least 10% of the building footprint area. *Ecological Open Space* shall have green area for at least 25% (natural pools surrounding with relaxing areas can be counted toward *Ecological Open Space*). Do not use this area for roads or car parks. Hardscape can be counted as part of the *Ecological Open Space* if the activities on the hardscape can support quality of life of the building occupants such as walkway or recreation activities. Roof area cannot be counted toward *Ecological Open Space*.

**Alternative 2**

If the area is Not Previously Developed, site survey and list of environmental elements that have high ecological value are required, and construction should be avoided in these areas. Limit development boundary not exceed 15 m from the edge of the building (to prevent high biodiversity area invasion from the building perimeter). The development boundary shall not exceed 5 m from the edge of infiltration area, walkway, road, and car park. Do not disturb the area outside the development boundary.

**Implementation**

For the project located on the previously developed area or low ecological value area, study and select the appropriate plant species local to the area. Opportunity to receive the points in the section SL3 Sustainable site planning shall be considered.

For the project located on the existing green area, building construction boundary and the development area shall be limited. Survey the site to specify the necessary environmental elements which lead to the appropriate land use planning. Design the building which affects to the environment or has building footprint as small as possible, and/or has more number of floor. Avoid car park construction. Opportunity to receive the points in the section SL3 Sustainable site planning shall be considered.



**SL 1 Locate project on the developed land****NC (1 Point)****Intent**

Select the construction site in previously developed area and in urban areas with existing infrastructure to protect forest, habitat and natural resources from invasion.

**Requirement**

Select the construction site that has 10 types of urban facilities within 500 m radius from the main entrance of the project. These facilities shall be accessible within the specified radius (not separated by canal, fence, etc.).

- |                              |                                    |
|------------------------------|------------------------------------|
| 1. Temple or Religious Place | 10. Museum                         |
| 2. Shop                      | 11. Hospital and Health Station    |
| 3. Post Office               | 12. Supermarket                    |
| 4. Police Station            | 13. Market                         |
| 5. Fire Station              | 14. Beauty Shop                    |
| 6. Beauty Salon and Massage  | 15. Coffee Shop and/or Bakery Shop |
| 7. Restaurant                | 16. Office                         |
| 8. Public Park               | 17. Government Office              |
| 9. Educational Institute     | 18. Etc.                           |

Restaurants and shops can be counted twice for each category. For example, if there are 2 restaurants and 2 shops, they can be counted as 4 types. In case of department store, list of urban facilities that meet the requirement of specified number and type shall be presented, and the department store shall be located within the 500 m radius. Urban facilities not listed may be counted, but approval from TGBI is required. Facilities that do not promote morality or health of building occupants cannot be counted. Stalls or booths shall be considered as a group and regarded as market type (counted as only 1 type).

**Implementation**

Project site shall be located near various and enough urban facilities. In addition, urban facilities shall be convenient to access. Site with public transport systems shall be considered to get credits from the Section SL2: Reduce using private cars.

**SL 2 Reduce using private cars****NC (4 Points)****Intent**

To reduce pollution and land development impact from car and motorcycle use.

**Requirement**

Select the site and/or prepare car parking as follow (1 point for each topic but not more than 4 points):

1. **Public transportation system, Railway:** Select the site within 500 m (measured from main building entrance) from at least 1 rail station, sky train station or underground train station, or have a shuttle service plan to the station that can serve 25% of building occupants per day. The shuttle vehicle shall be eco car, CNG, Hybrid, E20+, electric, or other vehicle types that can reduce petrol and natural gas demand significantly.

2. **Public transportation system, Road:** Select the site within 500 m (measured from main building entrance) from bus stops or bus stations or other public vehicles that has at least 2 routes, and the building occupants can access these stations easily, or have a shuttle service plan to the station that can service 25% of building occupants per day. The shuttle vehicle shall be eco car, CNG, Hybrid, E20+, electric, or other vehicle types that can reduce petrol and natural gas demand significantly.

3. **Bicycle parking system:** Provide bicycle parking not less than 5% of the maximum of regular building occupants and transient building occupants (such as guests or customers). Provide shower rooms not less than 0.5% of the total number of full time equivalent (FTE) occupants. Bicycle parking areas and shower rooms shall be located not more than 80 m from the main building entrance. In case of residential building, shower room is not required but bicycle parking spaces are increased to not less than 15% of the dwellers.

4. **High performance car parking system:** Provide preferred car parking location for eco car, CNG, Hybrid, E20+, electric, or other vehicle types that can reduce petrol and natural gas demand significantly, or for carpool near the main entrance of the building as much as possible for at least 5% of the total vehicle parking of the building.

5. **Other public transport systems:** Water Transportation or Sustainable Public Transportation.

**Implementation**

Select the project site near public transportation systems. Survey the walking route from the main building entrance to the stations or bus stops. Locate building and main entrance of the building appropriately and near mass transit. Design car parking that has enough area for eco car, CNG, Hybrid, E20+, electric, or carpool including preparing bicycle parking area and shower area that are enough and convenient.

**SL 3 Sustainable site planning****NC (3 Points)**

SL 3.1 *Ecological Open Space* not less than 25% of the building footprint or 20% of the land area. (1 Point)

**Intent**

Design for more open space ratio which is the opportunity to increase green area, animal habitats, reduce flooding problems, reduce urban heat island effects, and increase outdoor public activities.

**Requirement****Alternative 1**

Design *Ecological Open Space* not less than 25% of building footprint, and green area for at least 40% of *Ecological Open Space* (include the natural pool that is specified to be a relaxing area around the pool). Do not use this area for car and car parking. Hardscape can be counted as part of the *Ecological Open Space* if the activity on the hardscape can support quality of life of the users such as walkway or activity space. Roof area cannot be counted for the points in this alternative.

**Alternative 2**

In case of the project that aims to get the point in the section SL 1 Develop project on the developed land, design the building which has an *Ecological Open Space* not less than 20% of the project area. Roof area can be counted for the points in this alternative but the characteristic of the roof shall be *Ecological Open Space* that is specified in the alternative 1.

**Implementation**

Survey the site to specify the elements that will be used for appropriate land use planning. Locate the building position appropriately or design for as small building footprint as possible. Avoid large building footprint on the site. Avoid large car parking on the ground but stack car parking or build underground car parking. Consider for planning green area in the open space efficiently and reach to the requirement. In case of densely area, use roof area for ecological open space. Consider getting the points with the section SL 5 Reduce Heat Island Effects in urban area from project development.

**SL 3 Sustainable site planning****NC (3 Points)**

SL 3.2 Plant 1 big tree per 100 m<sup>2</sup> of open space (do not relocate natural big trees from other sites). (1 Point)

**Intent**

Improve microclimate appropriately for good environment in the building, improve energy saving, reduce urban heat island effect, and support harmony living among human being, animals and other creatures.

**Requirement**

- Plant no less than 1 big tree per 100 m<sup>2</sup> of open space.
- The planted trees must be fully grown to provide permanent shading within 5 years.
- Keep the existing plants and/or grow additional native plants. The tree canopy diameter when fully grown shall be no less than 4.5 m or the tree height when fully grown shall not less than 6 m. The trees shall not be relocated from other places except relocated from commercial plantation areas.

**Implementation**

Try to provide shading for outdoor hardscape using medium/large size tree to create comfort microclimate and improve building energy saving. Consider locate big trees correspondent with requirement in SL5 Reduce Heat Island Effects which big trees are used to shade hardscape. High reflectance hardscape materials shall also be used to reduce heat absorption from solar radiation.

**SL 3 Sustainable site planning****NC (3 Points)**

SL 3.3 Use local or native plants appropriately. (1 Point)

**Intent**

Develop the appropriate ecosystems and support good environment for energy saving. Reduce water use for landscape. Reduce urban heat island effect. Promote constructing and recovery of ecosystems.

**Requirement**

Select local or native plants for landscape in the project which are suitable for local climate and environment i.e. withstand drought and disease. Do not use invasive alien species or weed. Plant selection shall be referred to plant species as specified in this section.

**Implementation**

Consult with Landscape Architects to select local or native plants. Consider planning green area to get points from SL 3.1 *Ecological Open Space* not less than 25% of the building footprint area, SL 3.2 Plant 1 big tree per 100 m<sup>2</sup> of open space (do not relocate natural big trees other sites), and SL 5 Reduce Heat Island Effects in urban area from project development.

**SL 4 Infiltration of storm water and flooding prevention.****NC (4 Points)****Intent**

Reduce flooding problem because of project development by reducing the impervious surface. Increase the infiltration area or build retention pond to slow down water flow before releasing to the area outside the project.

**Requirement****Alternative 1**

Calculate area-weighted average runoff coefficient of overall surface area of the project (not include retention pond area). The result from calculation can be transferred to the points as specified in Table SL4 T1

**Table SL4 T1**

Area-Weighted Average Runoff Coefficient Points	Points
more than or equal to 0.70	1
more than or equal to 0.60 but less than 0.70	2
more than or equal to 0.50 but less than 0.60	3
less than 0.50	4

**Alternative 2**

Compare before and after volume and peak discharge rate of storm water runoff from the project. Peak discharge rate of storm water runoff that does not exceed the volume and rate before the development or reduce after the project development can be transferred to the points as specified in table SL4 T2. Calculate Volume and Peak Discharge Rate of Storm Water Runoff from the statistic of rainstorm for the 2-year, 24-hour design storm. Use Bangkok data if there is no data of the project area.

**Table SL4 T2**

Difference of Volume and Peak Discharge Rate of Storm Water Runoff between before and after project development		Points
Case 1: Area-Weighted Average Runoff Coefficient before project development less than or equal 0.5	Not change	4
Case 2: Area-Weighted Average Runoff Coefficient before project development more than 0.5	Reduce 10%	1
	Reduce 15%	2
	Reduce 20%	3
	Reduce 25%	4

**Implementation**

Design the project that has infiltration surface. Select landscape materials such as grass blocks (which has grass area 50% of the surface area), floor planks with space between the planks, or flooring

materials which have gap or hole and water can leak through the ground. Use retention pond which can be natural type or man-made type. Consider possibility to get points from the section SL 3.1 *Ecological Open Space* more than 25% of the building footprint using the open space which has a potential to receive and slow down water, and can be used as green area of the project.

<b>SL 5    Reduce Heat Island Effects in the urban area from project development</b>	<b>NC (4 Points)</b>
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**SL 5.1 Green roof or vertical garden (2 Points)**
**Intent**

To reduce urban heat island (the different temperature between developed and not developed area) impact from roof and building envelope that affects to microclimate and human dwelling and animal habitat including other wildlife.

**Requirement**

Proportion of green roof and vertical garden [have slope  $< 60^{\circ}$ , measured from horizontal (according to definition of wall and roof in ASHRAE 90.1 2007)] that covered by plants, and use the equation as follow:

$$GSA = GRA + GWA \times 0.5$$

Meaning

GSA = Green Surface Area

GRA = Green Roof Area

GWA = Green Wall Area

GSA/the total of roof area (not include building systems area and void for natural light)

> 0.5 (get 1 point)

GSA/the total of roof area (not include building systems area and void for natural light)

> 0.8 (get 2 points)

**Implementation**

Grow the plants on the roof or outside walls that may be pergola climbing plants, semi-permanent potted plant, and vertical garden. Avoid plot for trees or grass type which is wasteful because of high maintenance requirement, and may be harmful to the environment because of chemical pesticide requirement. Consider to get the points with the section SL 3.1.



<b>SL 5    Reduce Heat Island Effects in the urban area from project development</b>	<b>NC (4 Points)</b>
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SL 5.2 Hardscape area received direct solar radiation not more than 50% of the total hardscape area. (1 Point)

**Intent**

To reduce urban heat island (the different temperature between developed and not developed area) impact from hardscape that affects to microclimate and human dwelling and animal habitat including other wildlife.

**Requirement**

Shade the outdoor hardscape by plants, or select the appropriate construction and material. Apply these strategies for hardscape for more than 50% of the total outdoor hardscape area.

- Shading the hardscape to reduce direct solar radiation by big trees.
- Flooring materials: high solar radiation reflectance value more than 30%
- Roofing materials: high solar radiation reflectance value more than 30%
- Roofing by plants or solar cells.
- Use grass block (planting area 50% or more of grass block area).

**Implementation**

Reduce outdoor hardscape area. Try to shade outdoor hardscape surface by plants including selecting flooring materials which have high solar radiation reflectance value to reduce solar radiation absorption. Consider providing roof for the walkway by materials which have high solar radiation reflectance value. Consider to get the points with the section SL 3 Sustainable site planning, and the section SL 4 Infiltration of storm water and prevent flooding problem.

<b>SL 5    Reduce Heat Island Effects in the urban area from project development</b>	<b>NC (4 Points)</b>
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SL 5.3 Place big native trees that can shade the building efficiently and do not damage the building at the Western, Eastern, and Southern sides of the building. (1 Point)

**Intent**

To reduce impact from direct solar radiation to the building, and reduce building surface temperature which may contribute to urban heat island effect including heat to microclimate.

**Requirement**

1. Grow big native trees at the Western, Eastern, and Southern sides of the building. Put the position of the trees that the branch radius of each tree (5 years old) shall be touched or had a distance not more than 1 m from each other for efficient shading.

2. Branch and root radius shall have appropriate distance, and not disturb or damage the building.

**Implementation**

Shade outdoor walls and windows by native big trees, and consider to create landscape around the building. Put the position of the trees for the maximum benefit to reduce solar radiation absorption by the building and other elements. Consider to get the points with the section SL 3 Sustainable site planning, and the section SL 5.2 Hardscape area received direct solar radiation not more than 50% of the total hardscape area.

## Section 3 Water Conservation

Average water use in Bangkok is approximately 329-340 litres / person / day. The average water use for typical water closet is approximately 13 litres / flush. If every person uses water closet 4 times a day, the water use is 52 litres / person which are 30% of the amount of daily water use per person. Portable water demand is increasing because of rapid population growth while the amount of untreated water is limited. Water saving and efficient water use are the ways to reduce water scarcity problem in the future.

Selecting water saving fixtures and faucets, or green label products instead of using general products can reduce portable water using significantly. Furthermore, rain water collection for use in some parts of the project instead of portable water including water meter installation are helpful for efficient water management in each part of the projects.

For an efficiency of water saving and water use in the building, assessments in this section comprises the followings:

Topic	Detail	Points
WC 1	Water Saving and Water Use Efficiency	6

The topic offer 2 compliance choices. If one choice is selected, all of the process in that choice shall be carried on until finished. These two choices have the same objective: to reduce untreated water demand for portable water production including reduce cost and energy of waste water treatment for the government sectors and the private sectors.

**WC 1 Water saving and water use efficiency****NC (6 Points)****Intent**

To increase water efficiency in the building and/or water management and/or rain water collecting which is clean and do not have a cost in order to reduce the burden from potable water supply and treatment.

**Requirement****Alternative 1****(Select 1 or 2)**

1. Use water saving water closet and urinal more than 90% of overall toilet (1 point).
2. Use water saving water closet and urinal 100% of overall toilet (2 points).

**(Select 3 or 4)**

3. Use water saving faucet or metering faucet more than 90% (1 point).
4. Use water saving faucet or metering faucet 100% (2 points).

**(Select 5 and/or 6)**

5. Install sub-meter for water in the project (1 point).
6. Install rain water tank to collect rain water for 5% of rain water quantity in 1 year (1 point).

**Alternative 2**

1. Reduce water use consumption 15% from baseline (2 points).
2. Reduce water use consumption 25% from baseline (4 points).
3. Reduce water use consumption 35% from baseline (6 points).

**Implementation**

Reduce water use by installing water saving fixtures and/or water saving faucet or have metering faucet, or use other technologies such as waterless urinal and compost toilet which does not need water including water meter installation to manage water use. Check water leakage regularly especially at the main area and around the building. In addition, rain water collecting may be considered to reduce potable water demand.

## Section 4 Energy and Atmosphere

Energy use in the building is one of the most important cause of pollution and greenhouse effect which are serious crisis at the present. In general, the energy use in the building is electrical produced from power plants. Electrical power in Thailand typically requires non-renewable and expensive energy source which also produce pollution during the generation processes. In addition, energy is loss more than 2/3 during transmission in distribution systems (in form of heat dissipation). Electricity generation from clean sources such as solar energy, wind, or water has a very little proportion when compared with total energy sources requirement for electricity production of the country. Therefore, TREES-NC gives the most points for this section with the maximum total score of 20 points, and has 2 prerequisite topics. Efficiency of energy use and supporting renewable energy use in the project are the main topics. These 2 parts shall also pass quality assurance in the building to assure building energy conservation systematically. Apart from that, this section covers to refrigerant in air conditioned systems that may affect Ozone layer. This section comprises various topics as follows:

Topic	Detail	Point
EA P1	Building system commissioning Plan for commissioning by the third person	Prerequisite
EA P2	Minimum energy efficiency Get 4 points in the section EA 1	Prerequisite
EA 1	Energy efficiency	16
EA 2	Renewable energy Produce renewable energy not less than 0.5-1.5 % of energy cost in the building.	2
EA 3	Measurement and verification to confirm energy saving Plan for measurement and verification the result as specified in IPMVP.	1
EA 4	Refrigerant in air conditioning systems that does not destroys ozone layer Not use CFC and HCFC-22	1

**EA P1 Building system commissioning****NC (Prerequisite)**

Plan for building system commissioning by third party.

**Intent**

To verify that the building's energy-related systems are installed correctly as specified on drawings and in the specifications.

**Requirement**

Follow the following 6 topics.

1. Designate the third party as Commissioning Authorities to manage, review, and control system commissioning as follows:

1.1 Commissioning Authorities shall have evidence to present working experience that involved with testing and adjustment of the building systems not less than 2 buildings.

1.2 Commissioning Authorities shall be independent of the Architects and the Supervisor.

1.3 Commissioning Authorities shall report the commissioning result and give suggestion directly to the Owners.

2. Owners shall have Owner's Project Requirement Documents. Designers (Architects and Engineers) shall have Basis of Design Documents. Commissioning Authorities shall review these documents clearly. Owners and Architects shall revise both documents that they are correspondent to each other's.

3. Provide plan for commissioning, and comply with the plan systematically.

4. Collect the requirements for commissioning, and present the details in construction documents.

5. Verify the installation and performance of the systems that are commissioned.

6. Prepare the complete report that presents commissioning result.

Commissioning activities that involved with building energy use shall cover to these systems for at least the followings:

1. Air conditioning and ventilation systems

2. Electrical and lighting systems

3. Hot water systems of the building (In general, these systems appear in hotel and hospital)

4. Renewable energy systems (if any)

**Implementation**

Owners shall seek out Commissioning Authorities that have experiences and expert in these areas.

1. Energy systems design, installation, and operation.

2. Management and controlling commissioning for the systems that involved with energy use.

**EA P2 Minimum Energy Efficiency****NC (Prerequisite)**

Get 4 points in the section EA 1

**Intent**

To establish the minimum level of energy efficiency for green building.

**Requirement**

Get at least 4 points in the section EA 1.

**Implementation**

Architects shall consider designing the building which has high efficiency in energy use. Design and select building envelope systems, air conditioned systems, electrical and lighting systems, and other systems involved with energy use that are appropriate with climate and have higher efficiency than general standard. Whole building energy use shall lower than baseline as specified in energy use regulation and law of new building construction in the selected alternative.

**EA 1 Energy Efficiency****NC (16 Points)****Intent**

To develop efficiency of energy use in the building that shall be higher than the standard: ASHRAE 90.1-2007, or Ministerial Regulation for Energy Saving Building Design B.E. 2552 (2009) under The Energy Conservation Promotion Act (second version) B.E. 2550 (2007), or Thailand Energy and Environmental Assessment Method (TEEAM) for environmental impact reduction from energy use.

**Requirement****Alternative 1**

Use Whole Building Simulation as specified in Ministerial Regulation for Energy Saving Building Design B.E. 2552 (2009). Compare energy use reduction with points using Table EA1 T1.

**Alternative 2**

Use Proposed and Baseline Energy Simulation from ASHRAE 90.1-2007 Appendix G that can be used with Thai's climate. Compare energy use reduction with points using Table EA1 T1.

**Alternative 3**

Use TEEAM model 49 which shall be counted for credits only section 3-9 (only energy points). Transfer the result to the points by using Table EA1 T1. Send the evaluation form that is produced by the project team with documents and evidence such as drawings or specifications to confirm.

**Table EA1 T1**

Points	Ministerial Regulations B.E. 2552 (2009) (Energy Value)		ASHRAE 90.1-2007 Appendix G (Energy Cost)		TEEAM	
	Renovate	New Construction	Renovate	New Construction	Renovate	New Construction
4	0-5	6-10	0-5	6-10	51-55	51-55
6	6-10	11-15	6-10	11-15	56-60	56-60
8	11-15	16-20	11-15	16-20	61-65	61-65
10	16-20	21-25	16-20	21-25	66-70	66-70
12	21-25	26-30	21-25	26-30	>=71	>=71
14	26-30	31-35	26-30	31-35		
16	31-35	36-40	31-35	36-40		



**Implementation**

Architects shall consider designing high performance and energy efficient building. Design and select the building envelope systems, air conditioning systems, electrical and lighting systems, and other systems that involved with energy used, appropriate with climate and have efficiency higher than general standard. Whole building energy use shall be lower than baseline as specified in energy use regulation and involved laws for new construction in the selected alternative.

**EA 2 Renewable energy****NC (2 Points)**

Produce renewable energy not less than 0.5-1.5 % of energy cost in the building.

**Intent**

Give priority to use renewable energy to reduce environmental and social impacts associated with fossil fuel energy use.

**Requirement**

Use on-site renewable energy systems such as solar power (solar cell, water heater), wind power, or bio fuel-based energy for 0.5-1.5 % of the building's annual energy cost which may be calculated from computer simulation model in the section EA 1.

1. Produce renewable energy not less than 0.5 % of energy cost in the building. (Get 1 point)
2. Produce renewable energy not less than 1.5 % of energy cost in the building. (Get 2 points)

In case of choice 3 in the section EA1, use the average of the energy per building area in each building type as specified in Table EA2 T1 and calculate energy cost using 3.5 THB per Unit for the average of energy cost.

**Table EA2 T1**

Building Type	Energy Use per Usable area per Year
<b>1. Office</b>	kWh/year/sq m
1.1 Large and high-rise building	215.80
1.2 Extra-large but not high-rise building	199.90
1.3 Extra-large and high-rise building	218.50
<b>2. Mall</b>	kWh/year/sq m
2.1 Discount Store	336.40
2.2 Department Store	240.60
2.3 Shopping Plaza or Area for Rent	204.20
2.4 Supermarket	418.40
<b>3. Hospital</b>	Energy Use per Patient per Year MJ/Bed-Day (in Year)
3.1 Public Hospital	262.00
3.2 Private Hospital	625.00
<b>4. Others building type which are not specified</b>	240 kWh/year/sq m

**Implementation**

Renewable energy systems such as solar, wind, bio-fuel based energy shall be installed in the project which may be sold back to the electricity grid of the Electricity Authority.

<b>EA 3    Measurement and verification to confirm energy saving</b>
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<b>NC (1 Point)</b>
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Plan for measurement and verification the result as specified in IPMVP.

**Intent**

Provide a plan to investigate and verify the actual energy use in the building. The building shall have actual energy saving as calculated and simulated.

**Requirement**

1. Provide a plan for inspection and evaluation building energy use that conforms to International Performance Measurement & Verification Protocol (IPMVP) Volume III. Concepts and Options for Determining Energy Saving in New Construction: Option D: Calibrated Simulation (Saving Estimation Method 2), or Option B: Energy Conservation Measure Isolation.

2. The plan in no. 1 shall be launched within 1 year after the building start operating and the building energy use is stable.

**Implementation**

Provide a plan for inspection and verification the actual energy use with install energy use meters for inspection as specified in the principle of inspection and evaluation the energy use result that conform to IPMVP. In the Option D, this option specifies evaluation methodologies of the actual energy use using computer simulation model (shall be the same model in the section EA1) comparing with actual energy use. Adjust the computer simulation model that the energy value shall be conformed to the value from actual measurement. Computer simulation model can be used to analysis the alternative of energy saving measures in the building. In case of small buildings, IPMVP: Option B specified that systems can be selected for inspection. Use computer simulation model for whole building or for each system for comparison. Then, adjust the value in the model to conform to actual energy use by each system.

**EA 4    Refrigerant in air conditioning systems that does not                      NC (1 Point)**  
**harm ozone layer**

Not use CFC and HCFC-22

**Intent**

Reduce using refrigerant that harms ozone layer.

**Requirement**

Do not use CFC and HCFC-22 in all air conditioning units that use refrigerant more than 0.3 kg.

In case of new building expansion from old building (that the old building is also assessed), refrigerant of the old building shall be changed to be non CFC and HCFC-22 except the plan to reduce refrigerant leakage is provided.

**Implementation**

Do not use CFC and HCFC-22 based refrigerants that is harmful to ozone layer in air conditioning systems.

## Section 5 Materials and Resources

Building construction requires a lot of resources. There are lots of waste from building use and construction process. Waste and natural resource use directly increase pollution and damage the environment. Therefore, reuse existing building, recycle the waste, use local materials or environmental friendly materials are the main objectives in this section with credit topics, totally 16 points as follows:

Topic	Detail	Point
MR 1	Use existing building Keep the existing elements of the existing building for 50-75%.	2
MR 2	Construction waste management Recycle construction waste for 50-75% of the volume or weight.	2
MR 3	Reused material Reuse construction materials for 5-10% of the total of material cost.	2
MR 4	Use recycled material Use recycled materials for 10-20% of the total of material cost.	2
MR 5	Use local or regional material Use materials that are excavated, produced, assembled, or local materials or domestic materials not less than 10-20% of the total of material cost.	2
MR 6	Materials with low pollution, or low environmental impact	3
MR 6.1	Use environmental friendly materials that are certified Green labels or Carbon labels of Thailand.	2
MR 6.2	Use materials that publicized their environmental friendly data not less than 30% of the total of material cost.	1

When considering each topic in this section, the criteria can be separated to 3 groups: reducing the quantity of new material demand, reducing the quantity of construction waste, and using low environmental impact materials.

### Reduce the quantity of new material demand

Reducing the quantity of new material demand by using the elements of the existing building as much as possible, using recycle materials that affect to the environment less than the new materials. The involved credit topics are:

MR 1 Use existing buildings, Keep the existing elements of the existing building for 50-75% of the surface area.

MR 3 Reused materials for 5-10% of the total of materials value

MR 4 Use recycled materials 10-20% of the total of materials value



Credits in Materials and Resources Section have a similar characteristic. The common characteristic for calculation shall be as follows:

### 1. Execution

Getting credits in the topic MR1-6 will refer to the proportion and material price according to the category of CSI Master Format 2004 from Division 03-10 12 31 and 32 only, not include wage, and not include materials and wage in other categories such as electric appliances and mechanicals.

#### CSI CONSTRUCTION SUBGROUP

Division 03 Concrete

Division 04 Masonry

Division 05 Metals

Division 06 Wood, Plastics, and Composites

Division 07 Thermal and Moisture Protection

Division 08 Opening (except in the section MR1)

Division 09 Finishes

Division 10 Specialties

Division 12 Furnishing (Optional, if included, shall be included consistency across credits)

#### SITE AND INFRASTRUCTURE SUBGROUP

Division 31 Earthwork

Division 32 Exterior Improvements

### 2. Calculation

For calculation, Division 12 Furnishing from CSI Master Format is optional. If furniture is included, it shall be included consistency across credits. For the section MR1, calculate include roof area and floor area of the existing building which is different from MR2 that uses volume or weight of the waste. MR3, MR4, MR5, MR6.1, MR6.2 shall be calculated using material weight that can be summarised in the table as follow:

Credit Topics	Getting credits
MR 1	Building surface, not include area of the openings.
MR 2	Volume or weight of the waste, not include soil, plants, and toxic materials.
MR 3-6	Materials Value according to weight proportion and CSI Master Format 2004.



**MR 1 Use existing building****NC (2 Points)**

Keep the existing elements of the existing building for 50-75%.

**Intent**

Reduce materials, natural resources, and energy that are used in construction the new building. To get benefit from the existing building structure as much as possible.

**Requirement**

Maintain the existing building elements for at least 50%. Get 1 point for keeping more than 50% and get 2 points for keeping more than 75%. Calculate only the completeness area and can be kept to use with hygienic condition and not harmful to the building occupants. The damage area or toxic area shall be excluded from the calculation. Materials which are not permanent structure such as fabric or opening shall be excluded from calculation. The damage area or parts that produce pollution or harmful waste shall be excluded from calculation not more than 15% of the existing building area. To get the credits in this section for existing building renovation, the additional building area shall not more than double of the existing building area.

**Implementation**

Select the site that has existing building. Survey the structure, floor, and roof of the existing building that shall still be in good condition. Design to keep the element of the existing building as much as possible. Size of the expansion area shall not more than double of the existing building. For building envelope, select the building envelope systems that have high performance in energy conservation to get the credits from EA1 Efficiency of energy use.

**MR 2 Construction waste management****NC (2 Points)**

Recycle construction waste for 50-75% of the volume or weight.

**Intent**

Reduce waste from construction and reduce to use virgin raw materials that would result in impact reduction from landfill and raw materials production process.

**Requirement**

Landfill or dumping or burning the construction waste shall be diverted for at least 50% by weight or volume (select one for calculation). Get 1 point if divert construction waste more than 50% from landfill or dumping or burning, and get 2 points if divert construction waste more than 75% from landfill or dumping or burning. Construction waste should be sold or donated for recycle. Soil, stone, and plant waste cannot be counted toward this credits in this section but materials, equipment, and machines can. Existing material used in the project, toxic and harmful materials shall be excluded from calculation in this section.

**Implementation**

Establish goal for construction waste diversion from landfill dumping and burning. To reach the goal, separate and collect the materials that can be recycled. Assign the contractor to manage construction waste systematically: recycle, donate to NGO, or use with other buildings.

**MR 3 Reused material****NC (2 Points)**

Reuse construction materials for 5-10% of the total of material cost.

**Intent**

Change waste management process and scrap management from construction, demolition. Prevent bringing all construction waste to landfill or burn but reuse through production process. These materials shall not be toxic.

**Requirement**

Use reused materials 5-10% of the total of material cost. Calculate the price using the price of actual products or equivalent products in case the price is higher. Get 1 point if use reuse materials more than 5% of the total of material cost, and get 2 points if use reuse materials more than 10% of the total of material cost. If some parts of those materials are reuse materials, count the percentage of those materials by comparing to the total material weight, and use that proportion to calculate reuse material cost. Mechanical, electrical, elevator, and water supply pipe are excluded from calculation. Count only materials that are installed permanently in the project but do not include furniture, soil and/or debris, elements from excavation, cut and fill and grading.

Reused materials cannot be counted as recycle quantity in the section MR4 although the materials might have recycle quantity to avoid duplicate credit points. However, scrap from construction or reuse materials in the project can be counted for the credits in the section MR 5 Select the local/domestic materials. Materials in this group shall not be counted toward credits in the section MR 2 Waste management from construction.

**Implementation**

Try to find reuse materials from various sources, or use scrap from construction site or existing buildings to repair for using in the new building construction. Selecting the reuse materials that have high price will gain an advantage to get the credits. Consider to get the credits in the section MR 5 Select the local/domestic materials.

**MR 4 Use recycled material****NC (2 Points)**

Use recycled materials for 10-20% of the total of material cost.

**Intent**

Use recycled materials in the project to reduce using virgin materials and reduce waste that will help reduce impact from material extraction and from processing of virgin materials.

**Requirement**

Use recycled materials or materials that comprise recycled contents for more than 10% of the total of material cost in the project. Get 1 point for more than 10%, and get 2 points for more than 20%. The recycled content cost of material shall be determined by weight of recycled material divided by the total weight of that material. Mechanical, electrical, elevator, and water supply pipe are excluded from calculation. Count only materials that are installed permanently in the project. Furniture can be counted but shall be counted consistency in MR3-MR6.

Recycle content in steel in construction shall be 25% if there is no information available from Suppliers. In fact, steel shall have recycle content higher than the specified value.

In this TREES NC, recycle material content does not separate to Pre-Consumer and Post-Consumer for simplicity of calculation and documentation and to allow transition time for manufacturers. Pre-consumer and Post-consumer content would be used in the future TREES rating system version.

**Implementation**

Specify the goal to use materials that have the maximum performance and recycled content. Find the seller of those materials. Ensure that the selected materials have recycled contents as specified. Consider selected materials qualification based on environmental and economic features especially price of the products.

**MR 5 Use local or regional material****NC (2 Points)**

Use materials that are excavated, produced, assembled near the project site, or use local materials or regional materials not less than 10-20% of the total of material cost.

**Intent**

To increase demand of local materials that will help to promote local material use and reduce environmental impact from transportation.

**Requirement**

Use local/regional materials. Get 1 point if the local material cost is more than 10%, and get 2 points if the local material cost is more than 20% of the total of material cost.

1. Locations of production, excavation, assembly not far than 500 km by radius from the site, or
2. Locations of production, excavation, assembly are in Thailand.

If some parts of the material are produced from the source of production near the construction site as specified in the above criteria, count the percentage of that materials by weight and calculate local/regional material cost. Mechanical, electrical, elevator, and water supply pipe are excluded from calculation. Count only the materials that are installed permanently in the project but do not include furniture.

**Implementation**

Specify the goal to use local materials and find the seller of those materials by considering selected materials qualification based on environmental and economic features especially price of the products. Consider select materials which can also be counted toward other MR topics to increase points such as Green label materials or reuse materials.

<b>MR 6</b> <b>Materials with low pollution, or low environmental impact</b>	<b>NC (3 Points)</b>
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MR 6.1 Use environmental friendly materials that are certified Green labels or Carbon labels of Thailand.

NC (2 Points)

CS (1 Point)

#### Intent

Consider the impact from the products that affect energy use and environment in production process including environmental benefit when using that products in the building.

#### Requirement

Use the environmental friendly materials with Green labels or Carbon labels certified for at least 10-20% of the total material cost. (The materials that received 2 labels can be counted twice). Mechanical, electrical, elevator, and water supply pipe are excluded from calculation. Count only the materials that are installed permanently in the project including furniture. Get 1 point if the material cost received both labels more than 10%, and get 2 points if more than 20%.

#### Implementation

Specify the goal to use the materials which certified Green labels or Carbon labels of Thailand, and come from environmental friendly production process that reduce energy use and Greenhouse gas, and low or non-toxic. Consider with other MR topics to increase the credit points from those topics such as domestic materials and materials that publicized the environmental friendly data.

<b>MR 6</b> <b>Materials that produce low pollution, or low environmental impact material.</b>
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**NC (3 Points)**

MR 6.2 Use materials that publicized their environmental friendly data not less than 30% of the total of material cost.

(1 Point)

**Intent**

Promote the manufacturer to research and develop their products to be environmental friendly products, and publicize the data to provide alternatives in material selection.

**Requirement**

Select the materials which publicized the environmental friendly data in the format of Eco Product Type 2-Self-Declaration Environmental Claims for 30% of the total of material cost. Mechanical, electrical, elevator, and water supply pipe are excluded from calculation. Count only the materials that are installed permanently in the project including furniture. The materials that pass the criteria in this section and have the Green label can also be counted in the section MR 6.1.

**Implementation**

Specify the goal to use the materials which publicized the environmental friendly data conform to requirement of Eco Product Type 2-Self-Declaration Environmental Claims. The label format depends on each manufacturer but under the regulation of International Organization for Standardization. Find the seller of those materials using domestic database such as Eco Market. Consider to other MR topics to increase the credit points from those topics especially Green label materials.

## Section 6 Indoor Environmental Quality

According to the related research, people usually spend most of time in buildings more than outdoor. If indoor environment is not good or inappropriate, it will affect building occupant health and well-being which might also affect workability, and may result in building occupants paying for medical fee, absenting from work, and consequently affect the productivities the organization. Therefore, providing good indoor environmental cannot be ignored.

Criteria to evaluate indoor environment aim to promote good environment and quality of life in the area of thermal comfort, natural lighting, view, and indoor air quality with no toxin or any contaminant. Specify proper design methods, select the building systems appropriately, and select good quality materials which do not release harmful chemical, etc. are strategies in this section. Overall, the topic in this section comprises the details as follows:

Topic	Detail	Point
IE P1	Ventilation rate in the building Ventilation rate: Pass the standards.	Prerequisite
IE P2	Illuminance in the building Minimum illuminance level: Pass the standard.	Prerequisite
IE 1	Reducing impact from pollution	5
IE 1.1	Air Intake is not located at the position that has heat or pollution.	1
IE 1.2	Negative pressure for printing room, photocopying room, chemical storage, and cleaner storage.	1
IE 1.3	Prevent pollution from outside to inside of the building.	1
IE 1.4	Smoking area is located outside the building and not less than 10 m from doors, windows, or air intakes.	1
IE 1.5	The efficiency of air filter: Pass the standard.	1
IE 2	Low emitting materials	4
IE 2.1	Use low emitting adhesive, sealant, and primer in the building.	1
IE 2.2	Use low emitting paints and coatings in the building.	1
IE 2.3	Use low emitting carpet in the building.	1
IE 2.4	Use low emitting composite wood in the building.	1
IE 3	Indoor lighting system control Separate artificial lighting circuits at every 250 sq. m or as requirement.	1
IE 4	Use natural light in the building Regularly occupied spaces shall be designed to achieve enough natural light.	4
IE 5	Thermal Comfort Temperature and relative humidity at the air conditioned area are conform to the standard of air conditioned and ventilation systems.	3



**IE P1 Ventilation rate in the building****NC (Prerequisite)**

Ventilation rate: Pass the standards

**Intent**

Confirm well-being of the building occupants in the area of appropriate ventilation.

**Requirement****Alternative 1**

Ventilation flow rate in both air conditioned area and non-air conditioned area meet the requirements of the Building code, Vol.39 B.E.2537 (1994), according to Building Control Act, B.E. 2522 (1979), and meet the requirements of ventilation standard for indoor air quality (IAQ) of EIT (EIT-3010)

**Alternative 2**

Ventilation flow rate in both air conditioned area and non-air conditioned area meet the requirements in ASHRAE62.1-2007.

**Implementation**

Design fresh air volume into the building that shall meet the minimum requirements as specified in the laws and EIT standard or international standard.

**IE P1 Illuminance in the building****NC (Prerequisite)**

Minimum illuminance level: Pass the standard

**Intent**

Confirm about well-being of the building occupants in the area of appropriate illuminance.

**Requirement**

Illuminance from artificial lighting (not include natural light) pass the requirement as specified in the ministerial regulations in occupational health safety management and working environment that involved with heat, lighting, and noise, and pass the requirement as specified by Illuminating Engineering Association of Thailand (TIEA).

**Choice 1**

Use the result from actual measuring at every 3 m or at least 4 points in the room. Confirm that natural light shall not be present in the building while measuring. Measuring in horizontal plane at 0.75 m height from the floor away from furniture while measuring. Lux meter that used for measuring shall be calibrated or have calibration certification from the manufacturer.

**Choice 2**

Computer Simulation: lamp candle distribution curve (such as IES) from the manufacturer or testing shall be obtain for simulation. Horizontal Illuminance at height 0.75 m is to be measured. No natural light and furniture be modelled in the simulation.

**Choice 3**

Hand calculation using method such as Lumen Method to confirm the number and type of light bulbs are specified appropriately.

**Implementation**

Select the lamp and/or lighting methods that have high performance and appropriate dispersion.  
Select the position and height of luminaire for appropriately installation and for the maximum efficiency.

**IE 1 Reducing impact from pollution****NC (5 Points)**

IE 1.1 Air Intake is not located at the position that has heat or pollution (1 Point)

**Intent**

To avoid pollution that will get into the building because of inappropriate position and location of air intake.

**Requirement**

Study the site and condition around the building. Design air intake which shall be far from heat or pollution such as car parking building, smoke ventilation outlet from the kitchen, air ventilation outlet from other buildings, road, chimney, etc. The distance from air intake shall far from the pollution sources not less than 10 m and has height from the ground not less than 3 m. Natural ventilation area can pass this section if there are active ventilation systems for enclosed space according to criteria in this section.

**Implementation**

Specify air intake at the green area or not less than 10 m far from the pollution sources and has height from the ground not less than 3 m. In case of high rise building, air intake shall be located at the top of the building to avoid pollution from the road or nearby buildings.

**IE 1 Reducing impact from pollution****NC (5 Points)**

IE 1.2 Negative pressure for printing room, photocopying room, chemical storage, and cleaner storage  
(1 Point)

**Intent**

To avoid, manage, and control pollution that may happen in the building from direct resources.

**Requirement****Alternative 1**

In the space where pollution or hazardous gases or chemicals may be presented or used (include laundry room, print room, photocopy room), exhaust in each space shall not recirculate air. Provide self-closing doors and exhaust rate not less than 2.5 litres / ls / sq m. The pressure differential with the surrounding spaces shall be at least 5 Pascals and 1 Pascal at a minimum when the door to the room is closed.

**Alternative 2**

For the building which does not have the area involved with the characteristic as specified. The building can get the credit in this section automatically.

**Implementation**

High pollution area shall be designed to have enough air ventilation systems to reduce contamination in the building. Air vacuum shall have enough vacuum power to prevent the pollution that may spread to other using areas. To avoid this problem, the best strategy is to separate chemical and harmful toxin storage from the area that have regularly occupied users.

**IE 1 Reducing impact from pollution****NC (5 Points)**

IE 1.3 Prevent pollution from outside to inside of the building (1 Point)

**Intent**

Reduce toxin, harmful chemical, and dust that may come from the building occupants especially at the building entrance.

**Requirement**

Install entryway systems at the main entrance of the building. The accepted system is double layer doors with permanent grate system installation which has a slot for cleaning underneath. If using carpet, the weekly carpet cleaning contract from the cleaning company is required. The contract shall specify to cleaning period for at least 1 year after open the building to use.

**Implementation**

Consider preventing pollution and dust into the building at the building entrance by the appropriate systems. Double layer doors with permanent grate system is a good system with high efficiency. Using carpet shall be the second alternative but if this alternative cannot be avoided, contract with the cleaning company to confirm approximately weekly carpet cleaning is required.

**IE 1 Reducing impact from pollution****NC (5 Points)**

IE 1.4 Smoking area is located outside the building and not less than 10 m from doors, windows, or air intakes. (1 Point)

**Intent**

Reduce impact from smoking to the occupants in the building, indoor area, and ventilation systems.

**Requirement**

1. Prohibit smoking in the building
2. Smoking area is not less than 10 m away from building entries or air intakes.

**Implementation**

Specify the smoking area according to the Notice of the Ministry of Public Health of Thailand (Vol.9) B.E. 2540 (1997), and mark or make signs for non-smoking area.

**IE 1 Reducing impact from pollution****NC (5 Points)**

IE 1.5 The efficiency of air filter: Pass the standard (1 Point)

**Intent**

Reduce indoor air quality problem because of dust and pollution, and to improve air conditioned systems for promoting building occupants' health especially preventing respiratory diseases.

**Requirement**

Air Handling Unit (AHU) that has supply rate more than 1000 litres/second as specified in the standard of air conditioned and air ventilation of EIT (EIT-3003) shall has the minimum MERV of air filter for at least MERV 7 (ASHRAE Standard 52.2) or for at least 25-30% (ASHRAE Standard 52.1 Dust Spot), or the air filter which have performance as specified in others reliable equivalent standard. Install at both Return Air and Outdoor Air.

**Implementation**

Select air conditioned systems which air filter can be installed at the proper position especially for AHU size more than 1000 litres/second.

**IE 2 Low emitting materials****NC (4 Points)**

IE 2.1 Use low emitting adhesive, sealant, and primer in the building (1 Point).

**Intent**

Reduce contamination from adhesive, sealant, and primer in the building that are odorous, irritating and harmful to health and well-being of installers and occupants.

**Requirement**

Adhesives, sealants, and primers in the building shall comply with the standard of South Coast Air Quality Management District (SCAQMD) Rule#1168 which is specified the quantity of Volatile organic compound as follow. This standard launched on 1 July 2005, legislated on 7 January 2005.

**Implementation**

Specify low-VOC materials on drawings. Ensure that adhesives, sealants, and primers are Low-VOC as specified. Find the manufacturer and agents who sale low-VOC materials.



**IE 2 Low emitting materials****NC (4 Points)**

IE 2.2 Use low emitting paints and coatings in the building (1 Point)

**Intent**

Reduce the quantity of contaminants from paints and coatings that are odorous, irritating, and harmful to health and well-being of the installer and the building occupants.

**Requirement**

Select products and coating as follows:

1. Paints and coatings in the building shall be certified Green Label, or
2. Paints and coatings in the building shall comply with the criteria of the reference standard as

follows:

Paints, coatings, and primers that used for wall and ceiling shall have VOC content not more than the criteria in Green Label Standard GS-11, Paints, First Edition, May 20, 1993

- Flats: 50 g/L
- Non-Flat: 150g/L

Corrosion resistance paints and rust proofing paints that are used in the building and used as primer for metal parts shall have VOC content not more than 250 g/L as specified in Green Label Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.

Clear wood varnishes, floor lacquers, finishing for the stain, and shellacs that used for indoor materials shall have VOC content not more than the criteria in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, on January 1, 2007.

**Implementation**

Specify low-VOC materials on drawings. Ensure that paints and coatings are low-VOC as specified. Select the manufacturer and agent who sale low-VOC materials.

**IE 2 Low emitting materials****NC (4 Points)**

IE 2.3 Use low emitting carpet in the building (1 Point)

**Intent**

Reduce VOCs from indoor carpet.

**Requirement****Alternative 1**

All indoor carpet systems shall be tested and certificated from Carpet and Rug Institute's Green Label Plus Program or NFS / ANSI Standard 140-2007 Sustainable Carpet Assessment or others equivalent standard which TGBI will consider case by case. Installation of carpet cushion in the building shall be complied with the regulations of Rug Institute Green Label Plus Program. Carpet adhesive shall be complied with the criteria of the section IE 2.1.

**Alternative 2**

Building with no carpet will get point in this section automatically.

**Implementation**

Avoid using carpet. If necessary, low VOC carpet shall be considered to use, and this carpet shall be tested from Carpet and Rug Institute's Green Label Plus Program or other standards either local or international.

**IE 2 Low emitting materials****NC (4 Points)**

IE 2.4 Use low emitting composite wood in the building (1 Point).

**Intent**

Reduce VOCs from composite wood and agrifiber products in the building.

**Requirement**

Composite wood and agrifiber products in the building shall not contain urea-formaldehyde resins in both materials and adhesives. Adhesives shall be E0 formaldehyde resins level. Composite wood and agrifiber products are particleboard, medium density fibreboard (MDF), plywood, wheat board, strawboard, panel substrates, and door cores.

Loosed furniture, old products, or recycle materials are excluded from this criterion.

**Implementation**

Specify wood and agrifiber products that contain no added urea-formaldehyde resins or have E0 formaldehyde resins level for both materials and adhesive. Consider using wood substitute materials from plant scraps to get credits in the section MR4 Recycle Materials and MR5 Local Materials or Regional Materials.

**IE 3 Indoor lighting system control****NC (1 Point)**

Separate artificial lighting circuits at every 250 sq m or as requirement.

**Intent**

Building occupants can control illuminance appropriately for productivity and well-being.

**Requirement****Alternative 1**

Provide lighting systems control for building occupants. Each lighting circuit shall not cover area more than 250 sq m. For the room that is smaller than 250 sq m, the circuit shall be separated for each room.

**Alternative 2**

Design lighting systems control for regularly occupied space such as open plan office. Every user shall have a freedom to control illuminance for his or herself. Design task lighting for 90% of regular users.

**Implementation**

Design the building with lighting system control for each area such as ambient lighting and task lighting. For indoor space, the circuit shall not cover more than 250 sq m per circuit, or use Task and Ambient light for regularly occupied space.

**IE 4 Use natural light in the building****NC (4 Points)**

Regularly occupied spaces shall be designed to achieve enough natural light.

**Intent**

The building shall use natural light appropriately to reduce energy use and increase the quality of lighting in the regularly occupied spaces.

**Requirement**

Simulation by computer to calculate proportion between the areas that Daylight Factor (DF) in Overcast Sky are more than 2% and the total area of the regularly occupied spaces (measure at horizontal height 75 cm from the floor). The credits will be calculated from the minimum DF in the room that is more than 2% (when the minimum value in the room is more than 2%, this result means whole area of the room receive natural light) or only the area that the result is more than specified value such as open plan office.

Credits can be calculated as specified in Table IE 4 T 1.

**Table IE 4 T 1.**

Comparison of regularly occupied spaces proportion that is received natural light, and credits.

Proportion of the aAreas with Daylight Factor (DF) more than 2%	Points
45-55%	1
56-65%	2
66-75%	3
76-100%	4

Simulation shall reflect the actual physical of the building such as Transmittance of the glass, Reflectance of materials in the building. In simulation, no need to consider curtain in the building or have other buildings or exterior factors to reduce incoming natural light. Only permanent shadings are calculated.

Regularly Occupied Spaces means the area that have regular building occupants such as working room, working desk, meeting room for office building or public building, drawing room or living room for residential building.

**Implementation**

Consider to use natural light in the building. Regularly occupied spaces shall be designed to achieve natural light appropriately. Consider to depth of the room. Have enough area and number of openings, and locate at the appropriate location. Apply natural light design strategies such as light shelf, light pipe for more scattered light. Use skylight if natural light from windows is not enough. Avoid too big openings which may affect to more energy use and may loss the credits in the section EA1 Efficiency of energy use.

**IE 5 Thermal Comfort****NC (3 Points)**

Temperature and relative humidity at the air conditioned area are conform to the standard of air conditioned and ventilation systems.

**Intent**

Promote well-being and productivity of the building occupants in the area of thermal comfort.

**Requirement**

1. Design air conditioned area of the building to have temperature and relative humidity as specified in the standard of air conditioned and ventilation systems of EIT (EIT-3003) or ASHRAE 55-2004.

2. Design non air conditioned area of the building as specified in the standard of ASHRAE 55-2004: topic 5.3.

The building will get credits when the total proportions of the area meet two requirements. Regularly occupied space (as specified the definition in the section IE4) will be counted only, and shall meet thermal comfort standard (not include irregularly occupied space, corridor, storage). Credits for proportion of the area that meet thermal comfort standard are specified in the Table IE 5 T1.

**Table IE 5 T1**

The proportion of the regularly occupied space that pass the thermal comfort standard	Points
More than 60%	1
More than 90%	2
100%	3

**Implementation**

Design air conditioning systems which can work with full performance in peak operation period. Consider thermal comfort factors in various ways which are not only temperature and relative humidity but also heat radiation, wind velocity, activity, clothing including design which does not create trouble and uncomfortable to the users such as draft, stratification discomfort, radiant asymmetry.

## Section 7 Environmental Protection

Environmental Protection Strategy for Construction is required for design team since the beginning of design and construction process to prevent long term ecological impact, and effects to human health.

Credits in this section emphasize long term negative impact prevention from construction to natural resources in terms of ecosystems and human health and well-being by design and construction processes including construction management.

This section comprises 7 topics: 2 prerequisite topics and 5 credit topics. The project shall pass the requirement in prerequisite topics before considering getting the points in credit topics. The prerequisite topics emphasize to ecological and natural resources protection by planning to manage and control pollution from construction and waste management during building operation. The credit topics emphasize the selection of the product which do not affects, or prevent impact to human health. For example, select the chemical products which not affect to the environment, prevent problem from light and heat, control disease from building systems including promote waste water treatment to reduce environmental impact as follows:

Topic	Detail	Point
EP P1	Reduce pollution from construction Plan to prevent pollution and disturbance from construction.	Prerequisite
EP P2	Waste management Provide recycling collection area.	Prerequisite
EP 1	Low environmental impact products in fire suppression systems Non CFC, HCFC or Halon in fire suppression systems.	1
EP 2	Condensing unit/ cooling tower position Positions of condensing unit (compressor or cooling tower) shall be located far from the nearby area.	4
EP 3	External glazing Glazing visible light reflectance not more than 15%	1
EP 4	Control disease that involved with the building Comply with the Notice of the Department of Health, Ministry of Public Health of Thailand: Procedure to control Legionella in cooling tower of the building in Thailand.	1
EP 5	Install meter for wastewater treatment systems electricity use	1

**EP P1 Reduce pollution from construction****NC (Prerequisite)**

Plan to prevent pollution and disturbance from construction.

**Intent**

Reduce pollution from construction activities by controlling soil erosion, including sedimentation to water sources which affect to water quality, and prevent dust to the air.

**Requirement**

Provide Construction Pollution Prevention Plan as follows:

- Soil erosion: to prevent sedimentation to water sources.
- Water pollution: to prevent changing in water quality.
- Air pollution: to prevent dust, soot, smoke.

**Implementation**

Provide Construction Pollution Prevention Plan.

- Prevent soil erosion from eluviation, from drainage, storm water runoff from the project, or wind including losing the top soil layer by keeping the top soil to reuse.
- Prevent soil sedimentation to drain channel and nearby water sources.
- Prevent air pollution: dust, soot, smoke.



**EP P2 Waste management****NC (Prerequisite)**

Provide recycling collection area

**Intent**

Prepare to manage waste or debris for recycle which affects to landfill when the building is operated.

**Requirement**

Provide waste management plan for the building or the project as follows:

1. Provide enclosed and easily-accessible recycling collection area.
2. Provide trash collection point clearly in each floor or each part of the building with litter bins that shall be separated to garbage, hazardous waste, and rubbish. Rubbish shall be separated to papers, metals, glass, and plastics for at least.

**Implementation**

Designate recycling collection area clearly for easy to manage waste in the future.

<b>EP 1    Low environmental impact products in fire           suppression systems</b>	<b>NC (1 Point)</b>
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No CFC, HCFC or Halon in fire suppression systems

**Intent**

Reduce to use the chemical that destroys Ozone layer. Do not use Halon, CFC, or HCFC in fire suppression systems.

**Requirement**

Not use Halon, CFC, or HCFC in fire suppression systems.

**Implementation**

Specify the chemical products that will be used in fire suppression systems. Collect the confirmation documents of each product to confirm that the products do not have prohibit chemical as specified.

**EP 2 Condensing unit/cooling tower position****NC (1 Point)**

Positions of condensing unit (compressor or cooling tower) shall be located far from adjacent land areas.

**Intent**

Locate the condensing units or cooling towers of air conditioned systems at the position which not affects to the environment around the building. (If the building does not use air conditioned systems, this section is not needed to assess.)

**Requirement****Alternative 1**

Not locate compressor, heat extractor, or cooling tower close to the adjacent lands less than 4 m. In case of high rise building or extra-large building, the set back of compressor or cooling tower from the edge of the land shall not less than 8 m.

**Alternative 2**

Air conditioned systems has no condensing unit or cooling tower or other component that disperse heat and moisture into the atmosphere.

**Implementation**

Verify the site around the building. Specify the direction and location of heat ventilation of condensing units or cooling tower appropriately and not disturb the environment around the building, or consider selecting Geothermal or Lake Cooling Systems.

**EP 3 External glazing****NC (1 Point)**

Glazing visible light reflectance not more than 15%

**Intent**

Reduce impact from light reflection of the building to the environment because of the glazing of the building.

**Requirement**

All types of glass for building envelope shall be specified to have Visible Light Reflectance (Rvis) not more than 15% when measured in right angle. Rvis shall be verified from the reliable organization.

**Implementation**

Specify Rvis of all type of the glass for building envelope. Consider to select glass characteristic for energy conservation which has the standard score in the requirement in laws, and should consider the impact in the section EA1 Efficiency of energy use.

**EP 4 Control disease that involved with the building****NC (1 Point)**

Comply with the Notice of the Department of Health, Ministry of Public Health of Thailand: Procedure to control Legionella in cooling tower of the building in Thailand.

**Intent**

To reduce risk from Legionnaires' disease that may spread to the building occupants both inside and outside of the building including the passers in nearby area.

**Requirement****Alternative 1**

Design, construction including planning for cooling tower maintenance as specified in the notice of Department of Health, Ministry of Public Health of Thailand: Procedure to control Legionella in cooling tower of the building in Thailand (for air conditioned systems that install cooling tower).

**Alternative 2**

Have no cooling tower in the project.

**Implementation**

Design, construct, and maintain cooling tower as specified in the notice of Department of Health, Ministry of Public Health of Thailand: Procedure to control Legionella in cooling tower of the building in Thailand or design the air conditioned systems without cooling tower.

<b>EP 5</b>	<b>Install meter for wastewater treatment system electricity use</b>
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<b>NC (1 Point)</b>
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**Intent**

Install meter to measure electricity use for waste water treatment systems.

**Requirement****Alternative 1**

Install specific meter to measure electricity using for waste water treatment systems only.

**Alternative 2**

Install waste water treatment systems that can treat waste water to have BOD5 and TSS equal or less than 10 mg per litre. The systems can treat waste water more than 50% of the total waste water from the project.

**Implementation**

Install meter to measure electricity using for waste water treatment systems only that is separated from other building systems, or install waste water treatment systems that can treat waste water to have BOD5 and TSS equal or less than 10 mg per litre.

## Section 8 Green Innovations

Although TREES has criterions to evaluate energy and environmental issues which cover in 7 topics: Building Management, Site and Landscape, Water Conservation, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, and Environmental Protection, there are many issues that are not mentioned in TREES. Green Innovation (GI) Section opens for presenting the topics that are suitable with the project to receive the points from this section. Furthermore, the points in GI Section can be come from the special points that are specified details in each issue. These special points will be received when the project can be presented the efficiency of each issue more than the specified in one level. Maximum point of GI Section is 5 as follow:

Topic	Detail	Points
GI 1	Technique which are not specified in the rating system (.....)	1
GI 2	Technique which are not specified in the rating system (.....)	1
GI 3	Technique which are not specified in the rating system (.....)	1
GI 4	Technique which are not specified in the rating system (.....)	1
GI 5	Technique which are not specified in the rating system (.....)	1

<b>GI 1-5 Techniques which are not specified in the rating system</b>	<b>NC (1-5 Points)</b>
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**Intent**

To encourage design and construction that achieves exceptional performance above the requirements and encourage innovative for green building categories not specifically addressed in this rating system.

**Requirement**

Follow these choices:

**Alternative 1**

Comply with the extra credit topics that are specified in each section above the requirement.

**Alternative 2**

Present the new energy and environmental topics which not addressed in this rating system.

**Implementation**

Study opportunity to receive special points in all topics, and energy and environmental issues that are not specified in the rating system to present to TGBI. In the future, if the innovation criteria for other projects are granted, the project can present topics from the criteria which are not mentioned in this rating system to receive the points in GI Section directly.