

The name of the concept: Green technology



Sustainable development goals (SDGs)

Goal 9: Industry, innovation and infrastructure

Goal 11: Sustainable cities and communities

Goal 7: Affordable and clean energy



Definition

Green technology is a 'type of technology which is **environmentally friendly**'. Its main purpose is to conserve nature, tackle problems associated with the depletion of natural resources, and to cure the negative impact of human activities, such as pollution and environmental degradation. The term 'green technology' is also known as '**environmental technology**' and '**clean technology**'. It includes various elements ranging from **renewable energy and power storage, smart buildings innovations, green living technology, to smart transportation and mobility, waste management and recycling and other** (Dasy, 2016; Babbitt, 2017).



Goals/ principles/ models related to the concept

1. Criteria of Green technology

- It minimizes the degradation of the environment;
- It has zero or low greenhouse gas (GHG) emission, is safe for use and promotes healthy and improved environments for all forms of life;
- It conserves the use of energy and natural resources;
- It promotes the use of renewable resources.

2. Business goals of Green technology

a. Sustainability goals

The systematic shift from short-term gain, which depletes natural resources, to the long-term prosperity of future generations. This kind of shift should be the mindset for a lot of organizations.

b. Product Life Cycle Goals

Performing life cycle evaluations can put an end to the 'cradle-to-grave' cycle of production, especially in relation to manufacturing. Products can be manufactured utilizing a life cycle evaluation to initiate 'cradle-to-cradle' cycles so that products can be reused/recycled at the end of their life.

c. **Product efficiency goals**

Decreasing pollution, waste and resource consumption during the manufacturing process at various stages. This may also involve making post-production more efficient by diminishing the impact of shipping, for example.

d. **Closed-loop innovation**

Technology controlled 'smart systems' monitor the consumption of resources and the management of waste, which close the loop for products, components and materials to promote resource efficiency. Remanufacturing, re-use and recycling approaches entail a multiple-times value creation which includes sustaining value beyond the original new product life cycle (Iravani, Akbari & Zohoori, 2017)



Daily Life

Application in daily life

1. **e-Technology**

Email, online shopping, e-bills and e-payments, e-readers

2. **Equipment**

LED monitors, solar chargers, solar cells

3. **Electronic Equipment Recycling**

Computers, smart phones



Industry

Application in specific industries

Link to case studies in different sectors:

Construction sector

- Green buildings: Hong Kong Science Park / Zero Carbon Building / Towngas Headquarters

Energy sector

- How much energy do data centers use?



Description of the related issues

1. **Green building**

Today, as industrial manufacturing is no longer the main economic activity in Hong Kong, the major source of electricity consumption is from buildings like housing estates, offices and malls. Building-related activities account for around 90 percent of Hong Kong's total electricity consumption, compared to a global average of 40 percent. In turn, this high level of energy consumption from buildings accounts for 60 percent of the city's greenhouse gas emissions. Therefore, green buildings play a crucial role in achieving energy savings in Hong Kong, and are also a global target set by the Paris Agreement 2015.

1.1. What is a Green building?

A green building, also known as a sustainable building, is a structure that is **designed, built, renovated, operated or reused in an ecological and resource-efficient manner. Natural ventilation, natural daylight and rooftop gardening** are features designed to reduce the energy consumption from air-conditioning, ventilation and lighting systems, thus cutting greenhouse gas emissions (GHGs).

Reducing reliance on non-renewable energy sources like traditional fossil fuels, such as oil, gas and coal, is one of the most common features of green buildings. These traditional energy sources release greenhouse gases and pollutants into the environment and accelerate global warming. Since green buildings are **designed with energy saving measures, such as the use of renewable energy sources** (e.g. solar, wind, hydro and geothermal energy), they can significantly reduce negative impacts on the environment.

1.2. What are the standards of green building in Hong Kong and in Mainland China?

Standards of green building in Hong Kong

- a. BEAM Plus New Buildings covers the demolition, planning, design, construction and commissioning of a new building project. The standard can also be applied to major renovations, alterations and additions.
 - Site aspects
 - Materials aspects
 - Energy use
 - Water use
 - Indoor environmental quality
 - Innovations and additions
- b. BEAM Plus Existing Buildings measures the actual performance of a building and evaluates its facility management practices. The assessment covers all aspects of management, operation and maintenance and may be initiated at any time during a building's operational life.
 - Site aspects
 - Management
 - Materials and waste aspects
 - Energy use
 - Water use
 - Indoor environmental quality
 - Innovations and additions
- c. BEAM Plus Interiors covers the design and construction of fit-out, renovation and refurbishment works in non-domestic, occupied spaces.
 - Green building attributes
 - Management

- **Materials aspects**
 - **Energy use**
 - **Water use**
 - **Indoor environmental quality**
 - **Innovations and additions**
- d. BEAM Plus **Neighbourhood** adopts a more holistic approach to assessing sustainability performance at the early, or inception, stage of a development project. It helps establish a broader framework of urban sustainability to enable the smoother implementation of the principles in later development stages. The tool relates to the design of space between buildings and focuses on the **socio-economic elements** of a development.
- **Community attributes**
 - **Outdoor environmental quality**
 - **Site aspects**
 - **Materials and waste aspects**
 - **Energy use**
 - **Water use**
 - **Innovations and additions**

Standard of green building in Mainland China

The Three-Star evaluation system has two different standards: one for **residential buildings** and one for **public (i.e. large commercial) buildings**. This standard can also serve as a reference for the evaluation of other buildings.

The evaluation standard rates buildings according to a variety of prerequisites (called 'control items' in the Chinese system) and credits (called 'general items' in the Chinese system) in **six categories**:

1. **Land savings and outdoor environment**
2. **Energy savings**
3. **Water savings**
4. **Materials savings**
5. **Indoor environmental quality**
6. **Operations and management**

A seventh category called 'Preference items' contains strategies that are both cutting edge and harder to implement, such as brownfield redevelopment, more than 10 percent on-site renewable power generation, etc.

The China green building system grants three levels of ratings: one-star, two-star, and three-star, hence the nickname 'Three-Star System'. The numbers of items required for the particular level of assessment of residential buildings and public buildings are shown in Table 1 and Table 2 respectively. For both residential and public buildings, controlled items are mandatory. All the mandatory items should be first completed then building can go through an evaluation process for rating.

General items and preference items are optional conditions for classifying green buildings into the three levels. The total amount of various general and preference items used in one building is the maximum result that this building can obtain. The star level is decided by the minimum number of each component, not the total numbers satisfied (Geng et al., 2012).

| Grade | General Items (Total: 40 Items) | | | | | | Preference Items (Total: 9 Items) |
|-------|--|---|--|--|---|---------------------------------------|-----------------------------------|
| | Land Saving & Outdoor Environment (Total: 8 items) | Energy Saving & Energy Utilization (Total: 6 Items) | Water Saving & Water Resource Utilization (Total: 6 Items) | Material Saving & Material Resource Utilization (Total: 7 Items) | Indoor Environment Quality (Total: 6 Items) | Operating Management (Total: 7 Items) | |
| ★ | 4 | 2 | 3 | 3 | 2 | 4 | - |
| ★★ | 5 | 3 | 4 | 4 | 3 | 5 | 3 |
| ★★★ | 6 | 4 | 5 | 5 | 4 | 6 | 5 |

Table 1. Item Requirement for Grade Classification of Green Building (Residential Building)

| Grade | General Items (Total: 43 Items) | | | | | | Preference Items (Total: 14 Items) |
|-------|--|--|--|--|---|---------------------------------------|------------------------------------|
| | Land Saving & Outdoor Environment (Total: 6 items) | Energy Saving & Energy Utilization (Total: 10 Items) | Water Saving & Water Resource Utilization (Total: 6 Items) | Material Saving & Material Resource Utilization (Total: 8 Items) | Indoor Environment Quality (Total: 6 Items) | Operating Management (Total: 7 Items) | |
| ★ | 3 | 4 | 3 | 5 | 3 | 4 | - |
| ★★ | 4 | 6 | 4 | 6 | 4 | 5 | 6 |
| ★★★ | 5 | 8 | 5 | 7 | 5 | 6 | 10 |

Table 2. Item Requirement for Grade Classification of Green Building (Public Building)

1.3. Renewable energy

More renewables in Hong Kong - the idea sounds a bit implausible. Hong Kong is a small, densely populated territory with a large electricity habit. Renewables suck in subsidies, take up space and don't produce very much electricity – and when they do, it's at unpredictable times.

But, is it really such a bad idea? In last year's fuel-mix consultation, the government estimated that the price of electricity in Hong Kong was set to almost double, as we invest in a gas generation plant, and replace cheap coal with expensive gas. This will bring our power prices more in line with countries that are putting restrictions on coal use. Recent overseas experience suggests that renewable energy, in the right policy environment, gets cheaper as it matures. Prices of onshore wind in Brazil and Europe are now similar to those of fossil fuels; the price of large-scale solar power in Britain's recent power auction was just 25 percent more than its gas-fired electricity.

Here in Hong Kong, solar output is wonderfully punctual, peaking just when we need it, on hot summer days. Also, renewables are an insurance policy against volatile fossil fuel prices. Over the past decade, natural gas prices in Asia have quadrupled.

The government last examined renewable electricity in 2002. According to its first-phase report on the potential applications of renewable energy in Hong Kong, our city could meet 17 percent of its electricity demand if a proportion of developed land and open space (roads and airports) had solar panels installed. A further seven percent of the electricity demand could be met by 1,000 well-situated wind turbines.

However, the report concludes that the scope for growth is limited - perhaps reaching two percent in 2017, and three percent by 2022. But these numbers now seem out of date. In response to the call for greener energy and rapid world development, CLP Power is investigating the feasibility of a 200MW offshore wind farm in Hong Kong's southeastern waters. HK Electric has also looked into offshore wind farms. Clearly, it's time for the government to update its analysis about the potential for renewables.

The scheme of control agreements, inked between the government and the city's two power suppliers, were developed with fossil fuels in mind. The power companies are rewarded on how many assets they build. Altering it for renewables might not be the most effective way to start. In the last agreement, the government encouraged the power companies to switch to renewables by providing an extra one percent in their permitted rate of return in exchange for investment in these alternative sources, but progress has been uninspiring. Only about 0.1 percent of the power they generate is from renewables.

Other places do not pay a return on how much capital is invested. Renewable developers compete against, or join with, energy companies to produce renewable electricity. They are rewarded through a predictable and usually subsidized price for the power they produce.

The price paid to generators of renewable energy in Europe is around HK\$0.70 per kWh. This compares with the retail price we pay for electricity in Hong Kong of around HK\$1.10 per kWh. One of the biggest obstacles to promoting renewable energy development is for outsider developers to access the power grid, the route to the market. Hong Kong has no law to regulate prices and contract terms for this.

Source: Wong, G. (2015). *Hong Kong needs to switch on to renewable energy*. [online] South China Morning Post.

