

Overview of International Green Building Rating Systems

François Citerne
Virginia Tech
Blacksburg, Virginia

David Goldsmith, Ph.D.
Virginia Tech
Blacksburg, Virginia

Yvan Beliveau, Ph.D.
Virginia Tech
Blacksburg, Virginia

This research presents a summary and comparison of green building rating systems used in residential construction in the United States, France, Sweden, Denmark, and Norway. The comparisons made emphasize that globally important green solutions to construction can be expressed in locally specific systems. Building rating systems take into account differing factors and offer different evaluation methods to arrive at the same goals of green construction. These differences can make it difficult to directly compare projects across rating systems but the ratings systems themselves can be portable.

Key Words: Green building, international sustainability, rating systems, LEED

Introduction

Even if we are looking to the same type of building, an individual house, in different countries, we will not see same things at all. In fact, each country has traditions, history, rules and a lot of things that make their houses unique. Even in one country we can find many differences between a region and another one. In United-States, the main part of the houses is wooden-framed, whereas in France, and more commonly in Europe, the houses are mainly made in masonry. the Scandinavian houses to this study, because even if they are built in wood as the American houses, they are mainly different due to the polar climate, as we will see further in the study.

Rating Systems

The U.S. Green Building Council (USGBC), co-founded by current CEO Rick Fedrizzi, Mike Italiano, and David Gottfried in 1993, is a private, membership-based non-profit organization. This organization promotes sustainability in how buildings are designed, built, and operated. USGBC is best known for its development of the Leadership in Energy and Environmental Design (LEED) green building rating systems and its annual Greenbuild International Conference and Expo, the world's largest conference and expo dedicated to green building. Promoting buildings that are environmentally responsible, profitable and healthy places to live and work is another aspect of the USGBC.. To achieve this it has developed a variety of programs and services, and works closely with its network of 77 regional chapters, 13,000 member organizations, key industry and research organizations and federal, state and local government. Through its partnership with the Green Building Certification Institute (GBCI), USGBC offers a suite of LEED professional credentials that denote expertise in the field of green building.

The Leadership in Energy and Environmental Design (LEED) green building-rating systems is intended to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions. There are different rating systems, one for each kind of construction. The essence of the LEED, and its particular genius, is that it is a point-based rating system that allows vastly different green buildings to be compared in the aggregate. LEED is also an amalgamation of best practices from a wide variety of disciplines including architecture, engineering, interior design, landscape design and construction. It is a mixture of performance standards and prescriptive standards, but it is weighted toward the performance side. In other words, LEED holds that best practices are better shown by results (outcomes) than by efforts alone (inputs). Each LEED rating system has a different number of points, so scores can be compared only within each system; however, the method for rewarding achievement is identical so a LEED Gold certification

for new construction represents, in some way, the same level of achievement as a LEED Gold certification for commercial interiors.

Following on the success of its other LEED programs, the USGBC launched the LEED for homes (LEED-H) pilot program for evaluation in 2005. This program has been published officially in 2008, and is now recognized as one of the LEED rating systems. This rating system has been design to certify multifamily and single family housing, working on the health protection of the inhabitants, the energy and water savings.

To evaluate the energy efficiency of a building, the LEED referential has developed his own score, based on the Energy Star standards. And since 2009, the U.S. Green Building Council developed Alternative Compliance Path (ACP), in order to adapt the LEED rating system to another market than the United-States one, in Europe and in Asia.

Many local and state homebuilders associations have adopted the guidelines developed by the National Association of Homebuilders (NAHB) as the basis for their own green building certification programs. The NAHB guidelines provide three levels of certification: Bronze, Silver and Gold. Projects must achieve a minimum score (varying by certification level) in seven guiding principles of builders and environmental concern, to ensure a balanced whole-system approach:

- Lot design, preparation, and development
- Resource (materials) efficiency
- Energy efficiency
- Water efficiency
- Indoor environmental quality
- Operation, maintenance and homeowner education

Global impact (e.g. low-VOC products)

France

Beginning in the 1980s, labels, standards, certifications, and references have been developed in France, as in the rest of the world.

Obtaining a certification or a label is a voluntary process initiated by a client or a developer who wants the quality of its constructions recognized. These labels and certifications are indicators for a buyer or prospective tenant, in terms of comfort, saving costs and environmental respect.

Today, many building owners and developers are concerned about the environmental and energy challenges mentioned above. The referential of certifications and labels serve as guides for those who wish to improve their skills in environmental and energy quality. They set the targets and performance levels they aspire, based on the standard in question. The project owners and developers have the opportunity to be accompanied by certification organism in their dynamic progress.

The intervention of a third-party organism prevents self-proclamations and helps the customers by giving them a reliable certification. Certification given by a third-party organism is a guarantee of independence both necessary and legal: in fact in France the Consumer Code requires a separation between the certification agency and the company that produced the certified product.

There are two main organizations that lead the green building in France. In one hand there is the French government, who passed laws on the energy efficiency of the buildings, called “règlementation thermique (RT)” (the French words for thermal regulation rules) and on the other hand, with a wider approach which take into account all the aspects of the sustainable development, there is the “Haute Qualité Environnementale” (HQE) system, which has been developed in the 1990s by the HQE association. (Agence, 2009)

The issue related to the reduction of energy consumption in building sector is firstly related to ecology: the main goal is to reduce emissions of greenhouse gases to protect the planet against climate change. In France, the building construction sector consumes about 43% of final energy (31% for the transport sector) and accounts for nearly a quarter of emissions of greenhouse gas. The priority given on the control of the energy consumption has two targets:

limit the use of the fossil energies, because the global reserves of fossil fuel fall down sharply, and strengthen the purchasing power by lower expenses related to energy consumption.

The latest version of the French thermal regulation, the RT 2005, has been passed to meet these goals. It is applicable to all building permits in the residential (housing) sector and non-residential (commercial) sector, since the 1st of September 2006. It strengthens the control requirements of the energy needs for new constructions of 15% compared to the previous thermal regulation law (the RT 2000).

The RT 2005 is a continuation of the RT 2000. The basic principles remain the same: the construction project is compared to a reference project and to avoid abuses, minimum values must be respected. For residential buildings, the new regulations require a maximum consumption of the whole project (heating, cooling, hot water, lighting, etc.) of primary energy, measure in kWh per square meter per year (kWh/m².year). This limitation is the same for individual and collective buildings and depends of the climate.

Heating system	**Climate zone**	**Maximum consumption of primary energy (kWh/m².year)**
Fossil energies	H1	130
	H2	110
	H3	80
Electric heating (including heat pumps)	H1	250
	H2	190
	H3	130

Since 2006, energy suppliers are obliged to make energy savings, which are recorded in certificates. Since 2007, during the sale or the leasing of a new or existing building, an energy performance certification is required, and must be attached to the contract of sale or lease.

Since 2007, the thermal regulations rules are also applied to the renovation or extension of the existing buildings. The energy saving potential is mainly in the existing buildings, with 31.3 million of housing and 875 million square meters of office space. These buildings, built mostly before the first thermal regulation rules, are now largely responsible of the emissions of greenhouse gas.

This regulation is based on strengthening the overall energy performance of the building, but project managers are free to choose the best solutions to achieve the overall performance required. They have the possibility to choose between several elements involved in the thermal efficiency. In addition, work on the design is better taken into account in the calculation methods of the RT 2005.

The next thermal regulation, the RT 2012, strengthen the thermal requirements gradually in order to reach the target of 40% reduction of energy consumption in 2020. The RT2012, is an addition to the RT2005, it insists on four main energy efficient systems and oblige to:

- Reduce significantly thermal bridges (exterior insulation)
- Use condensing boiler to produce hot water
- Use heat pumps
- Continue the development of renewable energies, in particular for heating

The buildings that are more efficient than the requirements of the thermal regulation may be certified by one of the five levels of the HPE label (Haute Performance Energétique - High energy efficiency).

- The HPE (High energy efficiency): total energy consumption 10% below the baseline RT 2005
- The THPE (Very high energy efficiency): total energy consumption 20% below the baseline RT 2005
- The HPE-EnR (High energy efficiency – renewable energies) HPE level label and heating needs provided more than 50% by a wood (or biomass) boiler fuel or a heat network fed with more than 60% of renewable energy

- The THPE-EnR (Very high energy efficiency - renewable energies): total energy consumption 30% below the baseline of RT 2005 and one of the following conditions
    - More than 50% of hot water needs produced by solar thermal panels and heating needs provided more than 50% by a wood (or biomass) boiler fuel or a heat network fed with more than 60% of renewable energy
    - More than 50% of domestic hot water and heating needs covered by solar thermal panels
    - More than 25 kWh/m2 floor area of primary energy covered by an electrical energy produced using renewable energies
    - Building with a heat pump efficient (coefficient of performance [COP]> 3.5)
    - More than 50% of hot water needs of a multi-storey building covered by solar thermal panels

The BBC label (Bâtiment basse consommation – Low consumption building): Global energy consumption is equal to or less than 50 kWh/m².year. The Effinergie label can be validated by obtaining the BBC level.

The HQE approach

The first project with a HQE approach was initiated in 1993, as a part of the program Ecology and Housing. The objective was to integrate issues of environmental protection and health in the building sector.

It is very important to understand that the HQE is not a rating system like the LEED or the BREEAM, but it is only an approach. Since 2005, if they match the approach, commercial building can receive a NF-HQE certification. To develop the approach, the French government gives financial incentives reducing the taxes to the owners, builders, associations, who follow the HQE approach to design their building, residential or commercial.

The NF-HQE certification is for all commercial buildings, whether public or private, and take into account the phases of planning, design and implementation. It allows the builders to promote their efforts to reduce the impact of their operations on the environment and health, and to maximize comfort.

The NF Commercial Buildings HQE already covers most sectors of commercial buildings. It will be gradually extended to new categories such as sports or cultural facilities, which are not yet in the certification system. The certification relies on technical standards developed by the third-party organism Certivéa, based on the 14 targets of the HQE.

In order to receive the certification, the commercial building must respect the requirements of the standard concerned (determined by the future use of the building) developed by Certivéa. Certivéa validates the certification, after consultation with the HQE Association and a committee composed of representatives of building owners, users of commercial buildings, and actors in the construction sector and construction experts.

The HQE approach aims to satisfy three requirements: obtaining a healthy indoor environment and comfortable for the occupants, controlling the impact of the building on its external environment, and preserving the natural resources by optimizing their use. This approach is also part of the current priority of controlling consumption energy and greenhouse gas emissions, by integrating of energy performance thresholds from the beginning of the building design.

To supervise the implementation of environmental quality in building construction, the HQE system does not provide a ranking system as the LEED or the BREEAM, but instead gives an environmental profile. The system identifies 14 environmental targets divided into four groups of objectives: site and construction, management, health, comfort. These 14 targets have implications for all steps of the design process and production of the building. The conventional aspect of this grid is not always suited to the daily practice of construction, but it nevertheless represents a basic tool, especially for certifications that validate the environmental quality of buildings. Anyway, the application of the approach is always a matter of compromise, in which the owner must be involved. Today, the HQE expands beyond the 14 targets, taking into account the land, the landscape, the neighborhood and the transportation systems.

The 14 main targets of the HQE approach:

Site and construction	
Target 1	Harmonious relationship between buildings and their immediate environment
Target 2	Integrated choice of construction products and processes
Target 3	Low-nuisance worksite
Management	
Target 4	Energy management
Target 5	Water management
Target 6	Waste management
Target 7	Maintenance
Comfort	
Target 8	Hydrothermal comfort
Target 9	Acoustic comfort
Target 10	Visual comfort
Target 11	Olfactive comfort
Health	
Target 12	Sanitary conditions
Target 13	Air quality
Target 14	Water quality

There are some other labels, which are used in France, like the German label Passivhaus, the Swiss label Minergie, or the French Effinergie. These certifications have been designed to supervise and assist builders who want to make their buildings particularly energy efficient. To obtain one of these labels, the project managers have to follow the referential of the label, and ask the certification to an accredited organism.

The requirements of these labels are expressed in terms of objectives and limits not to be exceeded, but do not give any solutions to reach these targets. They require neither constructive choices, or materials, or techniques, or energies, in order to allow any freedom of design and innovation in project management (architect and engineering). However, as shown by examples of achievements, materials and applied technology are often the same, regardless of the certification.

The additional investment costs to reach these performances are about 7 to 15% compared to a building following the RT 2005 requirements. But the investment is quickly recouped offset by the savings of energy consumption.

In order to improve the representation and to promote the green building construction in France, some French associations and firms have created the French Green Building Council, with is a member of the World Green Building Council. The main objectives of the council are to promote the green construction toward the public and help the professionals who want to develop green building projects.

Scandinavian countries

Formal ratings of green building appeared relatively recently in Nordic countries, compared to France and the United States. Scandinavian countries began to speak of green building construction in the 2000s. That is why there are relatively few buildings certified in these countries.

According to the 2012 EPI ranking, a survey published by Yale University that rank the countries on 25 ecologic points, the Norway (3rd) and Sweden (9th) are strongest performers, while Iceland (13th), Finland (19th) and Denmark (21th) are part of the strong performers. The countries are leader in Europe in term of renewable energies (47% of the energy production in Sweden, 30% in Finland, and 20% in Denmark) and waste management (the waste management of these countries is one of the best in Europe). They recycle a lot, they produce few greenhouse gases

and due to the harsh climate, their buildings have very good insulation systems and are very energy efficient for a long time. So in the 2000s, they followed the global trend and developed the green building concept. The Sweden Green Building Council has been created in June 2009, followed by the Denmark and Finland Green Building Councils in April 2010 and the Norwegian Green Building Council in September 2010.

Even if they work together, as during the Nordic Green Building Council Conference held in January 2013 at Helsinki, each country developed a different policy toward the green building construction, corresponding to their needs. While the Norwegian have adapted the British referential BREEAM, the Danish use the German DGNB and the Swedish have passed their own laws.

Sweden

In term of energy consumption, as the other countries of Europe, the Sweden follow the European Directive on Energy Performance of Buildings (EPBD) (Directive 2002/91/EC) requires the introduction of legislation in each member state that measures the energy consumption of buildings.

In Sweden, this law was introduced in 2006 (2006:1592). It requires that an energy certificate is issues stating the de facto energy consumption of the building on a practical basis (not based on a theoretical calculation as is the case in most other EU member states). In the case of apartment buildings, these should be certified at the end of 2008, other buildings will be started to be certified after that date. Individual house owners need to produce a certification at the point in time when the house is sold. As reference value, energy consumption for e.g. apartment buildings is set at between 130 kWh/m².year and 110kWh/m².year, depending on geographical location of the building. In 2008, around 15% of buildings of the country were certified.

As a result of these directives and the introduction of energy declarations, there is a trend to the construction of low-energy and passive houses. Until April 2008 there have been 183 passive housing units built in Sweden, mostly apartment buildings. At the same time 319 new apartments are under construction as passive houses, while 300 apartments are being renovated according to the Swedish definition of passive house standard.

In order to reach and implement energy saving and low/passive housing in Sweden, there are a number of different initiatives that provide information and training. These include the Swedish National Board of Housing, Building and Planning, but also from the side of Universities and/or a number of EU financed projects and industry initiatives. In addition, the Swedish government provides funds for investments in CO_2 reduction measures

A number of aspects of sustainable building and construction have been taken up in Sweden to a rather high extent. Low energy and passive housing is increasingly being built. Although numbers are still low compared to other European countries, the trend towards higher energy prices will most likely push for more passive housing.

Denmark

The Danish government has long recognized the fact that buildings constitute an energy area, which is different from most other areas of energy consumption. Buildings often have a very long life – which means that the consequences of the way that new buildings are constructed and built will have implications for many years to come. In this regard, Denmark has one of the strictest green building legislations in the world, which set strict demands for all new building projects. Besides this, the new Danish Energy Deal has a great focus on energy renovations of the existing building mass, which holds the greatest potential for energy savings.

It is of crucial importance that long-term decisions are being made both in regards to new construction and already existing buildings. Denmark has a culture of merging different plans and regulations, such as the Building Regulation, the Heat Supply Act, and the Planning Act. This ensures holistic and system-oriented policy-making. Furthermore, the general stability of the Danish political climate helps companies make long-term decisions concerning their areas of business.

To reach these objectives, the Green Building Council Denmark has established a Danish certification within sustainability, the DGNB Denmark, which is based on the German rating system DGNB.

The DGNB system is a framework with detailed specifications and characteristics for conducting a building life-cycle assessment. The DGNB created and promotes it. DGNB uses benchmarks with two elements (construction and operation) to define the life-cycle environmental performance of buildings. The first element is a fixed value that refers to the construction of the building. It is derived from a German national research project that evaluates ”typical” buildings to formulate benchmarks on the basis of average values and an understanding of the relation between a building and its environmental impacts. The second element is a variable part derived from the Energieausweis, the German energy performance certificate.

If a performance requirement is met, the DGNB awards the DGNB certificate in bronze, silver, or gold. In addition, there is the option of simple pre-certification in the planning phase.

Norway

The Norwegian Green Building Council choose to increase the environmental standard of Norwegian construction by developing BREEAM-NOR, the Norwegian version of the British BREEAM referential.

BREEAM is the world oldest environmental assessment method and rating system for buildings, launched in 1990. BRE Global, which develops the BREEAM, is an independent third-party approval body offering certification services to an international market.

The BREEAM assessment tool measures performance against a set of nine benchmarks to evaluate building design, construction, management, and overall use in the future. Some of these benchmarks include energy and water use, health and well being of the environment, transportation, materials, waste, ecology, and management process. A certified BREEAM assessment points out specific stages of a building life cycle.

Within each BREEAM section there are numerous environmental attributes for which a project can receive credits. The number of credits for each section are summed and compared to total available credits as follows:

Section score (%) = (total number of points achieved / total number of points available) x100

The resulting percentage is then weighted as follows:

Weighted section score (%) = (section score (%) x weighting factor) / 100

These section scores are summed, as well as any innovation credits that have been achieved. This produces the final BREEAM score, which translates to a particular rating level, such as “Outstanding” (above 85 percent) or “Excellent” (above 70 percent)

Here are the rating categories and their respective weights:

Section	Weighting (%)
1. Building/Project management	12
2. Health and well-being	15
3. Energy	19
4. Transport	8
5. Water	6
6. Waste	7.5
7. Materials	12.5
8. Land use and ecology	10
9. Pollution	10
Total	100
10. Innovation (additional)	10

Conclusion

To conclude this survey, we can say that the sustainable development in general, and therefore the green building construction is a global issue that can find regional solutions. In fact, if the climatic warming and all the environmental issues we face are global and touch any continents, the solutions to reach a sustainable development must take into account regional specificities, such as the climate, the local raw materials, but also the local governments, the knowledge and capacities of the local firms. Any solution that is viable in one country may be not adapted in another. That is why organizations of green buildings, if they want to export their certifications abroad, have to adapt their referential to the market targeted, as the BREEAM in Norway, or the LEED with the ACP in Europe for example.

The green building construction sector is in constant evolution in the world, and we can hope that in a few decades the green building, and more generally the sustainable development, will become the standard of construction, and not only an exception, for the health of the Earth and mankind.

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