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National and International Building Rating Systems

in Practical Usage

Master Thesis

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Kurzfassung

Der Gebäudesektor ist einer der maßgeblichen Verursacher von Stoffströmen und den damit verbundenen negativen Umweltauswirkungen. Die Ziele einer nachhaltigen Bauweise sind daher qualitativ hochwertige, also wirtschaftlich effiziente, umweltfreundliche und ressourcensparende Gebäude zu planen und zu konstruieren. Die Anwendung der internationalen Gebäudebewertungssysteme BREEAM aus Großbritannien und LEED aus den USA in Europa hat für eine entsprechende Nachfrage am Markt gesorgt. Im deutschsprachigen Raum werden daher nun soziale, ökologische und ökonomische Kriterien in das Gebäudebewertungssystem eingebunden.

Diese Arbeit liefert einen Überblick über bestehende nationale und internationale nachhaltigkeitsorientierte und umweltfreundliche Gebäudebewertungssysteme und stellt die grundlegenden Unterschiede dar. Es wird die praktische Anwendung des österreichischen Bewertungssystems klima:aktiv und des deutschen Bewertungssystems Deutsches Gütesiegel für Nachhaltiges Bauen anhand des Österreich-Hauses im Rahmen der Olympischen Spiele 2010 in Vancouver getestet. Zudem werden neben rechtlichen Rahmenbedingungen die unterschiedlichen Ansätze einer Integration von energierelevanten und nachhaltigen Aspekten in Architekturwettbewerben vorgestellt, weil sich hierbei das größte Steuerungspotential in Richtung energieeffizienter Gebäude bietet.

Die praktische Anwendung der Zertifizierungssysteme haben Schwächen und Stärken zutage treten lassen. Die praktische Anwendung der DGNB Steckbriefe hat verdeutlicht, wie anspruchsvoll und komplex das Zertifizierungssystem für Neubauten ist. Ein zukünftiges Ziel muss es daher sein, die Kriterien nicht weiter zu erweitern sondern Vereinfachungen in der praktischen Umsetzung möglich zu machen, ohne gleichzeitig die anspruchsvollen Ziele aus den Augen zu verlieren. Die praktische Anwendung des klima:aktiv Bewertungssystems hat gezeigt, dass das nachhaltige Gebäudebewertungssystem sehr einfach umgesetzt werden kann. Ziel dieses Systems muss es sein, die Anforderungen zu verschärfen, damit von einem zukunftsweisenden und nachhaltigen Gebäudebewertungssystem gesprochen werden kann.

Abstract

The building industry is a leading polluter and responsible for a negative environmental impact. The aim of sustainable building construction is to build and design high quality, economically efficient, environmentally friendly and resource saving buildings. Sustainable building rating systems are developed strategies for sustainable planning, constructing, using and recycling of buildings. These rating systems include a complete life cycle analysis. Therefore rating systems contain the assembly of building products and building processes as well as the cleaning, attendance and maintenance of buildings. Furthermore, sustainable building rating systems embrace possibilities for reconstruction and abilities for recycling. In German speaking countries criteria for building biology and ecology are embedded.

The following paper provides a review of existing national and international environmentally friendly and sustainable building rating systems as implemented/tested at the Austrian House within the 2010 Olympic Games in Canada. In addition, legitimate basic conditions are illustrated. This leads to the following specification of our central research question: Are these international and national sustainable building rating systems applicable or not? Furthermore, different approaches for integrating energy relevant and sustainable aspects in architectural competitions are presented because at this period the greatest controlling potential for energy saving can be reached. At the same time financial investment is low.

This paper tries to prove that an area wide appliance of sustainable building rating systems requires a reform in the building industry. As a consequence, this leads to integrated planning and to a consideration of operating costs, deconstruction costs and maintenance costs. Sustainable buildings differ from conventional buildings if real estate price appraisals develop a demand in the market. But in general sustainable buildings are not adequate to establish a market. Nevertheless, an increasing demand for sustainable building rating systems has come into existence. It was caused by an accentuation of legitimate basic conditions and an execution of international sustainable building rating systems by multinational companies.

1 Introduction

In Central Europe people spend 90 per cent of their lives within buildings.[1] Consequently, buildings not only represent an important branch of the economy, but are also a preferred place to stay. What is more, the building sector is crucial for the health of people and their environment.[2] We can all influence planners and architects so that oncoming generations can inherit an intact environment by saving energy, the reduction of unplanned settlements, the reduction of living space, the economical consumption of drinking water, the reduction of mobility, the utilization of renewable energy sources and intelligent heating technologies and the usage of environmentally friendly products and building materials.[3]

1.1 Motivation

The building sector is one of the main causers of mass flows and its negative consequences to the environment.[4] In the Austrian economy about a third of the entire consumption of raw materials is taken up by the building industry. About 40 per cent of the consumption of end-use energy go to room heating and hot water production. At the transformation of energy the combustion processes are responsible for the emission of environment effective gases like CO2.[5] In Germany 50 per cent of the waste disposal, 40 per cent of the demand for primary resources and energy and 30 per cent of greenhouse effect emissions can be attributed to buildings.[6]

About a third of the energy consumption in the EU is made up by services in connection with buildings. The European Commission deems it possible to achieve considerable savings in this field and to help reach the climate goals and the reduction of emissions that go with it by implementing stricter laws and by taking a series of measures. What is more, the dependency of the EU on energy supplies from non-EU members is on the increase, whereas the greenhouse emissions constantly rise. In the short run the EU only has minor options to influence the energy supply without endangering the security of it. However, the Community can affect the demand. Therefore the reduction of energy consumption by

[1] ETCP 2005

[2] GEISSLER 2007

[3] KOLB 2005

[4] GEISSLER et al. 2004

[5] BRUCK et al. 2002

[6] DGNB 2010a

improving the energy efficiency in the building sector is a logical consequence for the solution of both problems.[1]

This is why science and research have shown the significance of energy supply within the framework of the entire environmental protection. Meanwhile the political decision-makers have recognized the long-term benefits for all the parties involved and they have passed standards and laws. By implementing the elaborate environmental strategies the framework conditions for the building industry will be severely altered. Through environmentally friendly and sustainable planning, building, management and marketing ecological damage and costs can be reduced, the quality of the building can be improved and its value can be enhanced.[2]

Consequently, sustainable building aims at a high quality and ideational value of buildings and takes future developments into account. Sustainable development is divided into three dimensions: socially-, economically- and environmentally-compatible. As a result the buildings have to be constructed, renovated and managed according to these dimensions.[3] Sustainable building eases the burden on the environment, provides social benefits and supports the economy.[4] By implementing customised, regional products and services the local value added gets encouraged and the cash drain for imported goods decreases.[5]

To reach the aims of sustainable building political and independent organisations have developed methods. In Austria, for instance, a second economic package, which included thermal renovation was passed by the government. 100 million Euros of subsidies shall bring about a surplus value of 650 million Euros on additional investments and the money is supposed to contribute to the security of supplies. In doing so additional jobs are secured and about 5.3 million tons of CO^2 and 800 million litres of heating oil are saved.[6] Investments are also necessary in Germany. There the total costs for a 20 per cent reduction of emissions by 2020 amount to one trillion Euros.[7] In the USA 85 per cent of the future energy needs can be saved by an increase in efficiency in buildings. A national belief in sustainable and environmentally friendly building has the potential to create 2,5 million new workplaces.[8]

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[1] Europäische Union 2010

[2] BRUCK et al. 2002

[3] MINERGIE 2010a

[4] DGNB 2010b

[5] MINERGIE 2010a

[6] Austria Presse Agentur 2010

[7] DNGB 2010a

[8] USGBC 2010a

This market offers a good field of activity for the entire building and real estate industry. According to experts the certification of buildings plays a key role.[1]

In the past years the environmental pollution of buildings has been reduced and the user-friendliness has increased. However, the potentials in the fields of research and development as well as the spread and implementation of building concepts are by no means fully exploited. Extensive activities are in full progress to explore these working fields.

1.2 Research Question

The thesis covers an overview of existing national and international sustainability-oriented and environmentally friendly building rating systems. In addition the thesis deals with legal framework and building rating systems are applied based on the Austria House in Canada within the framework of the Olympic Games. The goal is to investigate the sustainability-oriented rating systems and to test the different national rating systems in practice. The social context of the thesis is reflected by the owners of buildings, planners and environmental public and private institutions, which apply or develop sustainable building rating systems.

The following research questions shall be answered:

- ✓ Which organisations have developed the investigated building rating systems and where are these organisations established?
- ✓ How do the rating system categories and certification processes differ in the various countries and which similarities do they share?
- ✓ Which legal regulations have been introduced to support the spread of sustainable buildings?
- ✓ Why are there two rivalling building rating systems in Austria and how do they differ in practice?

[1] FAZ 2010

- ✓ How do the interviewed experts answer the non-standardized interview guidelines to the topic of sustainability-oriented building rating?

The following results are aimed at:

- ✓ to provide a detailed overview of approved international and national building rating systems
- ✓ to provide a detailed overview of existing and future standards and laws
- ✓ to show the differences of the two national building rating systems (ÖGNB and ÖGNI) on the basis of their practical application
- ✓ to give recommendations and conclusions for a spread and the networking of the Austrian systems with the help of experts.

1.3 Methodology

This paper is based on extensive academic studies, literature and internet research as well as a substantial knowledge and practical experience of the building industry. The work focuses on the analysis of Austrian and German sustainable building evaluation systems and its involved practice oriented certifications of the Austria House in Whistler, Canada. Also introduced are internationally accepted special building systems from the United States, Great Britain and Switzerland.

In addition to my literature and internet research, expert interviews have been conducted. "Expert interviews are existent to create area- and object-specific statements. The interviews are not meant to analyse any base rules of social action, nor meant to break down universal constitutive structures".[1] The content of the interview deals with subject-specific experiences in the building and estate industry.

„The chosen expert should be in charge of the draft, the implementation or the control of the task, or should have a privileged access to information on relevant groups of people or decision processes.[2]

A decisive factor for selecting an interview partner, was a long time experience, as well as a managerial position in the building and estate industry. The below listed experts have been interviewed and are listed in alphabetical order:

[1] BOGNER et al. 2005

[2] BOGNER et al. 2005

Geissler, Susanne, Dr. Mag.: Austrian Energy Agency, director of the business area „Gebäude und Raumwärme“ (building and space heating) , person responsible for developing the building rating system klima:aktiv, board member of the “Österreichische Gesellschaft für Nachhaltiges Bauen“ (Austrian Society for sustainable building).

Kaufmann, Philipp, MMag.: Lentia Immobilien Philipp Kaufmann. Founding president of the ÖGNI, internationalisation representative of the DGNB system, staff member of a research institute for construction and real estate (Vienna University of Economy), president of the “Bauträgerverband“ (property developer society).

Kernöcker, Robert, Prof. Mag.Dipl.-Ing.: Land Oberösterreich (Upper Austria) – “Abteilung Umweltschutz“ (Department of Environmental Protection), head of department building physics and teacher at a higher technical college for construction and design in Linz (Upper Austria).

Lützkendorf, Thomas, Prof. Dr.-Ing. Hab.: University of Karlsruhe (TU), faculty of economics, Endowed Chair of economy and ecology housing, DGNB founding member and member of staff of the German Federal Ministry of Transport, Building and Housing.

Sabo, Manfred, Dipl.-Ing., HR: Land Oberösterreich (Upper Austria) – Department of environmental, building und planning technology. Head of department for the development of expert opinions for buildings promoted by the province of Upper Austria.

For a methodological approach, a non-standard guided interview is provided. These interviews consist of predefined topics and a list of questions. The interview guideline comprises questions that need to be answered in each interview. Neither the phrasing of questions nor the order are binding, however.

„The interviewer’s prepared list of open questions forms the basis of the conversation.[1] This form of interviewing is recommended when precise and individual sets of information are needed.“[2]

The interview guideline comprises the following issues:

- ✓ The first certifications have already been carried out. To what extent has the respective society arrived at the real estate market and which feedback does the company have?
- ✓ Does the cooperation and collaboration between all respective organisations and ministries work well?

[1] GLÄSER, LAUDEL 2006

[2] GLÄSER, LAUDEL 2009

- ✓ How much importance would you attach to marketing in the context of the certification system?
- ✓ How can sustainability already be anchored in the tendering process for a building so that a maximum range of organic, economic and social sustainability can be achieved?
- ✓ Which strong/weak points does the certification system have?
- ✓ What is your stance concerning the internationalization of certification systems?
- ✓ Dealing with sustainable building rating systems in Austria, unlike Germany, there are two existing organisations. What do you think of this current development?
- ✓ Sustainable building ratings are booming. Can this development pervade all of our society?

For the evaluation of a sustainable content analysis, electronically stored recordings have been transcribed. According to Meuser/Nagel[1] the text material will be summarised retrospectively by placing different headlines. Similar or identical topics are merged. The aim is to create a theoretical generalisation, which is suitable for empirical corporate know-how. Newly gained generalisations limit the analysis at hand. On the other hand, they allow to take up an opposite viewpoint and underpin certain points of my work. The utilized interview sections are written in italics.

1.4 Technical Terms

In the following chapter of this thesis frequently occurring technical terms are explained.

1.4.1 Sustainability in the Building Industry

The framework for the future of the building industry can be described with the term sustainability. At the UN conference the mission statement of sustainability was established at a political level[2] and the English term ‘sustainable development’ became the catchword for the combination of economic, ecological and socially acceptable development worldwide. The centre of this insight is that social responsibility, economic efficiency and the protection of the environment are inextricably linked. The German translation of sustainability with ‘Nachhaltigkeit’ goes back to forestry in the 18th century.[3] Today a sustainable development in the building industry is desirable It should meet the needs of the present generation

[1] GLÄSER LAUDEL, 2006

[2] UNCED 1992

[3] KOLB 2005

without restricting the possibilities of coming generations which would also like to satisfy their *own needs.*[1]

'A sustainable rating system is efficient when it has an effect in reality.'

(Geissler, June 2010)

'The knowledge of sustainable building and the advantages of sustainable building have not been established in society. To be precise, we have not come that far as to employ these criteria at architectural competitions.'

(Kernöcker, June 2010)

'We must ask ourselves the following fundamental question: If sustainable building, the way we imagine it, was implemented would the steering effects and the potential savings suffice to be able to achieve the superior goals? How many buildings must be certified with gold or silver to reach the Kyoto goals or possible successor protocols?'

(Kaufmann, June 2010)

1.4.2 Sustainable Buildings

The borderline between environment-oriented and sustainable building rating systems tend to become blurred; hence the term „Green Building“ can be equated with „Sustainable Building“ as well. As shown in the table 1-1 below, a sustainable building in the building industry includes all three dimensions of sustainability, as originally the term „environmentally friendly“ only represented the impact of the environmental media (e.g. ground, air, water).[2]

[1] Vereinte Nationen 1987

[2] GEISSLER 2008

Table 1-1: The three dimensions of sustainability in the building industry (source: author's design based on DGNB, 2010a)

The Dimension of sustainability	Economic Sustainability	Ecological Sustainability	Social & cultural Sustainability
quantifiable methods/criteria/indicators for evaluation	life cycle analysis of: ✓ building costs ✓ utilization costs ✓ reinstatement costs	- resource conservation - minimization of environmental impacts - indicators (e.g. primary energy requirement, acidification potential, greenhouse gas potential)	- accessibility - aesthetics and design - health and comfort

In the recent years, many terms in line with market and marketing have been developed to characterize the key features of buildings. These concepts were planned as a result of the oil crisis in the 1970s. Today the reduction of the energy consumption and the closely connected reduction of CO2 emissions are central issues. The use of definitions like low energy house, lowest energy house, passive house, zero energy house, energy self-sufficient house or plus energy house describe the quality of sustainable buildings, but also lead to confusion.[1] Table 1-2 gives an overview of types of sustainable buildings:

Table 1-2: Overview of types of sustainable buildings (source: author's design based on Kolb, 2005)

type of building	features of the building
low energy house	- fall below the technical requirements - energy category B: ≤ 50 HWB in kWh/m^2a[(a)]
Lowest energy house	- fall below the technical requirements - energy category A+: ≤ 25 HWB in kWh/m^2a[(a)]
passive house	- highly insulated building frame - highly insulated windows - electrical ventilation system with heat recovery
zero energy house = energy self-sufficient house	- further technical development of a passive house - balance between supplied and produced energy
plus energy house	- building standard of a passive house - energy surplus with the help of renewable energy sources - energy surplus induced in public system

[1] LÜTZKENDORF s.A.

1.4.3 Sustainability-oriented Building Rating Systems

With the implementation of the EU directive concerning the energy efficiency[1] of buildings, the awareness for an indispensable CO2 reduction[2] and the introduction of energy certificates the assessment of energy efficiency of buildings has increased in importance. Simultaneously, the conditions for the presentation and assessment of the energetic quality have been improved and the economic, ecological and health relevant advantages have been better conveyed to the user of the building. This has contributed to an emergence of a variety of sustainable building systems. A sustainable building rating system can be described with strategies for energy-saving, environmentally friendly and health-conscious planning, building and utilization. In the German-speaking countries more and more building ecological and building biological concepts are included in the rating system. A sustainable building rating system takes the entire life cycle into account and thereby also the manufacturing of building products and processes as well as the cleaning, maintenance and upkeep of buildings.[3] The possibility for dismantling and easy recycling of the constructions is included with regard to the assessment of processes at the end of the utilization phase. But location aspects such as facilities for recreation in the surrounding area are also taken into consideration.[4]

2 Objectives of a Sustainable Building Rating System

The building industry takes up more than 40 per cent of the demand for resources. The consumption of non-renewable energy sources for the heating of buildings and the associated rise of CO^2 into the atmosphere accelerates the anthropogenic climate change. Against this backdrop, the Enquete-Commission ‘Protection of Man and his Environment’ (a non–partisan work group employed by the German Bundestag or by the Federal States) has defined five important objectives for the building industry[5]:

[1] Richtlinie des Europäischen Parlaments 2002

[2] Vereinte Nationen 1997

[3] LÜTZKENDORF s.A.

[4] GEISSLER 2007

[5] KOLB 2005

- ✓ less land consumption
- ✓ termination of urban sprawl
- ✓ less soil sealing
- ✓ conservation of resources when constructing and operating buildings
- ✓ avoidance of pollutants when erecting new buildings, rebuilding and utilizing buildings

In principle, rating systems follow superior construction related aims. An environmentally friendly building rating system aims at promoting positive effects for the society and nature by erecting and utilizing buildings and minimizing negative effects.[1] The aim of sustainable construction is to plan and construct high-quality, economically efficient, environmentally friendly resource-saving buildings. Thus sustainable buildings maintain a high value for investors and users.[2]

In order to follow the three-column system of sustainability ecological, economic and social goals are incorporated into sustainable building rating systems. Major ecological objectives are the protection of the basics of human subsistence soil, air and water, the protection of nature and landscape, the protection of material and energetic resources and the protection of the world climate.[3] Exemplary economical intentions are the increase of value creation in one's own country and the reduction of energy and maintenance costs of sustainable buildings. Social objectives are the protection of human health, the rise in quality for users and the preservation of social and cultural values.[4] Examples for a measurable socio-cultural and functional quality are, for instance, the improved performance by users of buildings. Studies have proven, for example, that the performances of pupils increase in school buildings with a high interior quality and the performance of employees in office buildings has improved by 16 per cent.[5]

Sustainable building endeavours to minimize the consumption of energy and resources as well as to burden the ecosystem as little as possible in all the phases of the life cycle of buildings.

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[1] DGNB 2010c

[2] DGNB 2010b

[3] Vereinte Nationen 1987

[4] Bundesministeriums für Verkehr, Bau- und Wohnungswesen 2001

[5] DGNB 2010a

The objectives of sustainable building can be reached by the following measures:[1]

- ✓ the lowering of the energy demand and the consumption of operating equipment
- ✓ avoidance of transport costs and building material and components
- ✓ use of recyclable and re-useable building products / material
- ✓ life-time extension of products and building constructions
- ✓ safe recirculation of material into the natural material cycle
- ✓ extensive conservation of natural environment and making use of possibilities for area-saving building covering all of the process chain

'Do the objectives still fit? Resource conservation, input-output goals, effects on the people, distributive justice – all these aims must be kept in mind. How strict do I set these goals? At the present building rating systems these objectives, for instance the CO^2 reduction, are too little weighed and assessed' (Geissler, January 2010).

'But CO^2 and energy are issues and developments go in the direction that CO^2 will be reduced and the input of resources will be reduced. We are on the right track but the absolute objectives are probably too weak. But you have to bear in mind that we are in a transition of systems. We want to emit extremely little toxic substances, emit extremely little CO^2 and use up extremely few resources. But we are at a stage where this is not the case yet and a lot of toxic substances are emitted. Along this way we have to move gradually to be able to get from A to B (Geissler, January 2010).

The quality requirements for sustainable building ratings are diverse because of national circumstances and legislation. This is the reason why specific goals of sustainable building rating systems are quite different. While one building rating focuses on the reduction of the energy consumption, another one, with a contrary outlook, concentrates on the use of ecological building materials. As a consequence, the formulation of objectives influences the description of criteria and the operationalization of specific values which have to be fulfilled with regard to individual indicators.[2]

By a database and the rating result of a sustainable building rating system different objectives can be obtained and might serve as an incentive to use a national or international building rating system. The following objectives favour the application of sustainable building rating systems[3]:

- ✓ A rating provides proof of a reduced recycling risk, which leads to better financing conditions

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[1] Bundesministeriums für Verkehr, Bau- und Wohnungswesen 2001

[2] LÜTZKENDORF 2009a

[3] GEISSLER 2009

- ✓ An assessment of ecological and economical alternatives is the basis of a life–cycle optimization in the planning phase. The assessment of an alternative planning variant highlights the optimization measures at a building process.
- ✓ A quality control at the planning phase and during construction shows whether the planning objectives were really carried out during the construction phase.
- ✓ Building ratings provide technical assistance for the planning processes.
- ✓ The facility management, within the framework of an assessment by juxtaposing the planned potential with the actual 'performance of a building', can point out possible improvements in the utilisation phase.
- ✓ Real estate expert opinions are included in the assessment of the recycling risk.
- ✓ In the course of an assessment technical checks can be applied at a due diligence process of buildings and at the purchase and sale or real estate.
- ✓ Information gathered from building ratings support portfolio and asset manager in setting priorities concerning investment decisions.

Building assessors can also promote impressive buildings or they can be part of a corporate culture which strives for long-term, sustainable improvements in quality for man and the environment. Therefore the implementation of sustainability-oriented rating systems is advantageous if:

- ✓ The building ratings serve as a strategy for the Customer Relationship Management (CRM), which uses energy-efficient and climate-friendly methods for market communication in a profitable way.
- ✓ Businesses contribute their bit for a sustainable economy in the context of a Corporate Social Responsibility Strategy (CSR). Building assessments contribute to informing the public by environmentally friendly and sustainable measures.

3 Regulatory Framework

The building industry is a fundamental component to satisfy people's requirements. All kinds of buildings and the appropriate infrastructure have ecological and economical impacts on humans and their environment. Hence technological assistance is developed for an assessment and benchmarking of sustainable buildings. Guidelines, databases and checklists are created for a better and more integrated planning in the building industry. But these methodical and data-technological basic principles, these applied indicators and criteria differ from each other and have regional and national distinctions. As a consequence there is a need for an international or European standardization to secure quality, transparency and traceability of the underlying technical documentation and the subsequent sustainable building assessment.[1]

Standardization is the process of developing and agreeing upon technical standards. A standard is a document that establishes uniform engineering or technical specifications, criteria, methods, processes, or practices for the industry and society. The specification of legitimate standards takes places in the standardization process. Environmental associations, industries, public authorities, labour unions and sciences are making decisions by consensus and are working by choice.

Essential is the international standards project **ISO/TC 59/SC 17 "Sustainability in building construction"[2]** These standards form the basis for the European standards project **CEN/TC 350 "Sustainability of construction works"**[3]. These concepts lay down the details of generating and assessing sustainable constructions and the initialization of basic principles for sustainable criteria and calculations. These standards projects deliver fundamentals for a characterization of environmentally and sanitarily relevant attributes to describe construction products. Therefore standardization is important for characterization, assessment and demonstration of environmental quality of buildings.[4]

3.1 "Directives on Energy Performance of Buildings" (EPBD)

Miscellaneous standards organizations contributed with their work that **the Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings** was enacted.[5]

The main target is a common methodology for calculating the integrated energy performance of buildings. The standards calculate minimum standards on the energy performance of new buildings and existing buildings that are subject to major renovation and describe systems for the energy certification of new, existing buildings and for public buildings. Certificates must be less than five years old. In addition, regular inspection of boilers and central air-conditioning systems in buildings are prescribed. These technical regulations are valid for

[1] DGNB 2010d

[2] ISO/TC 59/SC 17 2004

[3] CEN 2010

[4] GEISSLER 2008

[5] Baunetz Wissen 2010

residential buildings and commercial interiors and have to produced at the sale, purchase and leasing.[1]

The implementation of the Directive on Energy Performance of Buildings was delayed in the European member states until 2009. Based on gathered experiences the European Union has decided to amend the EPBD guideline in 2010. European member states have to implement the new and amended directive into national law. Considerable technical innovations and modifications are presented in the table 3-1 Amended Directive on Energy Performance of Buildings.[2]

Table 3-1: Technical innovations and modifications of the amended *Directive on Energy Performance of Buildings* (Source: Modified from Tuschinsky, 2010).

Technical innovations and modifications of the EPBD-directive	Detailed Information for the change of EPBD-directive
Almost zero-energy buildings will be standard	✓ Minimization of heating energy, domestic hot water, air conditioning and cooling by 2020 ✓ Energy from renewable energy sources ✓ Energy generated at the location or close by
Purchaser and landlord have to show the Energy Performance Certificate	✓ EU-directive reduces the floor area to 500 square meters ✓ Energy Performance Certificate in to-be-sold and rental advertisements ✓ Energy Performance Certificate in hotels, cinemas and shopping centres
Energy Performance Certificate establishes ties to energy consulting	✓ Contain recommendations for modernisation ✓ Contain recommendations for feasible technical energy-saving methods to increase energy efficiency ✓ Estimation of the payback period or cost benefits during its economic life time
Energy Performance Certificate is legally binding	✓ Article11/ Point 6.: “At possible court proceedings the national law will be applied as to the effects of these certificates."
Energy efficient buildings create new chances for professionals	✓ Multiple challenges and chances for work related to energy services and certificates

[1] Europäische Union 2010

[2] Tuschinsky 2009

3.2 International Standard ISO/TC 59/SC 17 “Sustainability in Building Construction“

The International Standard Organization (ISO) develops standards for sustainable buildings. Therefore ISO creates a standardized regulatory framework for the global market in order to consolidate sustainability in the building industry. Table 3-1 presents the classification of the specific working groups. Working group 1 worked out the details for particular principles of sustainable buildings above ground level. The Swedish Institute of Standardization was involved to a large extent and headed work group one until it was terminated. Finally, the international standard "ISO 15392:2008 Sustainability in building construction - general principles" was published.[1]

Table 3-2: Overview of the international standard “Sustainability in building construction (Source: Modified from ISO/TC 59/SC 17)

Standard	Description
ISO/TC 59/SC 17	**Sustainable Buildings**
ISO/TC 59/SC 17/WG 1	General principles and terminology
ISO/TC 59/SC 17/WG 2	Sustainability indicators
ISO/TC 59/SC 17/WG 3	Environmental declaration of products
ISO/TC 59/SC 17/WG 4	Environmental performance of buildings
ISO/TC 59/SC 17/WG 5	Civil engineering works

Working group 2 developed a list of indicators for an acquisition in the building sector. In activity area 3 a regulation for the draft of a type-III-declaration was worked out. All building products shall be included in the environmental declaration, from materials to complex building components. Complex components are fitted together by simple declarations of building materials and components. Finally, these components are connected to buildings. The Norwegian Standardization Institute took the lead and the standard "ISO 21930:2007 Sustainability in building construction - Sustainability indicators - Part 1: Framework for development of indicators for buildings” was published. In working group 4 the assessment of sustainable buildings was composed. Sustainable indicators and environmental declarations of products were incorporated into the buildings assessments. Working group 5 dealt with the question of whether civil engineering works cover the standardization of other working groups or whether new standardization methods have to be developed. [2]

[1] ISO 15392, 2008

[2] DGNB 2010e

The three pillars of sustainability – economy, environment and social issues – are crucial for assessing sustainable buildings in the standardization process. The foundations for the formation of environmental compatibility are life cycle assessments and cycle inventories. The minimal requirements for sustainable building rating systems are taken into consideration by ISO TS 21931.

3.3 European Standard CEN/TC 350 “Sustainability of Construction Works“

CEN (Comité Européen de Normalisation) is the European Organization of Standardization. National member of CEN representing Austria is the Austrian Standards Institute (ÖNORM). European Standardization Institutes establish sub-committees which deal with the development of standards in the building industry. National standardization bodies support these sub-committees by delegating experts to those different supranational working groups.[1]

Table 3-3 gives an overview of European standardization projects[2]. Associated standardization organizations (representatives from industry, society and environment) obtain information about European standardization projects directly from technical committees. Once again the technical committee is divided into five working groups and consists of 30 national members and consultants of the European Union Commission or of the European Free Trade Association (EFTA). Its aim is to provide a unified body of standards. The CEN-members have to adopt European standards as national standards.[3]

The aim of CEN/TC 350 is to provide a unified method for assessing the environmental building performance and to develop its life cycle costs. Furthermore, the purpose is to provide a framework with principles, requirements and guidelines to support the sustainable assessment of construction works. The standard can be used to give a general description for quantifiable health conditions and rules for thermal comfort in buildings.[4]

[1] DGNB 2010e

[2] DGNB 2010f

[3] DGNB 2010e

[4] GEISSLER 2008

Table 3-3: Overview of CEN/TC 350 (Source: Modified from DGNB, 2010f)

Standard	Description
CEN/TC 350	**Sustainability of construction works**
CEN/TC 350/WG 1	Description of the environmental performance of buildings and the use of environmental declaration of building products
CEN/TC 350/WG 2	Life cycle of buildings - description
CEN/TC 350/WG 3	Description, communication and data basis for environmental quality of building products
CEN/TC 350/WG 4	Description of economical quality of buildings
CEN/TC 350/WG 5	Description of social quality of buildings

3.3 Overview of German, European and International Standards and Standardization Projects[1]

"I hope that market forces of international and European standardization induce a description of essential characteristics. We have to define what is good or bad sound insulation or heat insulation. There are still different opinions for an assessment of sustainable buildings because different groups evaluate those buildings. In order to fully trust a seal of a system it is necessary to find out about its standard of assessment and its socio-political dimensions " (Lützkendorf, November 2009).

[1] DGNB 2010g

Table 3-4: German, European and International produced standards and standardization projects (Source: Modified from DGNB, 2010f).

Standard	Designation	Issue	Published
DIN EN 15804	Sustainability of buildings	- Environmental product declaration -	04/2008
DIN EN 15804		- Standards for product categories	09/2006
ISO 15392	Sustainability in building construction	- General principles	05/2008
ISO/TS 21929-1		- Sustainability indicators - Framework for development of indicators for buildings	05/2010
ISO 21930		- Environmental declaration of building products	10/2007
ISO/DIS 21931-1		- Framework for methods of assessment for environmental performance of construction works	06/2010
prEN 15643-1	Sustainability of construction works - Integrated assessment of building performance	- General framework	08/2008
prEN 15643-2		- Framework for the assessment of environmental performance	06/2008
prEN 15643-3		- Framework for the assessment of social performance	04/2008
prEN 15643-4		- Framework for the assessment of economic performance	06/2008
WI 350005	Sustainability of construction works	- Description, communication and data basis for environmental quality of building products	05/2007
WI 350006		- Use of environmental declaration of building products	05/2007
WI 350007		- Life cycle of buildings - description	05/2007
350011 (TC 350 WI 011:2009)		- Assessment of environmental performance - Calculation methods	06/2008

Table 3-4 presents European and international standards as well as German standards. Sustainability in civil engineering was initiated by the German standards committee building industry. They founded the working group "NaBau" (Normenausschuss Bauwesen) and are working on new environmental product declarations and new calculation methods for sustainable buildings.

"Care should be taken to ensure highest possible conformity with standards at European level. Of course, committees have to make continuous amendments and adjustments. An optimal sustainable building rating system has a world wide accepted standard which could be managed by the International Organization for Standardization (ISO). The aim should be that at least Europe should have a standard rating scheme" (Kernöcker, Juni 2010).

3.4. National Standards and National Standardization Projects

The table 3-4 indicates Austrian standards and standardization projects. Standards are produced by the Austrian Standards Institute (ASI). The institute is bound by the Federal Act on Standardization (BGBl. Nr. 240/1971). In Austria their designation is ÖNORM and ON-rules.[1]

Table 3-5: National standards and national standardization projects (Source: Modified from Wirtschaftskammer Niederösterreich, 2009).

Standard	Designation	Issue	Published
ÖNORM EN 15643-1	Sustainability of construction works	- General framework - Assessing the sustainability of buildings	05/2009
ÖNORM EN 15643-2		- Framework for assessing environmental quality - Assessing the sustainability of buildings	05/2009
ÖNORM EN 15942		- Environmental product declaration - Communication formats between enterprises	06/2009
ÖNORM EN 15804		- Environmental product declaration - Standards for product categories	06/2008
ÖNORMEN 15978		- Determining environmental quality of buildings - Calculation methods	09/2009
ÖNORM H 5055	Energy Performance Certificate	- Energy performance of buildings	05/2006
ÖNORM B 6400	Exterior wall/ Thermal insulation/ composite system /	- Planning	03/2009
ÖNORM B 8110-5 Bbl 2	Thermal insulation in buildings	- climate model and using profiles	04/2009

3.5. Implementation of EU Directives at National Level

The implementation of EU directives at national level in Austria falls under the line of duty of the federal states. Therefore the area of responsibility, application, basics and principles of energy performance certificates are governed by federal state laws and energy performance certificate laws.

[1] Wirtschaftskammer Niederösterreich 2009

The Austrian Institute for construction technology (Institut für Bautechnik – OIB) set up working groups.[1] These task forces standardize and harmonize the technical building quality. Finally, they provided a national framework, the so-called OIB-directive. Different approaches for sustainable building certification are integrated with statutory requirements for energy efficiency in the “2002/91/EG Directive on Energy Performance of Buildings - EPBD".[2]

The OIB-directive 6 „Energy Saving and Heat Insulation” implement the EU-directive in article 3-6 and parts of article 7. The OIB-directive defines statutory minimum standards for energy efficiency, describes minimum requirements for individual components and contains the design and the content for energy performance certificates. Based on the OIB-directive and its defined calculation methods it is possible to check the compliance for energy performance indicators (OIB-calculation guideline “Energietechnisches Verhalten von Gebäuden”).[3]

“A fundamental strategic question is if everything must be inforced by law. Our system has no legislative regulation on sustainable building rating systems. In particular, the complex system of sustainability cannot be inforced by law”

(Kaufmann, June 2010).

[1] Bacher 2007

[2] EPA-ED 2004

[3] Land Öberösterreich 2010a

4. Sustainable Building in the Planning Phases for Public Buildings of the Federal State of Upper Austria

The next chapter focuses on three different approaches for an integration of energy relevant and sustainable aspects in architectural tenders. Architects and planning technicians in the building industry attempt to integrate new resolution methods for a fast and cheap integration of energy relevant and sustainable aspects.
Architectural tenders are the best way to design frameworks for exemplary, trendsetting and economical buildings. Here, architects find the highest control potential for energy efficient buildings and, at the same time, reduced costs.[1]

„At present the application of sustainable building rating systems is no issue in tendering processes. Certainly the department supports the corresponding developments by involving sustainable criteria into our deliberations and assessments. In principle, it is difficult to restrict certain building materials because we are interfering into the principles of the free market. In addition the procurement law does not satisfy the essential requirements"(Sabo, June 2010).

4.1. Specification of the Federal State of Lower Austria

The specification was published in 2008 by the Federal State of Lower Austria. The guideline contains energetic and ecological requirements for planning, construction and operating of stated owned buildings and its maintenance. The main objective of the specification is a reduction in energy consumption thus bringing about a significant reduction in CO_2-emissions of state-owned buildings. Measures implemented must also be accompanied by cost effectiveness. The successful implementation of the requirements is monitored and documented with the help of the energy accounting system for state owned buildings.[2]

The specification defines requirements, criteria, target and maximum values for new buildings, extensions of buildings, additional buildings and renovations. The compliance with these standards is obligatory. Target values must be submitted arithmetically to calculate planning standards and correspond to the state of the art technology. Maximum values must not be exceeded at full capacity, taking into consideration calculation methods.[3]

[1] Treberspurg 1996

[2] Land Niederösterreich 2008

[3] Land Niederösterreich 2008

4.1.1. Overall Assessment of State-owned Buildings

The following table shows heating requirements of target and maximum values for various state owned buildings. Furthermore, new buildings and renovations have to be planned in such a way that cooling requirements should not be necessary. These criteria are satisfied if ÖNORM B 8110-3 is proven and overheating in buildings is avoided. It is worth noting that building-specific energy expenses can be optimized but user behaviour cannot be planned. The heating requirements are determined by calculations and measurements which quantities of heat have to be supplied to ensure a given temperature in rooms in the long time average.[1]

Table 4-1: Heat requirements for public buildings (Source: Modified by the Federal State of Lower Austria, 2008)

Use of buildings	Heat requirement Target value = planned value in kWh/(m^2a)		Heat requirement Maximum value = operation of buildings in kWh/(m^2a)	
	New building	Renovation	New building	Renovation
Office buildings	80	100	90	170
Administrative buildings	110	130	130	150
Schools	80	100	140	170
Students' hostel	80	110	90	130
Nursing homes	80	110	90	130
Hospitals	130	160	145	180

The annual CO_2 emissions are determined by the heating requirements during operation. While renewable resources such as firewood, wood pellets, wood chips are CO_2 neutral (determined factor 0), electric energy at annual average (0,268), natural gas (0,2), heating oil light (0,28) have higher emission factors and contribute to additional anthropogenic CO_2 emissions.[2]

[1] Land Niederösterreich 2008

[2] Land Niederösterreich 2008

For a public building, which is in operation, building-specific power requirements have to be optimized in the planning phases. Energy figures within the limits of target and maximum values must be observed. Table 4-2 includes the lighting energy requirement for the relevant state-owned buildings.[1]

Table 4-2: lighting energy requirement for state-owned buildings (Source: Federal Government of Lower Austria, 2008)

Use of buildings	Lighting energy requirement in kWh/(m^2a)	
	Target value	Maximum value
Office buildings	7	15
Administrative buildings	7	15
Schools	7	15
Students' hostel	7	15
Nursing homes	7	15
Hospitals	7	20

4.1.2. Planning and Construction of Buildings

The Lower Austrian specification in particular includes reaching the planned energetic targets. Furthermore, the implementation of measures has to be economic efficient and environmentally compatible. Particular attention is paid here to minimize the total costs. Thereby the focus should primarily be on operating costs and life cycle costs of buildings. These costs arise for building users over a long time period. Planning goals have to be provided for competition phases. The composition of the council consists of suitable experts, who assess the targets of the specification. The following aspects should be noted for planning and constructing public buildings in Lower Austria:[2]

[1] Land Niederösterreich 2008

[2] Land Niederösterreich 2008

- ✓ A building is integrated harmoniously into its environment and considers energy relevant criteria by an optimal location of the building.
- ✓ Minimize soil sealing of outer surface and use land as far as it is necessary for operating a building.
- ✓ The impermeability for buildings has to be proven by a „blower door test". A blower door test measures the air tightness of buildings with mechanical ventilation. The measured recirculating air flow at a pressure differential between interior and exterior 50 Pascal (PA = N/m^2) must not exceed the target value of 0,6/h and the maximum value of 1,0/h. Air conditioning technology with heat recovery has to be installed for different types of buildings and provides a pleasant indoor environment for the end customer.
- ✓ Thermal comfort for buildings has to be proven by ÖNORM B 81103. Thereby the appearance of radiation through glass surfaces, the effects of shading systems, the extent of natural ventilation and the energy storage mass have to be measured.
- ✓ Target and maximum value for the proportion of glass surfaces must not exceed 20% or 30% of the façade area.
- ✓ If new buildings, major renovations of buildings and major extensions of hospitals and nursing homes are carried out, standard solar systems have to be installed. For an appropriate sizing of energy requirements, solar plants have to meet 50% of the water heating demand.
- ✓ The heat supply may be implemented with biogenic fuels. Only then should the proportion of biogenic fuels be at least 90%.
- ✓ In the planning phases water-saving sanitary fittings and sanitary installations have to be integrated. The use of well water for the irrigation of green areas has to be preferred.
- ✓ Units of rooms (zones) for an energetic and effective interior design with equal temperature requirements have to be created.

A new approach is presented, which illustrates the cost factor for a façade area. Thus these costs are made visible in running operating costs. In the course of the design of building shells an approach of operating costs over the period of use must be presented.
Table 4-3 shows investments/maintenance costs in non-current assets for facades over the period of use.[1]

[1] Land Niederösterreich 2008

Table 4-3: Maintenance costs over the period of use for various facades (Source: Modified from Land Niederösterreich, 2008)

Type of facade	**Maintenance costs over the period of use in Euro/m²25a)**
Plaster facade	5
Curtain facade	
Wood treated	150
Wood untreated	3
Smooth surfaces	10
Glass surfaces	35
Rough surfaces	13

4.1.3. Operating Costs

For a calculation of operating costs engineers have to know about heating energy requirements. This figure consists of the heating requirements, which is an important parameter in the building industry, and the annual utilization factor of the heating system. The annual utilization factor is proven by ÖNORM VORNORM H 5056 and is subject to power and heat supply system, heat distribution system and heat emission system of a building.

Operating costs arise from heating, hot water preparation, interior and exterior lighting, air-conditioning, cooling and general use of electricity. Energy management systems and energy accounting systems must only be implemented if there are very complex facilities such as hospitals. Main meters have to be installed for heat supply, electrical energy and cold water supply from a local network. In the field of heating supply systems sub meters have to be installed for air-conditioning, hot water preparation and special heating circuits.[1]

4.1.4. Operational and Maintenance Procedures

An authorized person is designated to control energy relevant measures and technical equipment. It shall be guaranteed that measuring and regulation systems are functioning and

[1] Land Niederösterreich 2008

the adaption of the specific use of the building is ensured. The authorized person, who uses, maintains and operates with technical systems/plants/facilities of a building, has to attend basic training relevant to this technical field. Furthermore this person has to expand his or her knowledge in object-specific schoolings.[1]

4.1.5. Ecological Effects

By minimizing dangerous substances high ecological effects can be reached at relatively modest costs (for example by active environmental protection as it does not contain burdensome deposited building materials). Through prevention of PVC coating materials, harmful greenhouse gases and asbestos fibres in building materials high ecological effects can be reached with comparatively low effort in the planning phases. By the recycling of building materials according to the Waste Management Act 2002, using local wood, by dispensing of carcinogenic, mutagenic and toxic paints and varnishes a more sustainable environment can be created. [2]

4.2. Integration of Energy Relevant Aspects in Architectural Tenders (IEAA)

“I think you need interaction of different disciplines for integral planning. As a consequence completely different design possibilities open up. If there is no need for radiators in rooms anymore, this leads to an optimized efficiency of space. Planning architects are working with new approaches for greater efficiency of space and include new design drafts and planning drafts for ventilation systems. Technical components influence design components. You see that these items are interlinked with each other. Therefore, I am in favour of integrated planning. Integrated planning should be already considered in architectural tenders” (Kaufmann, June 2010).

„Of course it would be a good thing if there is a coordinator, who assesses planning drafts and supports documentation processes. From my own practical experience I can say that a theoretical integrated planning approach exists. This theoretical idea is not yet working in practice” (Kernöcker, June 2010).

The research project „Integration of Energy Relevant Aspects in Architectural Tenders“ (IEAA) is a part of the big research project “Energy of the Future”, which is financed by the Federal Ministry of Transportation, Innovation and Technology and the Federal Ministry for Economy and Labour. Project partners for the IEAA program are the Inter-University Research Centre for Technology, Work and Culture (IFZ) in Klagenfurt, the Institute of Thermal Engineering of Graz University of Technology as well as the working group

[1] Land Niederösterreich 2008

“resource-orientated construction” at the University of Natural Resources and Applied Life Sciences in Vienna.
The IEAA assessment tool determines quantitative energetic performance indicators. The competition projects are neither assessed nor ranked in the IEAA system. The tool can be used in the competition phases if it fulfils the following criteria[1]:

- ✓ Simple interpretability of results
- ✓ Low manual input for participants
- ✓ Wide variety of possible applications for different types of tenders and different types of real estate in competition phases
- ✓ Basic quantitative assessment of present projects for accurate evaluation
- ✓ Assessment in the course of the examination and thus an advance performance for the council session

Based on this an assessment tool and a procedure guideline in accordance with regulatory requirements (energy performance certificate according to EPBD) and practical suitability (expenditures for project development and competition proceeding) was developed. Besides, the common competition practice was analyzed in a first state-of-the-art report. The survey examined the atmospheric picture of architects and technicians concerning this topic.

The concept focuses on a broadly based implementation. Therefore the following important Austrian organizations are involved in the IEAA project[2]:

- ✓ Federal Chamber of Architects and Consulting Engineers Austria
- ✓ Architectural Department, Styria
- ✓ Federal Building Management Styria (Landesbaudirektion Steiermark)
- ✓ Healthcare company of Styria (KAGes)
- ✓ Residence Management of the Austrian Exchange Service (ÖAD)
- ✓ Federal Chamber of Real Estate Company (BIG- Bundesimmobiliengesellschaft)
- ✓ Austrian Federation of Limited-Profit Housing Associations

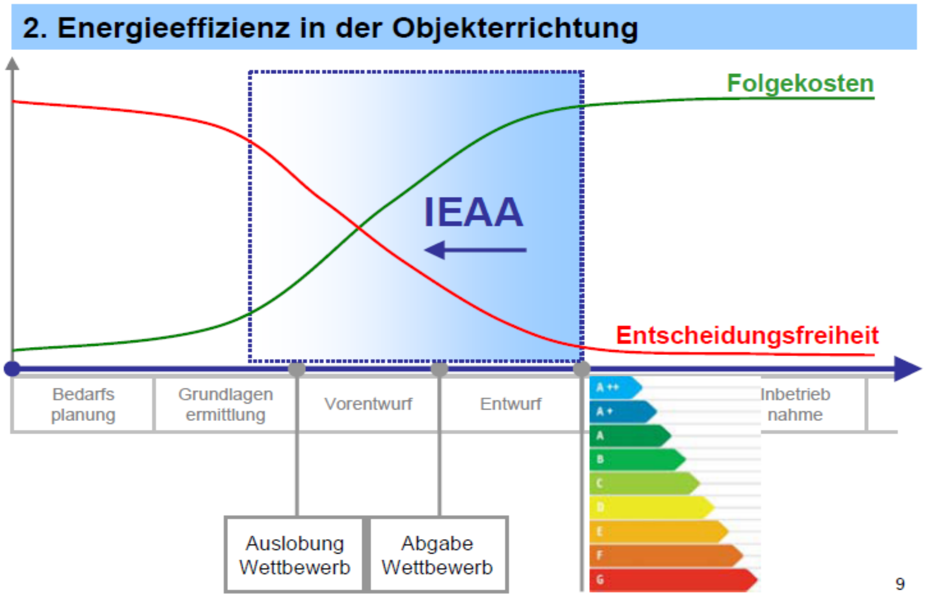
In project development phases and in the preliminary draft phase decisions have to be made by choosing the building technology or building insulation. Hence, the construction and its energy efficiency are influenced in these early phases. Inadequate compactness, disorientation of a building on lots, insufficient areas of glass leads to energy inefficiency. But

[1] Djalili 2010

[2] Smutny 2010b

planning errors can be avoided already at the beginning. If this is not done these mistakes can only be corrected with high financial expenses. This correlation is presented in the following illustration: During the planning process the freedom of decision making decreases while operating costs strongly increase in the course of the planning process.[1]

Illustration 4-1: Freedom of decision making und operating costs in the course of the planning (Source: Smutny, 2010b)



4.2.1. IEAA – Modules

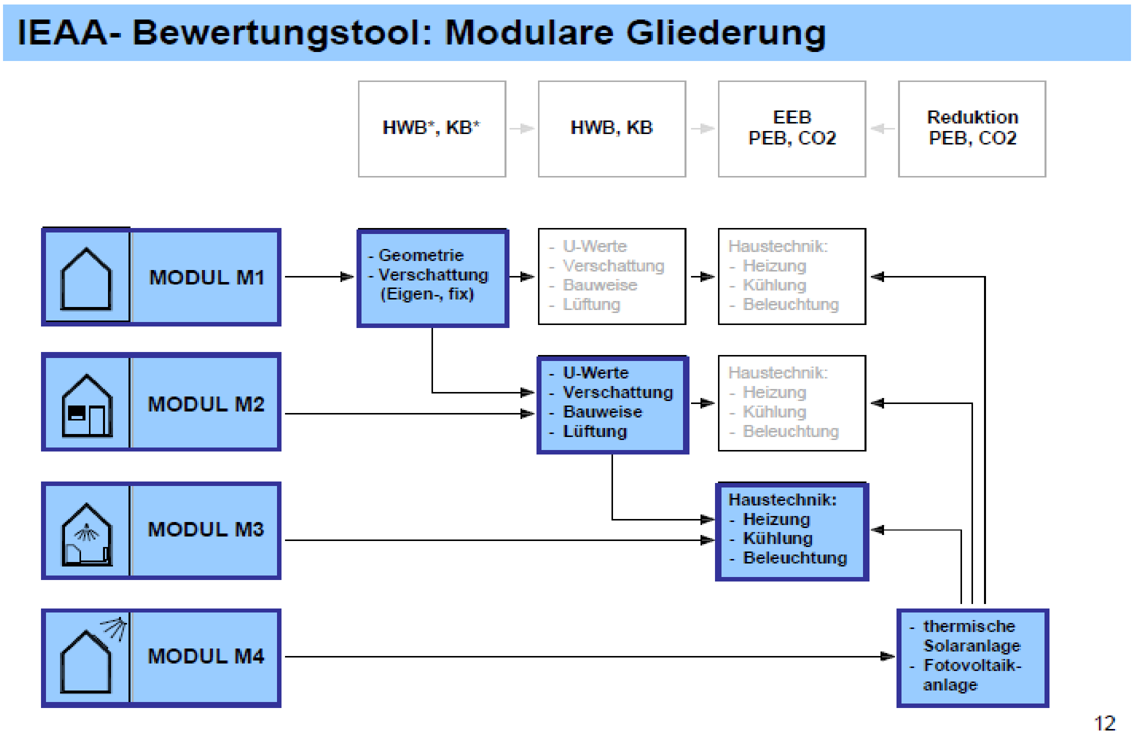
The program development started in 2009. The IEAA tool is based on valid calculation algorithms of the energy performance certification. The OIB training-tool has been taken as a basis for the development of the IEAA tool.[2] The training tool has been developed by Dr. Pöhn (municipal authority of the city of Vienna) and has been improved by Dr. Geyer (ENERTEC company) and DI Michlmair (Graz University of Technology) to provide new programme parts such as heat pump, cooling and ventilation. The modular structure divided into four modules enables flexibility and therefore the system is able to react more efficiently when different types of procedure and building tasks are inserted. In addition energy relevant objectives can be adopted for every kind of competition.

[1] Treberspurg et al. 2010

[2] Pöhn und Michlmair 2009

The IEAA-modules 1-3 are built on one another. Module 4 “Active use of solar energy” has been developed within the research project and can be integrated independently into other modules. Illustration 4-2 provides an overview of the IEAA – modules.[1]

Illustration 4-2: overview of the IEAA assessment tool (Source: Smutny, 2010b)



Module 1 „Building – Basic“ determines fundamental data of design elements such as the geometry of a building, shading or compactness. These parameters can be modified only at a very limited scale. This module will be sufficient for assessing a major part of an architectural bid.

Module 2 „Building – Deepening“ gives the possibility to consider aspects of an architectural project, which becomes obvious in the draft of technical design. The contestant has the chance to disclose the draft of the constructional conception in detail. Here, the heat transfer coefficient (U-value) of the thermal building shell, shading concepts, building design or ventilation concepts can be included in the assessment process. Module 3 “Building Services” is used to define and assess building services systems such as heating, cooling, lighting and ventilation of the draft, which can be expanded with renewable energy sources. Module 4 “Active use of Solar Energy” provides information about the returns of thermal

[1] Treberspurg et al. 2010

solar plants and photovoltaic systems. These systems are only roughly measured und are credited to the calculated values for the energy requirement of the basic modules.[1]

„For our department it would be an interesting approach to analyze buildings with the IEAA tool. Of course buildings should be comparable regarding data or size. Thus, participating persons can monitor these projects, run simulations and compare life cycle costs to reach an optimum between economic efficiency (construction and operational costs of a building) and ecological criteria for the environment" (*Sabo, June 2010).*

4.2.2. Support for Architectural Tenders and Application of the IEAA Excel - Tool

The IEAA tool calculates the energetic performance of architectural tenders. Furthermore selected architectural tenders were accompanied. Here architects and engineers have been supported by a research team. The IEAA Excel tool was used as evidence for energy efficient projects. This tool is can be downloaded for free by www.ifz.tugraz.at/index.php/article/articleview/1894/1/76/.[2]

The IEAA tool was organized jointly, had detailed invitation documents and was sent to the participants. After submission the spreadsheets and tables were filled out and returned for a plausibility check by a preliminary examination of the data input. The assessment was made with a specifically developed analysis tool. The comparative analysis of energy relevant aspects as well as main emphases and targets of architectures were presented by a jury. The examined competition projects display essential differences in achieved values.[3]

Experiences of accompanied competitions have shown that the limitation to module 1 “Building – Basic” has advantages. On the one hand they demonstrate an easier handling for preliminary examiners and participants of competition projects and on the other hand the present substantial decision aids for the energetic assessment of building drafts. This is justified by the fact that the proportion of window area, compactness and orientation of a building exclusively is incorporated into energetic efficiency. These three aspects are not related with additional costs. Module 2 “Building – Deepening” and Module 3 “Building Services” provides planners the possibility to recognize the effects of technical measures quickly and with less effort. These changes such as the use of different heating systems, using different energy sources or optimized device structures are presented in primary energy and final energy demand graphs in the following illustration. This illustration below

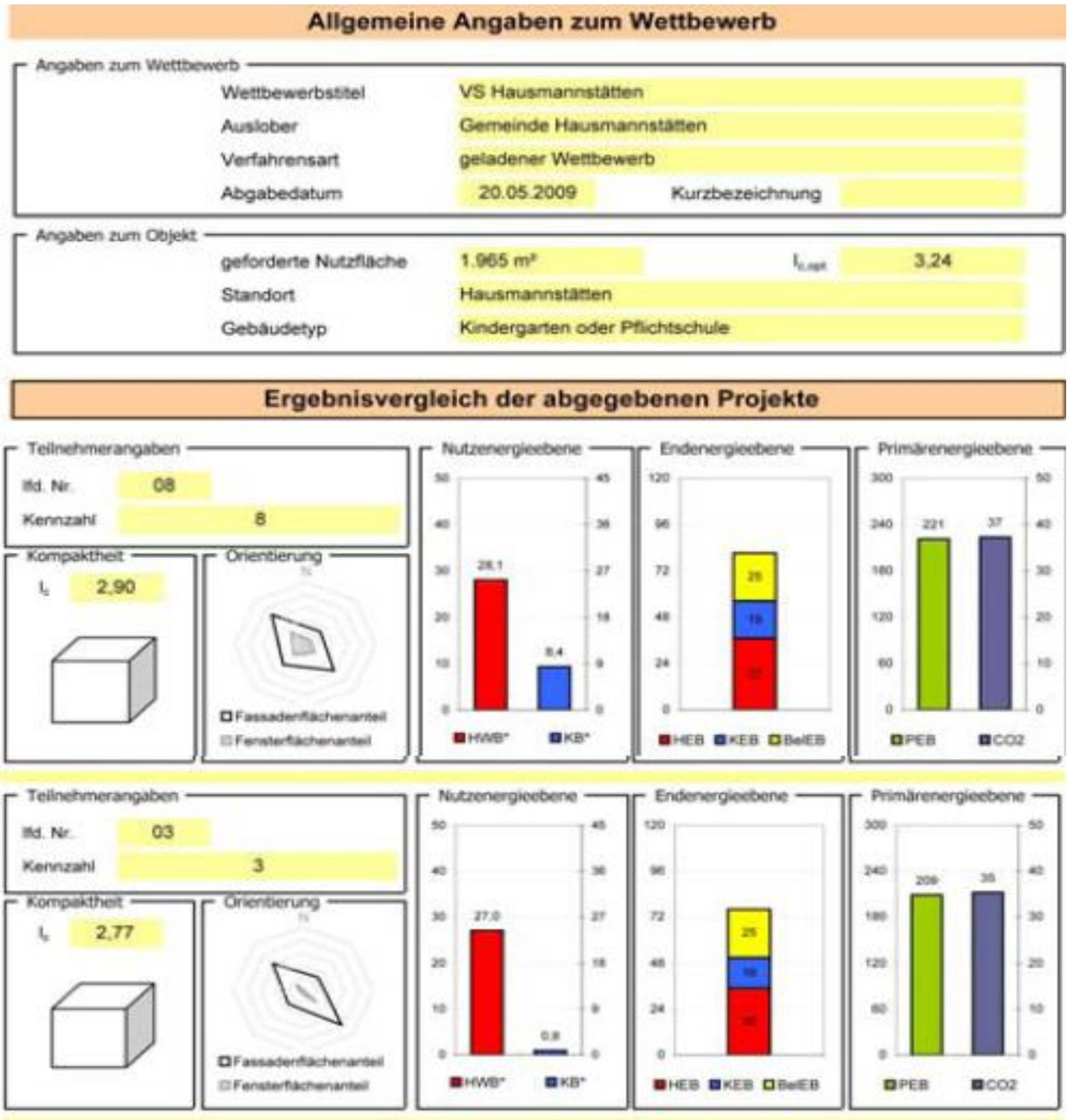
[1] Treberspurg et al. 2010

[2] Technische Universität Graz 2010

[3] Treberspurg et al. 2010

shows the easy comparison of results in an architectural competition which are made transparent through a specific developed Excel-Software.[1]

Figure 4-3: Comparison of Results, Basis – Module of a School Building (Source: Djalili, 2010)



The jury receives an objective presentation of energetic building efficiency of all competition entries. Furthermore, the quality of a project in accordance with the evaluation criteria set can be comprehensively assessed. The quantitative results are of importance in the complete draft of tender projects. Practical experience can confirm that the IEAA assessment tool gives a basic orientation in the early planning phase. The assessment tool shows if the

[1] Treberspurg et al. 2010

required building standard can be reached or which building variation demonstrates the favourable energy balance. The limits of implementation are achieved if large constructions with mixed use and special constructions with multiple building services have to be assessed with the IEAA tool. By the use of this free of charge tool energy efficient building knowledge is acquired for planners. Furthermore, the IEAA tool is used for more planning orders, which are not assigned in the tender process.[1]

„A flexible floor-plan composition should be involved in a sustainable building rating system. This is justified by the fact that functional requirements of a building may be changed over time. Even if sustainable building materials would have been selected, the overall design concept for a building does not longer correspond with changing requirements. In nursing homes the functional requirements have changed by a changing philosophy. This is an essential issue. Despite a selection of sustainable building materials, a reduction of operational costs, a reduction of maintenance costs and a longer life time of products we have carried out major renovations or erected new buildings because room concepts do not match anymore (Sabo, June 2010).

4.3. The German Sustainable Building Council (DGNB) System and its Implementation in the Planning Phase

The Vorarlberg company "Illwerke AG" integrates the sustainable building rating system developed by the German Sustainable Building. The company wants to achieve economical, ecological and social criteria from today´s perspective. Hence, the enterprise plans to construct a sustainable building, which mirrors a sustainable business philosophy. The company´s management places particular emphasis on a sustainable construction. Detailed information on the DGNB system is provided in chapter 6.1.[2]

„Most projects consider sustainability in architectural competitions. Planners cannot wait to integrate ecological building materials in the executing phase, because then it is too late. The DGNB system is a planning instrument and tool for building sustainable buildings. It is not just a sustainable assessment tool because we are measuring the performance of a whole building. Furthermore, we give planners freedom in their creative and technical work and do not restrict them. The freedom in planning creates possibilities for planners and participating construction companies to find the best systemic solution" (Kaufmann, June 2010).

The expected completion of the building in Schruns-Rodund in the region Montafon will be in 2011. Auditors of the real estate consulting company Drees & Sommer worked out a pre-assessment of the building. The preliminary certificate shall achieve the golden award. Therefore location quality and object assessment have to reach more than 80% of the

[1] Djalili 2010

[2] Smutny 2010b

degree of performance. The architect will be selected in an architectural tender. Illustration 4-4 shows the target values of the future building.[1]

Illustration 4-4: Target degree of performance in the planning phase (Source: Smutny, 2010b)

Particular importance was attached to get a high ecological quality of the building. Here, the builder only makes concessions with the criterion “land use”. The economic criteria shall achieve a compliance rate of 75 – 80%. The economic criteria would be awarded with the silver award. Socio-cultural and functional quality criteria contain certain weak points. In this case, the client made conscious decisions: the criterion “art in construction” is not considered or the criterion “influence of facility users” is not treated optimally. The technical quality criteria with their planned/target degree of performance are shown in figure 4-5. The maximum score of one criterion is 10.0 points. In general the planned technical quality is regarded as very high. Only the criterion “sound insulation” (5.0 planned points) achieves the minimum requirements and therefore it receives a subtraction of points. Technical thermal and moisture barrier of building shells (9.2 planned points), maintainability of the building construction (10.0 planned points) and demolition and recycling of the building (7.2 planned points) substantiates and comprises the main category technical quality.

Planned process quality would be awarded in gold. The preliminary certificate for the site quality is independent of the execution phases because most location factors do not change

[1] Smutny 2010b

in the short run. A subtraction of points has to be made only, because utilization-specific buildings such as schools or shopping centres are not in the immediate proximity.[1]

„The builder executes a functional tendering for integral planning. Additionally, the client would like an ÖGNI certificate awarded in gold. The guiding principles set high standards by reaching more than 80% of the DGNB target degree of performance. It's the client´s choice how these aims can be achieved. The builder decides, which timber construction or massive construction or which building services is used. The path leading towards this goal is, however, determined by the architects/builder" (Kaufmann, June 2010).

Illustration 4-5: Target degree of performance for technical quality (Source: Smutny, 2010b)

Technische Qualität

Kriterien	Bemerkung	Punkte IST *
34 Schallschutz		5,0
35 Wärme- und feuchteschutztechnische Qualität der Gebäudehülle		9,2
40 Reinigungs- und Instandhaltungsfreundlichkeit der Baukonstruktion		10,0
42 Rückbaubarkeit, Recyclingfreundlichkeit, Demontagefreundlichkeit		7,2
Erfüllungsgrad der Hauptkriteriengruppe (%)		

„The passive house standards are not favoured in architectural tenders, because the standards cause problems in the construction physics. Furthermore, the passive house standards are 10-20% more expensive than the low energy standards. Our department focuses on a large number of buildings with very low energy efficiency. In general, in Upper Austria buildings with low building standards are renovated. These buildings with low energy efficiency have to be renovated to reach a heat requirement of 30-60 kWh/m^2 per year. Renovations towards passive house standards connected with higher building costs do not justify the saving of energy. Furthermore, user behaviour speaks against the execution of passive house standards" (Sabo, June 2010).

[1] Smutny 2010b

5. International Organisations: Dealing with Sustainable Building Rating Systems

The first sustainable building rating system BREEAM (Building Research Establishment's Environmental Assessment Method) was developed in 1990. This system was created to rate office buildings to distinguish among building qualities on the supply market and to gain a competitive edge.[1] Life Cycle Assessment Standards have been worked out simultaneously. They analyse environmental impacts of products and processes during their lifetime.[2] Nowadays these accounting processes are a main tool to rate buildings and to standardize sustainability in buildings.[3] The utilisation of comprehensive and new building rating systems creates the possibility to use the valuation results and databases. If the underlying (political) goals, criteria and indicators change, the evaluation result can change as well.[4] With the development of all these sustainable building rating tools, organisations have been forged which bundle information, develop global basic concepts and organise conferences.

5.1. Green Building Challenge

In 1994, the "*Conseil International du Bâtiment* (CIB)" organised a conference in London for the first time. Forming the „Green Building Challenge" team in 1996 an environmentally friendly building rating system appeared based on a theoretical and scientific foundation. The GB Tool 1.3. was developed as well. This software is used for inserting sustainable building rating data and was developed for residential buildings, offices and schools. It was taken over by international networking members and it has been adapted to national standards. Further developments have been presented at international congresses, thus they have been implemented in national systems.[5]

The „Green Building Challenge" has been a continuous, international process the aim of which was to develop new sustainable building rating systems, to test them and to present them at congresses and conferences. By virtue of early experiences at a conference in Vancouver in 1998, framework conditions for sustainable building rating systems have been modified in more than 20 countries and adapted to the respective national data. Cooperating with the „International Energy Agency (IEA)" and the „Conseil International du Bâtiment

[1] Geissler 2008

[2] ISO 14040 ff

[3] Geissler et al. 2002

[4] Geissler 2008

[5] GBC 2010

(CIB)“, as well as by the installation of the „International Framework Committee“ (IFC), the development of building rating systems and their technical processes have been advanced.[1] The following sustainable building congresses in Maastricht 2000, Oslo 2002 and Tokyo 2005, yielded revised master tools and an attempt to establish an international accepted base construction for sustainable building rating systems was made.[2] The loose merger of the “Green Building Challenge“ work group led to the foundation of the International Initiative for a Sustainably Built Environment (iiSBE). Since, iiSBE has been in charge for the organisation of all conferences.[3]

5.2. International Initiative for a Sustainably Built Environment (iiSBE)

iiSBE is an international and non-profit organization. The association focuses on implementing policy objectives and supports the building industry with planning strategies, methods and tools for an accelerating development towards a sustainable building environment. iiSBE is a generic framework for rating the sustainable performance of buildings and projects.[4]

The institution pursues the following targets:[5]

- ✓ Establishment of common valid standards and testing of new methods of assessing building performance
- ✓ Sponsor conferences that promote exchanges between the building environment research community and building practitioners
- ✓ Increase awareness and attention for existing sustainable building initiatives for the building industry, interest groups and international architects and planners
- ✓ Fields of activity takeovers, which are not covered by existing organizations and networks

iiSBE has initiated the Sustainable Building Information System (SBIS), which is a multi-language, web-based data base of international research and development information relating to sustainable building.[6] In addition iiSBE established the web-based data base skills

[1] IISBE 2010a

[2] Geissler 2008

[3] IISBE 2010b

[4] IISBE 2010b

[5] IISBE 2010c

[6] IISBE 2010c

registry. The data bank contains skills profiles for individual and organizational members of iiSBE and relates to all aspects of sustainable building. IiSBE started an international training program in sustainable building and construction, in partnership with the international association of civil engineering firms.[1]

iiSBE, CIB und UNEP – SBCI (see chapter 5.1.5) is supporting and sponsoring these conference series together with partners from the building industry. Today these meetings are known as the Sustainable Building Challenge. After regional conferences, which were held in 2007, the results were presented at the world conference in Sydney in 2008. There the organizers showcased best-practice examples of green buildings around the world. After organizing international training programs in Thessaloniki in 2009 and in Quatar in 2010 the next global conference will be held in Helsinki in 2011.[2]

For the year 2010 the rotating board members of iiSBE are: Joel Ann Todd from the United States of America (U.S. Green Building Council), Faridah Shafii from Malaysia (UNEP-SBCI), Luis Alvarez Ude from Spain (iiSBE Spain) und Sung-Woo Shin from the Korean Hanyang University.[3]

5.3. Sustainable Building Alliance (SB Alliance)

The organisation Sustainable Building Alliance (SB Alliance) was founded in 2008 and is located in Paris. The main targets are to bundle competences and activities for the sustainable building rating systems and to use as well as develop common international standards, despite different regional characteristics. In detail the establishment of basic criteria is aspired. This leads to a basically guaranteed comparability and a higher satisfaction for system users. A further focus of the programme is to provide planning and assessment tools for architects, planners and the building industry.[4]

The association comprises among others the German Sustainable Building Council, the U.S. Green Building Council, the IISBE or the enterprise Building Research Establishment. In addition more private companies such as BNP PARIBAS or the **Royal Institution of**

[1] IISBE 2010b

[2] IISBE 2010d

[3] IISBE 2010e

[4] Lützkendorf 2009b

Chartered Surveyors (RICS) are also members of the organization. SB Alliance, once again, is a member of UNEP – SBCI.[1]

“The real estate industry can set positive signals for a standardized certification system. As a consequence the Sustainable Building Alliance was founded. The association of different certification systems should develop a minimal criteria list for sustainable certification systems“ (Lützkendorf, November 2009).

5.4. United Nations Environment Programme – Sustainable Buildings & Climate Initiative (UNEP – SBCI)

On behalf of the “United Nations Environment Programme”, the Sustainable Buildings and Climate Initiative (SBCI) supports strategies and practices for political and environmental decision makers in order to create a secure, clean and efficient use of resources. Playing a key role the construction industry is able to provide a valuable contribution to society. The SBCI is acting as a sponsor for international congresses as well.[2] The SBCI provides a platform for the construction industry’s interest groups. There the anthropogenic climate change and the energy efficiency form a focal point.[3]

Table 5-1 shows UNEP-SBCI board structure.

Table 5-1: Chair´s overview of UNEP-SBCI (Source: Modified after UNEP, 2010c)

Chair	Hydro Building Systems Birgitte Holter
Vice Chair	BROAD Air Conditioning Zhang Yue, CEO
Past-Chair	FIDIC Ike Van der Putte
Board member	Lend Lease Corporation Maria Atkinson, Global Head of Sustainability
Board member	Lafarge Constant Van Aerschot, Director Construction Trends
Board member Board member	Brasilian Sustainable Building Council Marcelo Takaoka, President US Green Building Council Rick Fedrizzi, President, CEO and Co-founder

[1] Sustainable Building Alliance 2010

[2] UNEP 2010a

[3] UNEP 2010b

5.5. World Green Building Council

The World Green Building Council (WGBC) was founded in 2002 und consists of national associations which represent large parts of the construction industry in each country. The main target is to facilitate the global transformation of the building industry towards sustainability. The organization fosters and supports new and emerging Green Building councils by providing them the tool and strategies to establish strong organizations and leadership positions in their markets. Furthermore, the WGBC provides international forums, helps with formal applications for funding and tries to implement new scientific knowledge and experiences. Once established the organization works closely with councils to advance their common interests by promoting local green building actions.

The WGBC is a partner of the "Clinton Climate Initiative", is participating in the „United Nation's Environmental Programme" and supports the World Business Council on Sustainable Development.[1]

As illustrated in table 5-2, the WGBC is composed of following persons:

Table 5-2: WGBC board of directors (Source: Modified from the WGBC, 2010b)

Position in board	Name	Function
Chair	Tony Arnel	Green Building Council of Australia
Vice-Chair	Rick Fedrizzi	U.S. Green Building Council
Vice-Chair	Raman Parasu	Indian Green Building Council CEO of BMTC-UAE Group
Founder	David Gottfried	CEO of WorldBuild Consulting
Legal matters	Dan Sione	Environmental Law
Financial Issues	Paul King	UK Green Building Council
Member	Cesar Ulises Trevino	Mexico Green Building Council
Member	Thomas Mueller	Canada Green Building Council
Member	Chilin Cheng	Taiwan Green Building Council
Member	Kazuo Iwamura	Japan Sustainable Building Consortium

[1] WGBC 2010a

The WGBC does not prefer a certain system or a determined methodology as a global standard. Instead the organization developed accepted and testified sustainable building rating systems in the following countries as shown in table 5-3:

Table 5-3: National building rating systems under the roof of WGBC (Source: author's table based on WGBC, 2010c)

Country	Green Building Council System
Australia	Green Star
Canada	LEED Canada
Germany	DGNB Certification System
India	IGBC Rating System & LEED India
Japan	Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)
New Zealand	Green Star NZ
South Africa	Green Star SA
United Kingdom	BREEAM
USA	LEED Green Building Rating System

6 International Sustainability-oriented Building Rating Systems

The following chapter gives a survey of environmental and sustainability-oriented building rating systems. Besides a portrayal of internationally applied building rating systems LEED (USA) and BREEAM (Great Britain), DGNB (Germany) and MINENERGIE (Switzerland) the emphasis lies on the Austrian national systems for the assessment of the building quality. In Austria both the rather comprehensive building rating system TQB and the simplified building rating system by the Ministry klima:aktiv dominate as tools.

„LEED and BREEAM are available in international versions. With LEED certifications you must provide proofs according to American standards, which is relatively costly. In my opinion an international building rating system is meaningful if international corporations, which have branches worldwide, build one common standard. This standard should be valid for all corporations, e.g. LEED Platin“ (Geissler, January 2010).

Building certificates are more than mere figures for the ecological index and life cycle assessment and contrary to energy certificates they not only provide information concerning the thermal quality of an object, but they also investigate criteria which on the one hand control the satisfaction of the user and on the other hand consider the economical use of resources in the entire life cycle of the building. They serve architects and house owners alike as instruments for quality assurance and marketing and to the customer they provide a comprehensive presentation of the living and housing quality of a house.[1]

Meanwhile a lot of international building rating systems have come into existence. Although worldwide there are building rating systems in Japan, South Korea, China, Taiwan, Hong Kong, Canada, Mexico, Brazil, Portugal, Spain, Italy or the Arab Emirates the focus lies on the Central European systems in Germany and Switzerland as well as on the internationally leading systems in the USA and Great Britain.

„Investors adhere to a high extent to internationally applied certification systems. I have my doubts if this is a good idea, because the using of real estate lies in the regional context“ (Lützgendorf, November 2009).

[1] Land Oberösterreich 2010b

6.1. German Society for Sustainable Building (DGNB)

As a rule DGNB is short for “Deutsche Gesellschaft für nachhaltiges Bauen“ (German Society for Sustainable Building). In order to be able to differentiate between abbreviations it is mentioned here that DGNB is also used for “Deutsches Gütesiegel Nachhaltiges Bauen“ (German quality seal for sustainable building).[84]

6.1.1. Structure of the DGNB and Methodology of the Building Rating System

The DGNB strives to show and promote ways and solutions to enable sustainable building in the planning, implementation and utilization of a building. DGNB and BMVBS (Ministry of Traffic, Construction and Urban Development) focus on the development of a common and transparent system for the assessment of sustainability in the building sector. DGNB also functions as a central organisation for the exchange of knowledge, for continued education and for greater public awareness. DGNB issues certifications, is responsible for training, examination and registration of auditors and carries out independent inspections of the submitted documentations of sustainable buildings that are handed in by the auditors.[1]

The work groups supply the basic system. The goal here is to create a criteria catalogue by means of establishing criteria profiles and protocols by the work groups. The coordination of the system is done by the head of the work group and the DGNB expert committee. The aim is the verification of system compliance and applicability so as to be able to begin the pilot phase. The administrative office of DGNB works out the documentation requirements for its practical application. The system testing is done by auditors working on pilot projects, the heads of the work groups and the DGNB expert committee. The aim herein is the practical testing of the documentation requirements and the criteria catalogue. A system modification will be carried out by the work groups and members. The administrative office coordinates the building certification system. Hereby the finalisation of the criteria catalogue is attempted.[2]

The DGNB administrative office comprises the departments System, Training, Marketing, Service, Press and Finances. Managing Director and head of the key department System is Dr. Christine Lemaitre. In the following table the following bodies, their tasks and members that work for DGNB are listed in addition to the administrative office.[3] The expert committee

[1] DGNB 2010b

[2] DGNB 2010h

[3] DGNB 2010b

consists of seven thematic fields. These are higher perspectives for sustainable building, global environmental protection, health and satisfaction of building users, regional surroundings and public property, stock and location and processes.[1] Tabble6-1 gives a survey of the structure of DGNB, informs about leading members of various committees and also explains their tasks.

"DGNB is highly accepted at the German real estate market, especially because it is the first example of a second generation of certifying systems. Besides the key topics environment and health the present German system extensively highlights technical quality, concept quality and functional quality whereby the German certification system also considers the economic side by integrating the life cycle costs. This development makes the system interesting" (Lützgendorf, November 2009).

[1] DGNB 2010i

Table 6-1: Survey of the structures of DGNB (Source: author's design based on DGNB, 2010b and DGNB 2010i)

board	head board member	area of responsibility/working method
executive board	Prof. Dr.-Ing. Dr.-Ing. E.h. Werner Sobek	• appointment, dismissal and controlling of the management • appointment and dismissal of the committees • coordination and integration of the different special subjects
expert committee	7 expert committees speaker: Dipl.-Ing. Peter Mösle	• committee for making decisions concerning contents and quality assurance • examination of system variants, topic-related adaptations of existing variants and further developments of contents • ensurance of main focus and objectives of DGNB • support of the administrative office in the area of system development and system application • support of the work groups in developing criteria for contents
work groups	Work groups for each of the 15 building rating types (e.g. new building habitation) with their own person responsible	• integrated development of the systems with architects and specialist planners as well as representatives of the real estate business, the economy and auditors of pilot projects • application of the first system variant "New Constructions of Office and Administration Buildings" as a basis for the adaptation of other building types • fixed procedure of kick-off meeting, Milestone- and completion-workshops and gradual formulation of new system variants
real estate advisory board	17 members	• counselling of the executive board and the administrative board of DGNB in questions of the real estate business
certification board	Prof. Alexander Rudolphi	• controlling the conformity testing towards their plausibility • formal release of the testing results fort the certification awards
admittance and examination board	Prof. Manfred Hegger	• support and counselling of the DGNB administrative board regarding auditor training • impulses for contents and organisational development of training concepts

After a prior assessment of the interest for cooperation and market application a work group is founded which works on the criteria profiles. Then the application of the beta-version within the limits of a pilot phase is tested. The evaluation of the pilot phase and the revision of the beta-version is done by the work group. Finally, the market introduction of the alpha-version is launched.[1]

6.1.2 Rating of Buildings with the German Quality Seal Sustainable Building

The German quality seal sustainable building serves as an instrument for the planning and assessing of buildings. It is based on the idea of integrated planning. Hereby the objectives of sustainable building are defined at first so that future and state-of-the-art buildings can be realised. The foundation of the system was devised with the construction type “New Constructions of Office and Administrative Buildings” Further system variants for different buildings are being developed on this basis. New industrial buildings and new commercial buildings can already be certified. The building categories new educational buildings, new residential buildings, new hotel buildings and inventory office and administration are in the pilot phase.[2] As table 6-1 shows six topic areas, which were established in a broad consensus, are summarised in the assessment of each building type. They are the foundation of the contained criteria: ecology (12), economy (2), socio-cultural and functional aspects (15), technology (5), processes (9) and location (6). The location quality is not included in the overall view of the building quality as each object is assessed in a location-independent way.[3]

[1] DGNB 2010h

[2] DGNB 2010j

[3] DGNB 2010k

Table 6 -1: The six relevant topic areas for the assessment of buildings (Source: DGNB presentation, 2010)

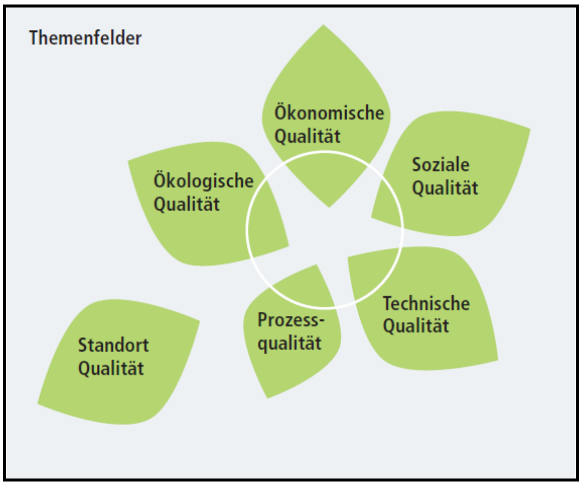
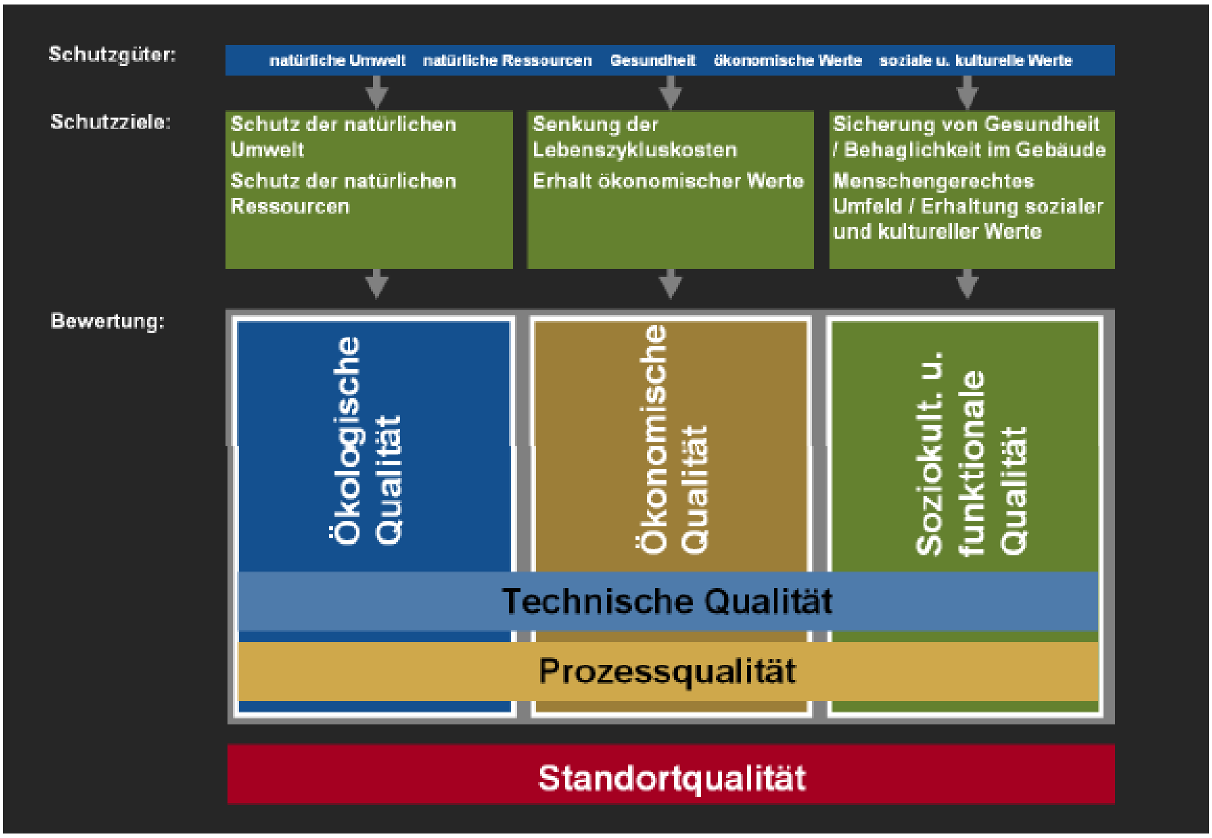


Table 6-2 provides an overview of the DGNB building rating system. The protected goals (Schutzziele) are deduced from the defined protected resources (Schutzgüter) . The goal formulations form the basis for the six main rating criteria which are subdivided into other criteria.

Table 6-2: Overview of the systematics underlying the rating (Source: LÜTZKENDORF, 2009b)

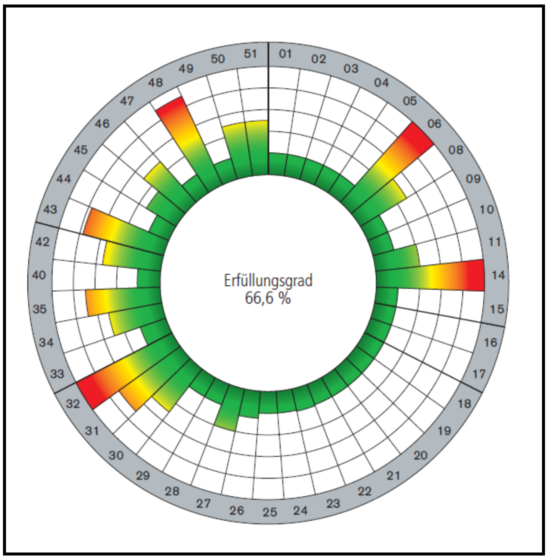


A software programme offered by the society of sustainable building supports the auditor in the documentation and rating process. The rating system awards extraordinary buildings in the categories gold, silver and bronze. The software hereby visualizes the performance of the building in a transparent way and already shows in the planning phase how a continuous, energy-efficient and sustainable building optimisation can be accomplished.[1] The matrix for the rating of new office and administration buildings with altogether 63 criteria demonstrated on page 55 is an illustrative example. Within the framework of the testing of the system the evaluation of the 14 profiles was not included. The criteria are weighed differently for each building. Thus each system variant gets its own weight matrix. The sustainability of new office and administration buildings is therefore measured by means of 49 criteria, whereby each criterion holds 10 rating points depending on the documented or calculated quality.

"*Owing to the complexity and planning of building on the one hand and the complexity of sustainable rating on the other hand there are many different criteria in the system. It is therefore of importance to integrate a list as complete as possible of all the vital features into the system"* (Lützgendorf, November 2009).

Each criterion is weighed 0 to 3 in its overall significance because some criteria are rated major while others are rated minor. The degree of performance in view of the requirements of the seal of quality is calculated on the basis of the rating matrix. As exemplified in table 6-3 the software generates a rating graph which illustrates the topic fields and criteria.[2]

Table 6-3: Graph of a rating matrix by DGNB software (Source: LÜTZKENDORF, 2009b)



With an overall performance rate of over 50 per cent the quality seal in bronze is awarded, of over 65 per cent the quality seal in silver and of over 80 per cent the quality seal in gold are

[1] DGNB 2010k

[2] DGNB 2010k

awarded. Alternatively, the marks 1,0 (overall performance >95 %), 1,5 (overall performance >80 %), and 2,0 (overall performance >95 %), are awarded.[1]

“We want to promote innovative power by our open system which is performance-oriented. We want to establish new materials and new products on the market. We accordingly want to contribute that, for instance, a new kind of concrete of a company gets established on the market. This building material, which is lighter than traditional concrete and is recycled from glass, is used like concrete. This material nevertheless has a lot of characteristics of traditional concrete and is therefore a meaningful alternative. This new material, however, is only used if the life-cycle assessment is a factor. Regarding the life-cycle assessment it is unbeatable and unequalled because it is made of glass, which would have to be deposited. If you just consider the price this material will not be used, because it is more expensive than conventional concrete. We only accomplish a paradigm shift in the building sector by adding new intelligent systems“ (Kaufmann, June 2010).

If an architect has so far made good buildings he/she has dealt with many aspects of the ÖGNI systems. However, there might always be some criteria which the architect did not pay attention to or which were not important enough for the architect respectively. The vital point is that if someone is already very good at planning this efficiency must be documented to the outside world“ (Kaufmann, June 2010).

[1] DGNB, 2010k

Table 6-4: Rating of new office and administration building with altogether 63 criteria (Source: DGNB, 2010k)

Haupt-kriterien gruppe	Kriterien-gruppe	Nr.	Kriterium	Punkte Kriterium Ist	Punkte Kriterium max. möglich	Bedeu tungs-faktor	Punkte gewichtet Ist	Punkte gewichtet max möglich	Erfüll ngs grad	Punkte Gruppe Is	Punkte Gruppe max möglich	Erfüllungs grad G up	Gewich tung Gruppe	Gesam erfüllungs grad
Ökologische Qualität	Wirkungen auf die globale und lokale Umwelt	1	Treibhauspotenzial (GWP)	10,0	10	3	30	30	100%	1 3,5	195	89%	22,5%	86,4 % Gold
		2	Ozonschichtabbbaupotenzial (ODP)	10,0	10	0 5	5	5	100%					
		3	Ozonbildungspotenzial (POCP)	10,0	10	0 5	5	5	100%					
		4	Versauerungspotenzial (AP)	10,0	10	1	10	10	100%					
		5	Überdüngungspotenzial (EP)	7 1	10	1	7,1	10	71%					
		6	Risiken für die lokale Umwelt	8 2	10		24,	30	82%					
		8	Sonstige Wirkungen auf die globale Umwelt	10 0	10	1	0	0	100%					
		9	Mikroklima	10 0	10	0,5	5	5	100%					
	Ressourcen-inanspruch-nahme und Abfallauf-kommen	10	Nicht erneuerbarer Primärenergiebedarf	10 0	10	3	30	30	100%					
		11	Gesamtprimärenergiebedarf und An ei erneuerbarer Primärenergie	8,4	10	2	17	20	84%					
		14	Trinkwasserbedarf und Abwasseraufkommen	5,0	10	2	10	20	50%					
		15	Flächeninanspruchnahme	10,0	10	2	20	20	100%					
Ökonomische Qualität	Lebens-zykluskosten	16	Gebäudebezogene Kosten im Lebenszyklus	9 0	10	3	27	30	90%	47	50	94%	22,5%	
	Wertentwicklung	17	Wertstabilität	1 0	10	2	20	20	100%					
Soziokulturelle und funktionale Qualität	Gesundheit, Behag ichkeit und Nutzer-zufriedenheit	18	Thermischer Komfort im Winter	10,0	10	2	20	20	100%	251,1	280	90%	2 5%	
		19	Thermischer Komfort im Sommer	10,0	10	3	30	30	100%					
		20	Innenraumhygiene	10,0	10	3	30	30	100%					
		21	Akustischer Komfort	10,0	10	1	10	10	100%					
		22	Visueller Komfort	8,5	10	3	26	30	85					
		23	Einflussnahme des Nutzers	6,7	10	2	13	20	67%					
		24	Dachgestaltung	9,0	10	1	9	10	90%					
		25	Sicherheit und Störfallrisiken	8,0	10	1	8	10	80%					
	Funktionalität	26	Barrierefreiheit	8,0	10	2	16	20	80%					
		27	Flächeneffizienz	5,0	10	1	5	10	50%					
		28	Umnutzungsfähigkeit	7 1	10	2	14	20	71%					
		29	Zugänglichkeit	10 0	10	2	20	20	100%					
		30	Fahrradkomfort	10 0	10	1	10	10	10 %					
	Gestalterische Qualität	31	Sicherung der gestalterischen und städtebaulichen Qualität im Wettbewerb	10 0	10	3	30	30	100%					
		32	Kunst am Bau	10 0	10	1	10	10	100%					
Technische Qualität	Qualität der technischen Ausführung	33	Brandschutz	8,0	10	2	16	20	80%	74	100	7 %	22 5%	
		34	Schallschutz	5,0	10	2	10	20	50%					
		35	Energetische und feuchteschutztechnische Qualität der Gebäudehülle	7 7	10		15	20	77%					
		40	Reinigungs- und Instandhaltungs-freundlichkeit des Baukörpers	7,1	10	2	14	20	71%					
		42	Rückbaubarkeit, Recyclingfreundlichkeit, Demontagefreundlichkeit	9,2	10	2	18	20	92%					
Prozessqualität	Qualität der Planung	43	Qualität der Projektvorbereitung	8,3	10	3	25	30	8 %	188,6	230	82%	10,0%	
		44	Integrale Planung	10,0	10	3	30	30	100%					
		45	Optimierung und Komplexität der Herangehensweise in der Planung	8 6	10	3	26	30	86%					
		46	Nachweis der Nachhaltigkeitsaspekte in Ausschreibung und Vergabe	10 0	10	2	20	20	100					
		47	Schaffung von Vorraussetzungen fü ine optimale Nutzung und Bewirt chaftu g	5,0	10	2	10	20	50%					
		48	Baustelle, Bauprozess	7,7	10	2	15	20	7%					
		49	Qualität der ausführenden Firmen, Präqualifikation	5,0	10	2	10	20	50%					
	Qualität der Bauausführung	50	Qualitätssicherung der Bauausführung	10 0	10	3	30	30	100%					
		51	Systematische Inbetriebnahme	7,5	10	3	3	30	75%					

Standortqualität: gesonderte Bewertung, geht nicht in die Gesamtbewertung ein

Haupt-kriterien gruppe	Kriterien-gruppe	Nr.	Kriterium	Punkte Kriterium Ist	Punkte Kriterium max. möglich	Bedeu tungs-faktor	Punkte gewichtet Ist	Punkte gewichtet max möglich	Erfüll ngs grad	Punkte Gruppe Is	Punkte Gruppe max möglich	Erfüllungs grad G up
Standortqualität		56	Risiken am Mikrostandort	7,0	10	2	14	20	70%	93,3	130	72%
		57	Verhältnisse am Mikrostandort	7 1	10	2	14,2	20	71%			
		58	Image und Zustand von Standort und Quartier	1,0	10	2	2	20	10%			
		59	Verkehrsanbindung	8,3	10	3	24,9	30	83%			
		60	Nähe zu nutzungsspezifischen Einrichtungen	9 7	10	2	19,4	20	97%			
		61	Anliegende Medien, Erschließung	9,4	10	2	18,8	20	94%			

(yellow)	ist einzutragen
(white)	wird automatisch berechnet
(blue)	unveränder iche Festlegung

No e 1,0	95 %
Note 1,5	80 %
Note 2 0	65 %
Note 3,0	50 %
Note 4,0	35 %
Note 5,0	20 %

Erfüllungsgrad

ab 80%	GOLD
65-79,9%	SILBER
50-64,9%	BRONZE

6.1.3 Certification Process

The building owner assigns an architect or planner to have the building certified. An auditor accredited by DGNB, who due to training is familiar with the requirements of the German quality seal, formulates the objectives for the planned buildings and within the planning team takes care of the integration of the agreed sustainability criteria which are summarized in an object specification. The certification actually begins with an online registration under http://www.dgnb.de/de/zertifizierung/anmeldung/index.php.[1] At the registration the auditor submits the object specification and the building owner makes a binding declaration of intent to reach the planned performance objectives. After the DGNB has scrutinized the data submitted by the auditor the building owner gets a pre-certificate for the building thereby taking on the responsibility for the implementation of the objectives established in the specification and into the bargain can make use of the pre-certification as a marketing tool and can optimize the building.[2]

After completing the building the German Society for Sustainable Building inspects the rules of procedure. If the building meets the criteria of the assessment rules the pre-certification will be permanently confirmed and the building owner receives a certificate as well as a plaque for the object from DGNB. In table 6-5 the certification process is once again summarized.[3]

Table 6-5: The DGNB Certification Process (Source: DGNB Presentation, 2010)

[1] DGNB 2010i

[2] DGNB 2010o

[3] DGNB 2010i

"In a next step to guarantee sustainable building you must define certain targets and demand certain measures concerning quality control. If you have, for instance, also commissioned pollutant measurements or put them out for tender, difficulties will appear in certifying without control. The objective therefore is integrated planning, good implementation and control which has to be considered at tender" (Kaufmann, June 2010).

6.1.4. Auditor Training

The auditor carries out the project registration at DGNB. The basic task of the advisory DGNB auditors is to control and document the regulations according to a documentation manual during the planning and building process. The project manager is entrusted with the organisation of the project and carries out an assessment and plausibility check of the documents provided by the auditor or third parties. If the documents handed in by the DGNB auditor meet the criteria of the company the building owner will receive the certificate.[1]

This additional training as DGNB auditor is offered by DGNB or universities, chambers and other educational institutions approved by DGNB. If the candidate is approved of after registration he/she will start with auditor training which is based on mandatory and variable modules. Mandatory modules, for example, train the application of assessment criteria of the system in the corresponding building variant whereas variable modules are meant to enhance the educational background in areas, which are not yet familiar to the candidate. The teaching units based on general knowledge are held by DGNB trainers but can also be partly done via an 'e-learning-centre'. As shown in table 6-6 the admission and examination committees decide whether the candidate is suitable as an auditor.[2]

Table6-6: DGNB - Auditor Training (Source: DGNB, 2010m)

[1] DGNB 2010i

[2] DGNB 2010m

6.1.5. Internationalization of DGNB

Abroad the first buildings go through the certification process. The internationalization of the DGNB certification system can be seen by the signing of the first contracts between DGNB and partner organisations in Austria, Bulgaria, China as well as 'memorandums of understanding' with organisations from Brazil, Italy, Hungary and Switzerland. At the moment the first certifications are being carried out in Austria and Luxemburg. The partner organisations will adapt the building rating system bearing in mind the specific regulations and building standards of the country so as to achieve a higher significance because climatic conditions and building requirements vary. The documentation effort is less, because proofs and required data have to be provided and collected only in the respective countries. The rating system can be adapted to the regional circumstances and to the future technical, ecological and economical developments.[1]

DGNB is playing a leading role in the international working committee "Carbon Footprint" in order to establish uniform guidelines for the calculation of greenhouse gas emitting buildings. This working committee is working under the auspices of the World Green Building Council, where DGNB is a full member, and SB Alliance. DGNB is also a member of the "European Construction Technology Platform (ECPT)", an economic interest group which develops strategies for conserving resources and creating sustainable buildings. The association is involved in research projects by the European Union. Philipp Kaufmann has been recently appointed to promote a further development of the network.[2]

"The goal is to be present in 16 countries in two years' time. There is a decision-making body in the framework of a competition among partners, the international board. There the basic parameters for the individual countries are prepared. The individual countries then make the respective adaptations." (Kaufmann, June 2010).

"I think nobody wants to impose a system on another country, but each country can learn from the approaches and strategies of other countries." (Lützgendorf, November 2009).

6.2. Sustainable Rating System for Federal Buildings (BNB)

Cooperating with the "Deutschen Gesellschaft für Nachhaltiges Bauen e. V. (DGNB)" (German Society for Sustainable Building) the "Bundesministerium für Verkehr, Bau- und Stadtentwicklung (BMVBS)" (Ministry for Traffic, Building and Urban Development), which was scientifically monitored by the "Bundesinstitut für Bau-, Stadt- und Raumforschung

[1] DGNB 2010n

[2] DGNB 2010n

(BBSR)” (federal institute for building, urban and space research) has developed an initial criteria catalogue for a holistic approach and assessment of sustainability aspects for buildings.[1]

With the building rating system for federal buildings by the „Bundesministerium für Verkehr, Bau- und Stadtentwicklung (BMVBS)“ (Ministry for Traffic, Building and Urban Development) a holistic quantitative evaluation system for office and administration buildings is available for the first time. It supplements the sustainability guidelines of the BMVBS.

With this new holistic sustainability approach the German government endeavours to establish a rating system for sustainable buildings which is based on science and planning. It is characterized by a comprehensive assessment of the whole life cycle of buildings considering the ecological, economic, socio-cultural quality as well as the technical and process aspects. It is also characterized by a transparent, objective and traceable rating system and thereby also reflects the international developments in the area of standardisation for sustainable buildings.[2]

The operating range of the rating system is for the moment limited to (new) office and administration buildings, because the rating criteria/ methods as a rule were developed for non residential buildings based on the at present valid German laws, rules and regulations as well as national standards and guidelines.[3]

The profiles are divided into the different qualities of sustainable building, i.e. the ecological quality, the economic quality and the socio-cultural and functional quality. Furthermore, two more aspects are defined as cross-section qualities, because they influence all the sub-goals of sustainability. Here the technical quality and the process quality are included into the overall assessment. The location features, however, are rated and listed separately from the object qualities because they can hardly be influenced by planning and building.[4]

“In Germany we have had first-rate experiences. On the one hand there is a round table (initiated by the Ministry for Building) which in the time-span of more than ten years and including all people involved has worked towards developing this system and towards providing basic data such as life cycle assessment data bases or life span data bases. This round table has led the way to national consent. On the other hand DGNB strives to integrate the interests of its members. In Germany you can take it for granted that the system is quite widely accepted in its general orientation concerning

[1] BNB 2010a

[2] BNB 2010a

[3] BNB 2010a

[4] BNB 2010b

energy efficiency, climate protection and conservation of resources. In other respects there discussions in Germany as well" (Lützgendorf, November 2009).

6.3. MINERGIE – Swiss Building Rating System

MINERGIE® is a Swiss building certificate and labels new and existing buildings. These buildings captivate with highly insulated and compact building shells, are free of thermal bridges and are equipped with ventilation system with heat recuperation (many of the building types). As a result building users can enjoy a high comfort of living. The building technology, mainly consisting of renewable sources, provides low energy consumption for heating, cooling, hot water preparation, lighting and electrical equipment.[1]

The quality seal is jointly approved of by industry, the federal government and cantons which are also members of the Swiss MINERGIE Association. MINERGIE makes recommendations regarding construction concepts, renovation and operation of sustainable buildings and supports the creation of regional markets through climate-friendly, energy efficient and renewable products and services in the construction sector.[2]

6.3.1 Organization and Methodology of MINERGIE

MINERGIE is organized as a registered society and is entered in the Commercial Register. The board is responsible for strategic management of the society and is led by counsellor Beyeler. The MINERGIE agency department and the MINERGIE office are responsible for the operating business. The central administrative office is located in the German-speaking city of Bern and provides further education as well as marketing and represents by events, meetings and exhibitions. Furthermore the society is a point of contact for their members and specialists.[3]

The MINERGIE agency department is a point of contact for certifications in foreign countries and for technical issues. The division is responsible for the further development of the system and defines technical requirements. Furthermore, the department carries out all types for certifications.[4] In addition, regional MINERGIE departments are established in the Italian and French speaking part of Switzerland to cover regional specific building and climate

[1] Minergie 2010a

[2] Minergie 2010b

[3] Minergie 2010c

[4] Minergie 2010c

characteristics. These regional agencies offer certifications for sustainable buildings and service features of the central office.[1]

The upgraded building rating systems MINERGIE-P and MINERGIE-ECO have higher requirements regarding building shells as well as ventilation systems and have their own certification offices. The certification office MINERGIE-lights gives advice regarding lighting system planning. The regional energy advisory offices and the cantonal energy offices advise on energy matters, the latter provides information about the MINERGIE building standard and on cantonal promotion programs. Information to renewable energy sources and incentives for renovations complete the offering of the society. Therefore a wide range of products (modules) and services (specialist partners) has been formed, which are presented in the next chapter.[2]

6.3.2 Requirements for MINERGIE Buildings

MINERGIE basic standard improves the quality of living through higher energy efficiency and a higher economic efficiency of a building. MINERGIE-P has higher requirements for a long-living and sustainable building. Both MINERGIE-ECO standards combine these quality features with aspects of health and building ecology. These standards are available for new buildings and existing buildings. While MINERGIE is applicable for twelve different types of buildings, MINERGIE-P is applicable for the following nine types of buildings: residential buildings, administration buildings, schools, buildings, public assembly locations, industry buildings, hospitals, restaurants, sport facilities, indoor pools and commercial interiors. MINERGIE-ECO standard is just available for new administrative buildings, schools and residential buildings.[3]

MINERGIE regards itself as an integrated system, which encourages an ingenious combination of building shells and buildings services such as ventilation systems, hot water production and heating. Energy consumption is defined as a limiting value (weighted energy index), as it is shown in table 6-2. For those building types which have lower energy consumption the source of energy is of subordinate importance. On the contrary, hot water consumption is of relevance in the energy balance. Therefore it is recommended to use at least 20% of renewable energy sources for hot water production. In addition, a builder must

[1] Minergie 2010c

[2] Minergie 2010d

[3] Minergie Festschrift 2010

be able to provide proof that ensures thermal comfort in summer. Supplementary requirements for heat generation are energy-friendly electrical household appliances, lighting according to the standard SIA 380/4 and heat recovery for cooling processes. Additional costs for MINERGIE standard must not exceed 10% of conventional building types.[1]

Table 6-2: MINERGIE requirements for various types of buildings (Source: Modified after MINERGIE, 2010d)

Category	Weighted energy index	Ventilation system	Additional requirements
Apartment building	38 kWh/m2	required	electrical household appliances: Energy A+ rating
One-family house	38 kWh/m2	required	electrical household appliances: Energy A+ rating
Administrative buildings, schools	40 kWh/m2	required	Lighting according to the standard SIA 380/4
Commercial interior	40 kWh/m2	required	Lighting according to the standard SIA 380/4, heat recovery for cooling processes
Industry buildings	20 kWh/m2	proposed	Lighting according to the standard SIA 380/4
Restaurants	45 kWh/m2	required	Lighting according to the standard SIA 380/4, 20% of renewable energy sources for hot water preparation

MINERGIE-P buildings have lower energy consumption than MINERGIE standards. The standard consequently pursues this objective by planning and building all parts of the building as well as optimizing the building during operation. Specific heating requirements and a “blower door test” are additional requirements. Additional costs for MINERGIE standard must not exceed 10% of conventional building types. The use of air conditioners and ventilation systems requires an object viewing according to the standard 380/4/ventilation/climate.[2]

MINERGIE-ECO is another complement to MINERGIE standard. Certified buildings additionally meet further requirements relating to hygienic and eco-friendly construction. The standard implies the criteria light, noise, indoor air, raw materials, production and dismantling. The implementation is realized in the phases preliminary studies, project

[1] Minergie 2010e

[2] Minergie 2010e

planning, tenders and realization. The standard is based on planning tools, which are illustrated in the following table:[1]

Table 6-5: Systematics of MINERGIE ECO standard (Source: Modified after MINERGIE, 2010d)

<table>
<tr><th rowspan="2">Criteria</th><th rowspan="2">Planning tools</th><th colspan="2">Assessment on the basis of a questionnaire</th><th>Certification MINERGI-ECO</th></tr>
<tr><th>Preliminary studies and project planning</th><th>Call for bids and realization</th><th>Total assessment</th></tr>
<tr><td>Light</td><td>SIA 380/4 “Electrical Energy in Building Construction”</td><td>✓</td><td></td><td>Health</td></tr>
<tr><td>Noise</td><td>SIA 181 “Sound Insulation in Building Construction”</td><td>✓</td><td></td><td>Health</td></tr>
<tr><td>Indoor air</td><td>Indoor climate, SIA 382/1, SWKI VA 104-01</td><td>✓</td><td>✓</td><td>Health</td></tr>
<tr><td>Additional requirements</td><td>e.g. Indoor measurements</td><td>✓</td><td>✓</td><td>Health</td></tr>
<tr><td>Raw materials</td><td rowspan="2">BKP – Instructions, eco-devis, module recycling materials, SIA D 0200 SNARC</td><td>✓</td><td>✓</td><td>Building ecology</td></tr>
<tr><td>Production</td><td>✓</td><td>Weighting to costs</td><td>Building ecology</td></tr>
<tr><td>Dismantling</td><td>Module “Applicability dismantling”</td><td></td><td>✓</td><td>Building ecology</td></tr>
<tr><td>Additional requirements</td><td>Building product labels</td><td>✓</td><td>✓</td><td>Building ecology</td></tr>
</table>

The performance model according to standard SIA 112 is an instrument for the communication of builder and planners and provides special performances for planners. BKP instructions ease the purchase of materials, which have to be considered in the project planning, tender and disposal phase. SNARC is a methodology for assessing ecological aspects in architectural competitions and in study assignments. Eco-devis characterizes building materials or building processes with low environmental pollution. Further planning

[1] Minergie 2010f

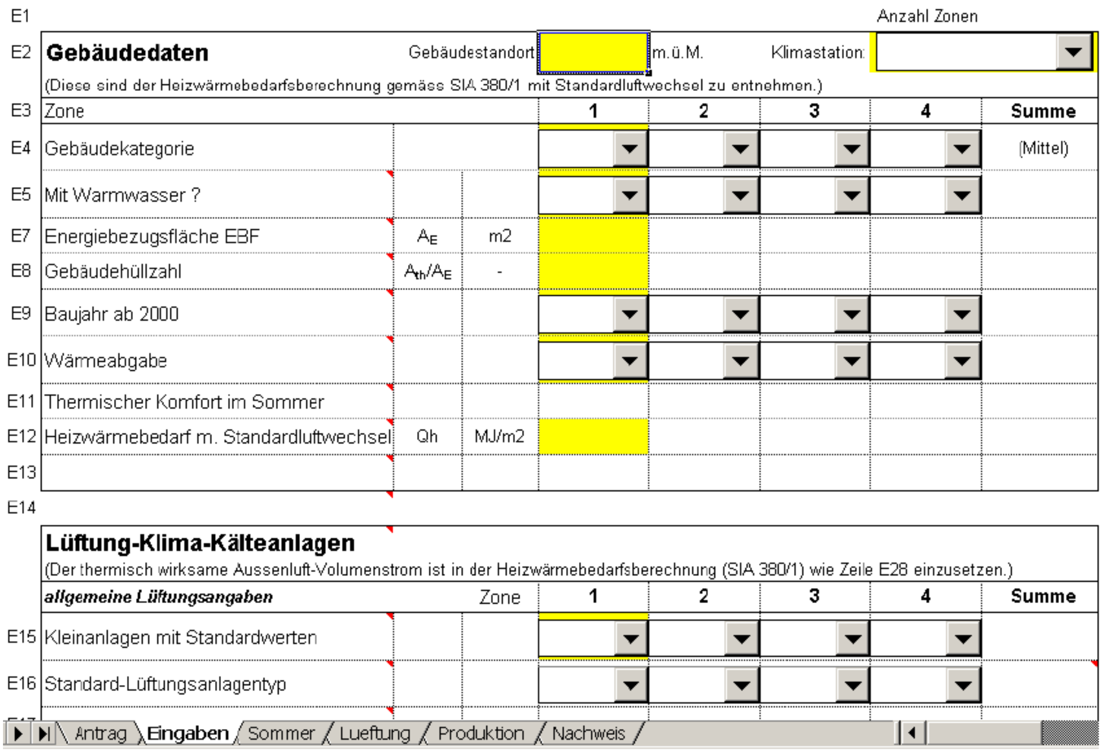
tools are measures and check lists for a hygienic indoor climate, which guarantees a good indoor air quality. Results are provided in leaflets and integrated in computer programs.[1]

Furthermore, a builder or planner can use MINERGIE modules. These modules consist of a detailed list of building components such as windows, doors, sunshade products, lights, wood-firing systems as well as wall- and roof constructions. These certified building components provide quality evidence, simplify the planning process and create the possibility to modernize a building stepwise to reach the MINERGIE standards.[2]

6.3.3 Documentation Tool und Documentary Proof of Minergie Standards

The MINERGIE® documentary proof according to the standard SIA 380/1 is applicable for all different types of buildings and operates with the help of Excel tools. The Excel documentation tool for MINERGIE is illustrated in the following picture 6-8.

Illustration 6-6: Tab of the MINERGIE documentary tool with register names and row numbering (Source: MINERGIE, 2010f)



MINERGIE standard solutions allow a simplified proof procedure. They include obligatory standard values and standard components for residential buildings with < 500 m^2 of living

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[1] Eco Bau 2010

[2] Minergie 2010g

space. The method of detection is implemented with the aid of a certain Excel tool, the so-called "MINERGIE® proof form for standard solutions" ("Nachweisformular für Standardlösungen"). Documentation components for technical, building ecological and hygienic additional requirements for MINERGIE-P standard and MINERGIE-ECO standard are downloadable at http://www.minergie.ch/minergie-ecop-eco.html and http://www.minergie.ch/minergie-p.html.[1]

6.3.4 MINERGIE Certification Process

Builders, planning architects or engineers submit their application at MINERGIE certification offices. The application includes calculations according to the Swiss Engineering and Architect Association (SIA) standard 380/1 "Thermal Energy in Building Construction" and MINERGIE documentary proofs. In addition, building plans, data sheets for the ventilation, heating, and hot water production system, data sheets for windows and building services systems, calculations for the coefficient of thermal conductivity in building shells, calculations for thermal bridges, type testing documents and products or material declarations have to be submitted.[2]

If requirements are met the certification body will issue a preliminary certificate, which can be used for advertising purposes. After completion of building operations and the implementation in conformity with agreed plans the building is confirmed with the MINERGIE label. A "Blower door test" has to be carried for MINERGIE-P standards. A quality assurance system is testing the MINERGIE quality with the help of sample tests on buildings.[3]

For an assessment of MINERGIE-ECO buildings (self declaration) a computer-based questionnaire is applied. The instrument allocates points if questions are answered with "YES". For each criterion, which fulfils the requirements, a sum of points is awarded. The ratio between achieved and possible points is the degree of performance for this criterion. There are three different category guidelines for MINERGIE-ECO standard as is shown in illustration 6-9. Must-criteria have to be fulfilled 100%. The degree of performance for all

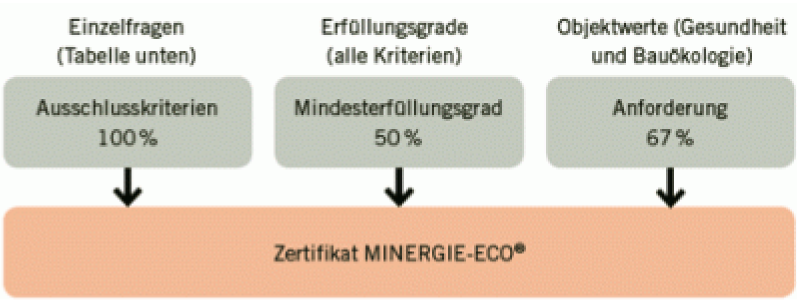
[1] Minergie 2010h

[2] Minergie 2010f

[3] Minergie 2010i

criteria has to be at least 50% and hygienic and ecological requirements have to be at least 67%.[1]

Illustration 6-7: Category guidelines for MINERGIE-ECO standards (Source: MINERGIE, 2010e)



15.767 buildings are certified with MINERGIE, 626 buildings are certified with MINERGIE-P, 148 buildings are certified with MINERGIE-ECO respectively with MINERGIE-P-ECO.[2] At the end of 2006 MINERGIE signed a license agreement with the French organization PRIORITERRE. MINERGIE acquired a license for the region Rhône-Alpes and tries to find further regional partners in France.[3]

6.4 LEED – The Building Rating System from the United States of America

"Leadership in Energy and Environmental Design" (LEED) is an international accepted building rating system and defines a set of standards for environmentally friendly, ecological and sustainable constructions. Prepared strategies (in the planning and realization phase) are used to increase the quality of buildings. Thus, the following targets can be achieved:

- ✓ Energy saving
- ✓ Water efficiency
- ✓ CO_2 emission reduction
- ✓ Improved indoor environmental quality
- ✓ Stewardship of resources and sensitivity to their impacts

[1] Minergie 2010f

[2] Minergie 2010b

[3] Minergie 2010j

6.4.1 Organization of the U.S. Green Building Council (USGBC)

The Washington, D.C.-based U.S. Green Building Council was founded by David Gottfried, Rick Fedrizzi and Mike Italiano in 1993. The resulting building rating system LEED and the USGBC community comprises 78 local branch offices, more than 18.000 member companies and organizations, and more than 140.000 LEED Professional Credential holders. The USGBC relies on highly qualified management persons who coordinate Council programs and activities and support members in various matters. Founding chairman of the executive stuff is S. Richard Fedrizzi. The USGBC Board of Directors is responsible for articulating and upholding the visions, values and missions for the future. Chair of the board of directors is Tim Cole.[1]

The objective of USGBC is to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life. Furthermore, the association provides training programs for various interest groups of the building industry conceives strategic plans for the future and is the host organizer of the world´s biggest international exhibition and conference for sustainable building “Greenbuild“.[2]

6.4.2 Methodology of the Building Rating System

LEED Version 1.0 was launched at the USGBC Membership Summit in August 1998. After extensive modifications, the LEED Green Building Rating System Version 2.0 was released in 2000, with new LEED Versions following in 2002 and LEED Version 2.2 following in 2005. New standards have been developed through technical innovations and enormous scientific progress. As a result the actual Version LEED 3.0 has been developed in 2009. The current standard focuses on energy efficiency and CO_2 emission reduction.

These standards have evolved and matured, the program has undertaken new initiatives. In addition to a rating system devoted to building operational and maintenance issues, LEED addresses the different project developments and delivery processes that exist in the U.S.

[1] USGBC 2010c

[2] USGBC 2010a

building design and construction market by implementing rating systems for specific building types. The following building types can be assessed, as it is shown in table 6-3.[1]

Table 6-3: LEED building rating system for nine building types (Source: Modified after LEED, 2009)

✓ Existing Buildings: Operations and Maintenance	✓ Existing buildings: operation and maintenance
✓ LEED for Core & Shell	✓ LEED building shell
✓ LEED for New Construction	✓ LEED new construction
✓ LEED for Schools	✓ LEED schools
✓ LEED for Neighbourhood Development	✓ LEED settlement development
✓ LEED for Retail	✓ LEED retailer
✓ LEED for Healthcare	✓ LEED healthcare
✓ LEED for Homes	✓ LEED homes
✓ LEED for Commercial Interiors	✓ LEED commercial interior

The LEED rating system includes energetic and ecological principles. Furthermore, a basic target of LEED is to standardize these "Green building principles". Environmental impacts are assessed over its entire life cycle. As the basis for an assessment a catalogue of criteria is used. For each criterion certain points are available. Additional points can be achieved in the category Regional Priority. The catalogue comprises the following main categories (100 points can be reached):[2]

- ✓ Sustainable Sites (SS)
- ✓ Water Efficiency (WE)
- ✓ Energy and Atmosphere (EA)
- ✓ Materials and Resources (MR)
- ✓ Indoor Environmental Quality (IEQ)
- ✓ Innovation in Design (ID)
- ✓ Regional Priority (RP)

6.4.3 Assessment of Buildings with LEED

There are different criteria for the seven main categories depending on the type of a building. Each system variant receives a weighting matrix by putting a different emphasis on each criterion. Sustainable building is measured by the standard New Buildings and Major Renovations with 57 criteria. Each criterion achieves points depending on the documented and calculated quality of the building. Therefore a lot of different approaches are used.

[1] LEED 2009

[2] Geissler 2008

Energy models, transportation analysis and assessments of life cycles are calculated and integrated into the system to measure the effect of each criterion on humans, the environment and society. Individual criteria are required (must criterion) and are the basis for each LEED certification.[1]

Each individual LEED building rating system contains an introduction, strategies and minimal requirements for the assessed building. For each building certified auditors are obliged to provide evidence with documents and calculations. Thereby, the catalogue of criteria and checklists, which are available for each building type, are helpful and necessary. As shown in table 6-10, the LEED New Buildings and Major Renovations catalogue of criteria contains the following criteria, which are used for the documentation of the building performance. For each criterion targets and requirements are defined and potential appropriate technologies and strategies are illustrated. In addition, "Errata Documents" are provided, which present innovations and corrections for rating systems.[2]

Illustration 0-1: Catalogue of criteria for new buildings and major renovations (Source: LEED, 2010)

LEED 2009 for New Construction and Major Renovation

Project Checklist

Project Name

Date

Y	N	?		Sustainable Sites	Possible Points: 26
Y			Prereq 1	Construction Activity Pollution Prevention	
			Credit 1	Site Selection	1
			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
			Credit 4.1	Alternative Transportation—Public Transportation Access	6
			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
			Credit 5.2	Site Development—Maximize Open Space	1
			Credit 6.1	Stormwater Design—Quantity Control	1
			Credit 6.2	Stormwater Design—Quality Control	1
			Credit 7.1	Heat Island Effect—Non-roof	1
			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1

				Water Efficiency	Possible Points: 10
Y			Prereq 1	Water Use Reduction—20% Reduction	
			Credit 1	Water Efficient Landscaping	2 to 4
			Credit 2	Innovative Wastewater Technologies	2
			Credit 3	Water Use Reduction	2 to 4

				Energy and Atmosphere	Possible Points: 35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
			Credit 1	Optimize Energy Performance	1 to 19
			Credit 2	On-Site Renewable Energy	1 to 7
			Credit 3	Enhanced Commissioning	2
			Credit 4	Enhanced Refrigerant Management	2
			Credit 5	Measurement and Verification	3
			Credit 6	Green Power	2

				Materials and Resources	Possible Points: 14
Y			Prereq 1	Storage and Collection of Recyclables	
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
			Credit 2	Construction Waste Management	1 to 2
			Credit 3	Materials Reuse	1 to 2

Y	N	?		Materials and Resources, Continued	
			Credit 4	Recycled Content	1 to 2
			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
			Credit 7	Certified Wood	1

				Indoor Environmental Quality	Possible Points: 15
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
			Credit 1	Outdoor Air Delivery Monitoring	1
			Credit 2	Increased Ventilation	1
			Credit 3.1	Construction IAQ Management Plan—During Construction	1
			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
			Credit 5	Indoor Chemical and Pollutant Source Control	1
			Credit 6.1	Controllability of Systems—Lighting	1
			Credit 6.2	Controllability of Systems—Thermal Comfort	1
			Credit 7.1	Thermal Comfort—Design	1
			Credit 7.2	Thermal Comfort—Verification	1
			Credit 8.1	Daylight and Views—Daylight	1
			Credit 8.2	Daylight and Views—Views	1

				Innovation and Design Process	Possible Points: 6
			Credit 1.1	Innovation in Design: Specific Title	1
			Credit 1.2	Innovation in Design: Specific Title	1
			Credit 1.3	Innovation in Design: Specific Title	1
			Credit 1.4	Innovation in Design: Specific Title	1
			Credit 1.5	Innovation in Design: Specific Title	1
			Credit 2	LEED Accredited Professional	1

				Regional Priority Credits	Possible Points: 4
			Credit 1.1	Regional Priority: Specific Credit	1
			Credit 1.2	Regional Priority: Specific Credit	1
			Credit 1.3	Regional Priority: Specific Credit	1
			Credit 1.4	Regional Priority: Specific Credit	1

				Total	Possible Points: 110

Certified 40 to 49 points   Silver 50 to 59 points   Gold 60 to 79 points   Platinum 80 to 110 applications. GBCI handles training programmes and building certifications for all LEED standards (issuing of authorizations and granting of certificates).[1]

The sum of points is essential which certification a building gets. 100 points can be achieved. In addition some extra points can be awarded. The LEED Version 2009 for New Buildings and Major Renovations Rating dictates the following score of points which have to be reached:[2]

Table 6-4: LEED Certification criteria (Source: author's own portrayal based on LEED; 2009)

LEED 2009 for New Construction and Major Renovations	Points
Certificated in	40-49
Silver	50-59
Gold	60-79
Platinum	80 and more

6.4.4 Certification

Certification project teams are working closely together with the „Green Building Certification Institute"(GBCI). In particular, they cooperate at project registrations and at preparing applications. GBCI handles training programmes and building certifications for all LEED standards (issuing of authorizations and granting of certificates).[3]

69.151 „LEED Accredited Professionals" were authorized to execute LEED projects in December 2008. The market for green buildings is estimated at a volume of up to $60 billion for 2010. By comparison, with sales of $7 billion in the year 2005 this is a big increase in this area. At the end of 2008 16.993 projects were registered und 2.150 buildings were certified.[4]

6.4.5 Internationalization of LEED

The origin and rapid growth of the „U.S. Green Building Council began in the nineties. Big affiliated groups discovered ecological programs and used them for marketing purposes. Simultaneous sustainable and ecological constructions were integrated into society, which were developed by different institutes. Furthermore, technological innovations such as the

[1] GBCI 2010

[2] LEED 2009

[3] GBCI 2010

[4] Geissler 2008

use of solar panels were established. This reorientation created the prerequisites for a rethinking in the building industry, which was supported by political change in the USA.[1]

While the national implementation of the system was successful, LEED started to capture international markets. By establishing the World Green Building Councils (see chapter 4.1.4.) in the year of 1998 the necessary conditions were created to implement the sustainable building rating system worldwide. Meanwhile, 20 national „Green Building Councils“ have been classified as full members. Australia takes a pioneering role (former manageress Maria Atkinson) and has the highest green building certification rate per capita worldwide. At the moment most LEED certifications are drawn up in India.[2]

„LEED started with a very successful marketing campaign and implemented the system afterwards. LEED invested in Marketing and is now leading in the perception of people´s minds. BREEAM has already certified more than 100.000 buildings worldwide. By marketing you can generate pressure demand. Therefore we want to reach quite deliberately all relevant clients of the building industry. Furthermore, we want to inform the public. An important objective is to establish sustainable building” (Kaufmann, June 2010).

6.5 BREEAM – a Building Rating System from Great Britain

The building assessment system BREEAM (BRE’s Environmental Assessment Method) was devised at the end of the 1980’s by BRE (Building Research Establishment) in Great Britain. BREEAM comprises a multitude of environmental and sustainable aspects and enables architects and project developers to provide evidence of environmental standards towards planners and clients.[3]

6.5.1 Structure of BRE

After the BRE group was privatised in 1997 it was possible the have the tested products certified on the market. In 2006 the entire environmental services as well as the building certification system BREEAM were integrated into the BRE Global group.[4] General Director of BRE Global is Carol Atkinson. The managing director of the company division BREEAM is Martin Townsend.[5]

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[1] Geissler 2009

[2] USGBC 2008

[3] BREEAM 2010a

[4] BRE 2010b

[5] BRE 2010a

BRE is a politically independent and research-related management resulting company. BRE provides expertise to the industry, economy and authorities and trains assessors at conferences and seminars. New innovations from research further the development of new and sustainable environmental products in the service sector. The head office is located in Watford, England. Additional regional offices are in England, Scotland, Wales and Ireland.[1] Besides environmental certifications of buildings (BREEAM) and certifications of environmental products (Green Book Live) BRE Global also offers fire and safety certifications and implements quality, health and safety management systems for the industry and authorities.[2]

6.5.2 Methodology and Assessment of Buildings with BREEAM

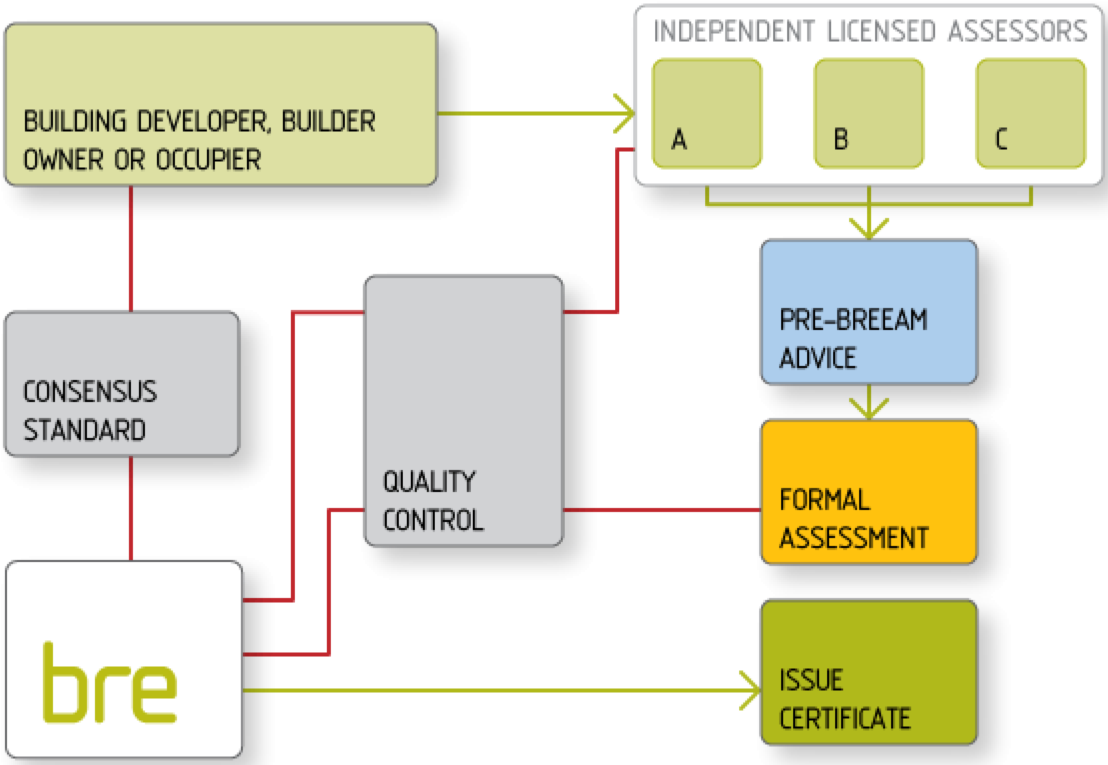
By certifying and controlling the quality BREEAM makes sure that a transparent and traceable assessment of building types is guaranteed. BRE excels in generating assessment standards for buildings and trains the assessors. Building owners and planners place a building assessment order to the licensed and independent assessor. The assessor carries out the assessment with the help of guideline documents. As Table 6-11 exemplifies BRE controls evidence and information concerning plausibility and correctness and issues the certificate.[3]

[1] BRE 2010b

[2] BRE 2010c

[3] BREEAM 2010b

Table 6-12: Outline of the Methodology of the Building Assessment System BREEAM (Source: BREEAM, 2010b)



BREEAM can be applied for the assessment of the environmental performance of new and existing buildings. There are different criteria settings for the diverse types of buildings. For the following common types of buildings the BREEAM standardized assessment is available: law courts, residential buildings, industry, office buildings, municipal residential buildings, health services, prisons, retailers, schools, residential building renovation and international versions. In addition, tailored assessment systems are offered for laboratories, leisure facilities or hotels.[1]

The assessment is done in compliance with the eight categories management, energy, health and convenience, pollution, transport, space requirements and ecology, material and water which are themselves subdivided into criteria. For each building type objectives are formulated and criteria are set up. By putting a defined emphasis on each criterion a different score is assigned, which forms the basis for the assessment and which enables to compare the buildings with one another. To exemplify the methodology of BREEAM table 6-5 shows categories, criteria, goals and score of the building type BREEA Ecohomes.[2]:

[1] BREEAM 2010b

[2] BREEAM 2010c

Table 6-5: Catalogue of criteria for BREEAM Ecohomes (Source: Modified after BREEAM Ecohomes, 2006):

Category	Criteria	Objectives	Points
Energy	- Dwelling emission rate - Building fabric - Drying Space - EcoLabelled Goods - Internal Lighting - External Lighting	✓ Minimize emissions of CO2 ✓ Improve insulation standards ✓ Proof the efficiency of dwellings ✓ Minimize energy used to dry clothes ✓ Encourage of provision of energy efficient internal and external lighting	24
Transport	- Public transport - Cycle storage - Local amenities - Home office	✓ Reducing the level of car use ✓ Wider use of bicycles for transportation ✓ Plan new housing developments	8
Pollution	- Insulate GWP - NOx emissions - Reduction of Surface Runoff - Renewable and low emission energy source - Flood risk	✓ Reduce the global warming potential in substances ✓ Reduce nitrous oxides ✓ Reduce and delay water run-off from the hard surfaces of a housing development to public sewers and watercourses ✓ Reduce atmospheric pollution ✓ Appropriate measures are taken to reduce the impact in an eventual case of flooding	11
Materials	- Environmental impact of materials - Basic Building Elements - Finishing Elements	✓ Encourage the use of materials ✓ Encourage the specification of responsible sourced materials for key building elements as well as for finishing elements and secondary building ✓ Recycle household waste	31
Water	- Internal potable water use - External potable water use	✓ Reduce consumption of potable water and encourage the recycling of rainwater	6
Health and Wellbeing	- Daylighting - Sound insulation - Private space	✓ Improve quality of life and reduce the need for energy to light a home ✓ Insure the provision of sound insulation ✓ Provide outdoor space for private use	8
Land Use and Ecology	- Ecological value of site - Ecological Enhancement - Protection of ecological features - Change of ecological value of site - Building Footprint	✓ Discourage and enhance the development of valuable sites ✓ Protect existing ecological features during construction work ✓ Minimize reduction in ecological value ✓ Ensure that material and land use is optimized for humans and wildlife	9
Management	- Home user guide - Considerate Constructors - Construction site impacts - Security	✓ Construction sites managed in an environmentally and socially considerate and accountable manner ✓ Provision of guidance for owners/occupiers	10

For each building type BREEAM makes documents for an assessment and the certification process available. The most important tool for assessing buildings is the guidance document such as the „Ecohomes Guidance document“. In our case, the guidance was developed for the building type BREEAM Ecohomes and contains the following information for auditors:

- Categories of buildings and a classification of criteria
- System of score allocation
- Definition of objectives
- Proof evidence which have to be exhibited by the BREEAM-auditor
- Supplementary guidelines and basic principles for an assessment
- Background knowledge and additional references

Furthermore, for each building type „developers sheet“(document for builder) are available, which support constructors or planners by the submission of dossiers and evidences. In addition this document provides information for the certified object and ensures the coordination with the BREEAM-auditor.[1]

6.5.3 Certification Process of BREEAM

In 2008 more than 2.000 buildings were certified in Great Britain. This represents an increase of 40% compared to the previous year. In 2008 more than 3.000 licensed auditors were authorized to handle BREEAM projects.[2]

In the planning phase a BREEAM licensed auditor is included to ensure a maximum sustainable building performance at lowest expenses. The performance of the building is estimated by the builder, planner and auditor with the document “amended sheets” (complementary document) before the actual assessment process starts. As a result the builder and planner report is aspired. The maximum score is 100 points. A four-grade certificate will be issued. The grading goes from “excellent”, to “very good” and “good” to “passed”. The builder and auditor form a symbiotic relationship and submit plans, relevant information and proofs for the assessment. BRE controls the assessment of the building and issues a certificate.[3]

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[1] BREEAM ECOHOMES 2006b

[2] Geissler 2008

[3] BREEAM 2010d

6.5.4 Internationalization of BREEAM

BREEAM is a member of the Sustainable Building Alliance and takes an active part in the United Nations Environmental Program. A common agreement for collaboration with the U.S. Green Building Council and the Green Building Council Australia has been developed.[1]

BRE has adapted the British building assessment system for the European and Arabian market. The BREEAM Europe assessment method enables developers to evaluate, improve and demonstrate the environmental credentials of their building in a consistent and comparable way in different European countries. The standard recognizes national building regulations as well as local context and issues such as climate. BREEAM gives the opportunity to design teams in each country to form their best practice codes and standards and supports local best practice construction codes.[2]

BREEAM Gulf has been developed in collaboration with a variety of large organizations based in Qatar, Abu Dhabi and Dubai. The aim of the scheme is to establish a building rating system for all the most commonly used building types in the Arab region. The scheme provides an independent means of assessing key environmental impacts associated with local construction in the Gulf region. An international licensed BREEAM auditor is executing the assessment. The score is then translated into a 1-5 star rating, with 5 stars being the highest environmental building performance.[3]

[1] BREEAM 2010e

[2] BREEAM 2010f

[3] BREEAM 2010f

7. Overview of Existing Sustainable National Building Rating Systems

Due to different frame works and their effects on the building sector, Austrian systems are worked out for an evaluation of sustainable construction works. Therefore, national systems differ from national evaluation systems in the choice and weighting of criteria, the reference value, as well as the extent and arrangement depending on the target groups.[1]

7.1 Energy Performance Certificate

The Energy Performance Certificate depicts a total energy performance of a building. By means of the energy consumption figures, it can be used to compare various buildings energetically. The respective federal state-specific building laws prescribe an Energy Performance Certificate for new, additional or modified constructions and comprehensive redevelopments. The Energy Performance Certificate has to be presented at a sale, renting or a lease of buildings. Depending on the energy demand, buildings can be categorised into "A++" to "G". "A++" represents a building that consumes very little energy, whereas "G" stands for an extremely inefficient building.[2]

The Certificate also comprises the specific heating demand of a building in kWh/m²a. The heating demand figure shows the expected annual heat requirement for a building considering a reference climate and the local climate. The heat requirement for hot water (WWWB) provides information about the hot water supply. The heating technology energy demand and the heating energy demand are significant figures as well. The heating technology energy demand points out all the energy loss which is caused by production, storage, distribution and output of space heating and water. The heating energy demand figure shows the energy demand needed for heating and hot water supply. The final energy demand demonstrates the amount of energy needed for feeding the building services providing hot water and heating. Each Energy Performance Certificate includes recommendations for renovating structural components.[3]

[1] Geissler 2008

[2] Land Oberösterreich 2010a

[3] Land Oberösterreich 2010c

„The energy consumption figures of the Energy Performance Certificate are working very well. There is hardly anyone in the discussion with journalists who questions these figures. Sustainability, which is a massive topic, causes a lot of problems and also uncertainty“ (Kaufmann, June 2010).

All energy consumption figures are user specific and have limited validity. The Energy Performance Certificate takes building physics and energetic criteria into account. On the other hand it ignores the quality of the interior or the used building material. The international trend is heading towards comprehensive building ratings, following ecological, economic and social sustainability criteria.[1]

„The first Energy Performance Certificate was issued in 1991 within the housing subsidy programme and it took until 1999 before it was anchored in the building laws. The European Union tackled this issue only in 2002 by enacting a directive. It will be some time before sustainability will be implemented in the building industry“ (Kernröcker, June 2010).

7.2. The Austrian Sustainable Building Council (ÖGNB)

The Austrian Sustainable Building Council is responsible for the structural development of the building rating system klima:aktiv, the TQB 2002 (Total Quality Building) and the “Ökopass” (ecological certificate).

Table 10-1 provides an overview of the independently involved institutions und their board members cooperating closely with experts of relevant construction industry institutions (administration, economy and research).[2]

Table 7-1: Institutions and ÖGNB board members (Source: author’s design based on ÖGNB, 2010a)

Institution	Board members
Austrian Institute for Ecology	Robert Lechner
Austrian Energy Agency	Dr. Susanne Geissler
Austrian Society for Environment and Technology	DI Christiana Hageneder
Austrian Institute for Building Biology and Building Ecology	Dr. Bernhard Lipp
Institute for Energy Vorarlberg	Dr. Adolf Groß

[1] Land Oberösterreich 2010a

[2] ÖGNB 2010a

The knowledge of various research initiatives, e.g. research program “Haus der Zukunft“ (house of the future), supports these institutions. The technology program “Haus der Zukunft“ analyses and explores renewable and ecological resources in the building industry, a solar low-energy construction method and the program also develops practicable Passive House concepts.[1]

The building rating systems are available for any interested person, company or institution. Therefore, the trend is towards very cheap building labels. The ÖGNB developed rating system methods and tools which contribute to a sustainable quality improvement of the Austrian building industry. In this respect the information and experience exchange with the building and real estate industry plays a major role in congresses and other events.[2]

„I believe that this is a bad development, as two different tracks have been laid. This causes confusion and it’s very difficult to follow the two different rating systems. For a small country like Austria, the main goal is to create one uniform rating system which both societies can stick to.“ (Kernöcker, June 2010).

„It is far better to look at the problem from two different perspectives. Unless the societies work diametrically against each other and if these societies exchange experiences then this plurality isn’t disadvantageous. It will only become an issue if there are ten different societies making different statements.“ (Sabo, June 2010).

7.2.1 klima:aktiv Award

Within the scope of the Environment Ministry’s climate protection initiative, a klima:aktiv award can be gained. The voluntary system of self-declaration focuses on environmentally friendly construction methods. The criteria are targeting energy efficiency, the ecological quality, comfort and the quality of implementation.[3]

„klima:aktiv isn’t a legally secured expert opinion, but an award. It’s also a program with the aim of raising consciousness and spreading information. The building standards and the award are part of it“ (Geissler, January 2010).

The following four main criteria are being rated:

A) Planning and executing

The basis for energy-efficient, ecological and open-minded buildings is accessibility, the minimisation of thermal bridges, infrastructural measures and air tightness. A simplified

[1] BMVIT 2010

[2] ÖGNB 2010a

[3] BMLFUW 2010a

calculation of life cycle costs for housing and office renovations is necessary to ensure planned measure efficiency. The category's maximum score is 120 points.[1]

B) Energy and supply

The heating demand of klima:aktiv buildings is at least 30% below the average of new buildings. klima:aktiv passive energy houses save more than 80%. Relevant data (e.g. heating demand) are listed in the energy performance certificate or in the "Passive energy house project package" (PHPP).[2] The building services consist of environmentally friendly and efficient heating systems or solar systems. The building shells are well insulated, ensuring a pleasant warmth in winter and prevent overheating in summer. The electrical energy demand and the water demand are reduced to a minimum. With excellent building properties in the category energy and supply, 600 points of 1000 points can be reached.[3]

C) Building material and construction

Building materials that harm the climate will be excluded. Therefore, windows, doors, floor covering and wallpapers must not contain any PVC (Polyvinyl Chloride). Any material weakening the life cycle shall be avoided. Furthermore, ecological building materials are preferred. The energy expenditure to construct a building should be minimized. At www.baubook.at/kahkp building materials corresponding to the evaluation criteria can be found. This category's maximum score is 160 points.[4]

D) Comfort and indoor air quality

klima:aktiv buildings are equipped with air conditioning or comfort ventilation with a heat recovery system. Some proof of the indoor air quality (indoor air pollutants measurement) and summer suitability have to be produced. The category's maximum score is 120 points.

[1] BMLFUW 2010b

[2] Die Umweltberatung 2010

[3] ÖGUT 2008

[4] BMLFUW 2010b

As illustrated in table 7-2, the following catalogues of criteria are available.

Table-2: catalogue of criteria of the klima:aktiv building rating system (Source: BMLFUW, 2010a)

Catalogue of Criteria	New building House / Housing	Renovation	Available since
Catalogue of Critera of klima:aktiv houses	✓		31.10.2008
Catalogue of Criteria of klima:aktiv passive energy houses	✓		31.10.2008
Catalogue of Criteria of residential building renovations of klima:aktiv houses		✓	16.02.2009
Catalogue of Criteria of residential building renovations, klima:aktiv passive energy houses		✓	16.09.2009
Catalogue of Criteria of office and service buildings, klima:aktiv houses	✓		26.01.2010
Catalogue of Criteria of office and service buildings, klima:aktiv passive energy houses	✓		26.01.2010

The Catalogues of Criteria of klima:aktiv houses serve to document and rate the energetic and ecological quality of newly built residential buildings, offices and service buildings, as well as already existing buildings.[1] The ecological requirements for a passive energy house are higher than for a normal new building. The annual heating requirements must not exceed 15 kWh/m²a, the annual supply for primary energy must not exceed 120 kWh/m²m as well. The required air tightness is n50 < 0,6. The certificate of the passive energy house institute in Darmstadt may be mentioned as the most popular certification institute regarding the passive energy house standards. The Austrian Institute of building biology and building ecology controls all the calculated parameters with the calculation programme “Passivhaus ProjektierungsPaket“ (PHPP).[2] Illustration 7-1 shows all four main criteria, their sub-categories and associated point system, focusing on the energetic quality of a building in category B. A translation for each criteria point and further details can be found in chapter 9.

[1] BMLFUW 2010b

[2] IBO 2010a

Illustration 7-1: Catalogue of criteria of a klima:aktiv house (Source: GEISSLER, 2008)

Kriterienkatalog k:a Haus

klima:aktiv

Der Kriterienkatalog benötigt an 13 Stelle(n) Ihre besondere Aufmerksamkeit		Punkte	1.000	0
Nr.	**Titel**	**Muss-kriterium**	**erreichbare Punkte**	**Eigenes Gebäude Punkte**
A	Planung und Ausführung		max. 120	0
A 1.	**Planung**		max. 100	0
A 1. 1	Qualität der Infrastruktur (Nähe zu Schule, ÖPNV etc.)		20	
A 1. 2	Fahrradstellplatz		30	
A 1. 3a	Barrierefreies Bauen - Teilausbau	nur ein Krit. Wählbar	20	
A 1. 3b	Barrierefreies Bauen - Vollausbau		40	
A 1. 4a	Gebäudehülle wärmebrückenarm		20	
A 1. 4b	Gebäudehülle wärmebrückenfrei		30	
A 2.	**Ausführung**		max. 40	0
A 2. 1a	Gebäudehülle luftdicht (Standard)	M (nur ein Krit. wählbar)	25	
A 2. 1b	Gebäudehülle luftdicht (Passivhausqualität)		40	
B	Energie und Versorgung		max. 600	0
B 1.	**Wärmebedarf und -versorgung**		max. 575	0
B 1. 1a	Heizwärmebedarf; $1/l_c = A/V$ [1/m]; $HGT_{20/12}$ [Kd]; HWB_{BGFh} [kWh/(m².a)]; $HWB_{BGFh,max}$ 0,0 [kWh/(m².a)]	M	350	0
B 1. 2	Keine Kohle-, Koks-, Stromwiderstandsheizung	M	0	
B 1. 3a	Gas- oder Ölbrennwertkessel	M (nur ein Kriterium wählbar)	0	
B 1. 3b	Wärmepumpe monovalent		60	
B 1. 3c	Wärmepumpe monovalent optimiert		110	
B 1. 3d	Wärmepumpen Kompaktaggregat		50	
B 1. 3e	Fernwärme aus Abwärme oder KWK		90	
B 1. 3f	Fernwärme aus Abwärme oder KWK - optimiert		140	
B 1. 3g	Heizungsanlage für biogene Brennstoffe		150	
B 1. 4	Keine alleinige elektrische Warmwasserbereitung	M	0	
B 1. 5	Solare Warmwasserbereitung		45	
B 1. 6a	Warmwasser-, Pufferpeicher (Standard)	M (nur ein Krit. wählbar)	20	
B 1. 6b	Warmwasser-, Pufferpeicher (optimiert)		30	
B 2.	**Energiebedarf elektrisch**		max. 40	0
B 2. 1a	Lüftungsanlage vorhanden	M	0	
B 2. 1b	Lüftungsanlage energieeffizient		20	
B 2. 2	Beleuchtung der Allgemeinbereiche energieeffizient		10	
B 2. 3	Spülen und Waschen mit Warmwasseranschluss		10	
B 2. 4	Photovoltaikanlage		35	
B 3.	**Wasserbedarf**		max. 40	0
B 3. 1	Handwaschbecken, Duschkopf wassersparend (Standard)	M	20	
B 3. 2	Handwaschbecken wassersparend (optimiert)		10	
B 3. 3	Duschkopf wassersparend (optimiert)		10	
C	Baustoffe und Konstruktion		max. 160	0
C 1.	**Baustoffe**		max. 110	0
C 1. 2	Fenster, Türen, Rolläden - PVC-frei		40	
C 1. 3	Rohre, Folien, Fußbodenbeläge, Tapeten - PVC-frei	M	40	
C 1. 4	Bitumenvoranstriche, -anstriche und -klebstoffe lösemittelfrei		10	
C 1. 5	Baustoffe ökologisch optimiert		40	0
C 2.	**Konstruktionen und Gebäude**		max. 100	0
C 2. 1	ökologischer Index der thermischen Gebäudehülle; $OI3_{TGH,BGF}$		100	0
D	Komfort und Raumluftqualität		max. 120	0
D 1.	**Thermischer Komfort**		max. 30	0
D 1. 1	Gebäude sommertauglich	M	30	
D 2.	**Raumluftqualität**		max. 110	0
D 2. 1a	Frischluftanlage optimiert (Schall etc.)	M (nur ein Krit. wählbar)	35	
D 2. 1b	Komfortlüftung optimiert (Schall, Luftfilter etc.)		60	
D 2. 2	Verlegewerkstoffe emissionsarm		10	
D 2. 3	Bodenbeläge emissionsfrei		15	
D 2. 4	Holzwerkstoffe emissionsarm		15	
D 2. 5	Wand- Deckenanstriche emissionsarm		10	
D 2. 6	Messung der flüchtige Kohlenwasserstoffe und Formaldehyd		25	
		Gesamt	1.000	0

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Version: V3.3.4, 18.01.2008

“Nominal value and obligatory criteria mustn’t be seen as a weak point, as you get confronted with all criteria. It’s useless to have a great system where you have to read about one hundred pages to understand the system. A project manager doesn’t have time to do that. The inhibition threshold working with the system is infinitesimal if the system is concise and substantial“ (Geissler, June 2010).

“The program is an Environment Ministry’s Climate Protection Program putting great emphasis on energy. Building materials are easily neglected, however. The programme targets a broad spectrum achieving a quality improvement. The lower the standard of energy consumption the greater attention will be given for building materials in the future. The rating scheme will give the builder the opportunity to decide which criteria are relevant for the building“ (Geissler, January 2010).

The rating is done by a 1000 point system. A klima:akitv house must have 700 points, a klima:aktiv passive energy house requires at least 900 points to fulfil the criteria of the building rating system.[1]

The building rating system klima:aktiv is based upon a concept of declaration. The builder announces the data. As shown in illustration 7-2 this information can be typed in online at the klima:aktiv internet platform. This basis is checked by regional partners of klima:aktiv and is provided to the klima:aktiv management. If there is a change of the rating result, the revised result has to be published as well.[2]

Illustration 7-2: Declaration platform of klima:aktiv buildings using the Austria House in Whistler, Canada (Source: BMLFUW, 2010c)

If the builder makes some further effort in the direction of a social, economical, ecological and sustainable building rating, a “Total Quality Building (TQB)“ certificate can be applied for.

[1] Land Oberösterreich 2010a

[2] Geissler 2008

7.2.1. Total Quality Building (TQB)

„Total Quality Building" (TQB), a voluntary rating system for structural engineering, is a further development of the building rating system. "Total Quality (TQ)"; started in 1998, it has been realised in the first years of this century. TQB is compatible with the klima:aktiv building rating system. Considering the criteria of quality it can be regarded as an enhancement.[1]

„TQB is an extended version of klima:aktiv. TQB is an expert opinion with legal certainty. Klima:aktiv could be seen as a first step towards gaining an award. Furthermore, TQB contains more criteria and you also could see it as a certificate" (Geissler, 2010).

Total Quality has been devised in close cooperation with the „Green Building Challenge". Therefore it was designed by the developers of LEED and BREEAM.[2] The perspective of the user, the owner and the general public are integrated by TQB to create a sophisticated building rating system which can already be used in the planning phase.[3] The main objective is to improve the quality of buildings by controlling determined planning targets while planning and constructing. TQB illustrates the quality of a building including the planning, construction and utilisation.[4]

7.2.1.1. General Information about the Methodology of TQB and the Structure of the Building Rating system

Within the planning process the data collection is accompanied by the TQB checklist. The sum of all evaluated criteria reflects the social values and form the framework of criteria. A criterion describes a feature of the building, e.g. the operation costs. The TQB criteria can be defined by numbers and instructions of measures. TQB also tries to improve the quality of buildings already in the planning phase by declaring all rating criteria as main objectives. Life cycle assessments of energy and building materials have been used for individual criteria as well. As a consequence, user-friendly, environmentally friendly and cheap buildings can be realised.[5]

The target has to be reachable at all times, but the margins are raised to ever more outlandish levels. Therefore, building rating systems can find themselves in a continuous development. On the one hand this is the result as the status quo is getting better and better and the reference points and scales of

[1] Geissler 2008

[2] Geissler und Bruck 2001

[3] Land Oberösterreich 2010b

[4] Bruck et al. 2002

[5] Bruck et al. 2002

assessment are changing. On the other hand the developers improve as well. (Geissler, January 2010).

These criteria adapted to the Austrian conditions have particular sub-criteria and indicators. They are needed in order to describe the performance of a building and should be comprehensible, life cycle-oriented and verifiable. Targets for quality (e.g. the preservation of biodiversity) are formulated verbally. If the target itself is used as an indicator, a simple yes-no decision is sufficient to describe the measures of reaching the economic aim. The approach towards a target criterion can be achieved by a verbal description in several steps. Subsequently, the assignment to one of these defined scale levels is done. Each of them is provided with their own score. Quantitatively formulated objectives are defined in numbers and units (e.g. the final energy consumption < 42kWh per m² and year). These indicators are calculated by measurements and calculations. They are assigned to figures which are again assigned to a determined score. The optimum value meets the defined target criterion. As a result, for each criterion a score can be allocated, organised by different weighting. The weighting describes the significance of each criterion in relation to one another. If a criterion is rated as being more important, the score will be multiplied by a factor (weighting factor). In case of a concentration of information (aggregation), the multiplied factor will be given more weight.[1]

The building will be registered in different rating categories, documented and evaluated. The nine criteria and sub-criteria can be seen in the following table 7-3:[2]

Table 7-3 Evaluation categories and TQB building rating systems criteria (Source: Author's design, based on Bruck et al, 2002)

Evaluation categories	Criteria
1. Resource conservation	- energy requirement of the building - soil conservation - conservation of drinking water resources - more efficient utilization of building materials
2. Reduction of pollution for the environment and man	- atmospheric emissions - waste avoidance - waste water - reduction of public road transport - load of building materials - avoidance of radon - avoidance of electro smog/electro biological indoor installation

[1] Bruck et al.2002

[2] Bruck et al. 2002

	- avoidance of mould
3. convenience for users	- indoor air quality - cosiness (thermal comfort) - daylight - sun in December - sound insulation in the TOPS - building automation
4. durability	- construction’s flexibility by a change of use - basis for the building operation and its maintenance
5. security	- security against housebreaking - fire protection - security regarding accessibility - surrounding risks
6. quality of planning	- planning process as part of a comprehensive real estate management
7. quality of construction	- construction supervision - acquisition (final acceptance)
8. infrastructure and equipment	- connection to the infrastructure - equipment features of the apartment and the residential complex
9. costs	- calculating the acquisition costs, the follow-up costs and the operating costs

To gain a more comprehensive insight into the TQB building rating system, the criterion of the energy demand of a building will be analysed by the TQB evaluation category resource conservation. The table below provides an overview of a criterion, the sub-criteria and the TQ-tool rating of the TQB building rating. The criterion is divided into four sub-criteria. Three of these will be rated.[1]

[1] Bruck et al. 2002

Table 4: Overview of the sub-criterion energy demand of a building and its classification (Source: Author’s design, based on Bruck et al, 2002)

criteria	sub-criteria	rating TQ-Tool
energy demand of the building	- primary energy to build the structure	+5 to -2
energy demand of the building	- primary energy to utilise the building - heating energy needs - heating requirements and hot water requirements	+1 to -1 +5 to -2
energy demand of the building	- LEK-value (line of European criteria U-values) after ÖN B 8110-1	Not rated – important additional information
energy demand of the building	- renewable energy sources	+5 to 0

Each sub-criterion comprises a defined planning target. To reach this target the applicant of the building certificate has to provide evidence, which will be typed into the TQ – Excel Tool. Table 7-5 gives an exact overview of the criterion energy demand of a building, which has been selected for the table below.[1]

Table 5: detailed structure of the criterion energy demand of a building (Source: Author’s design, based on Bruck et al, 2002)

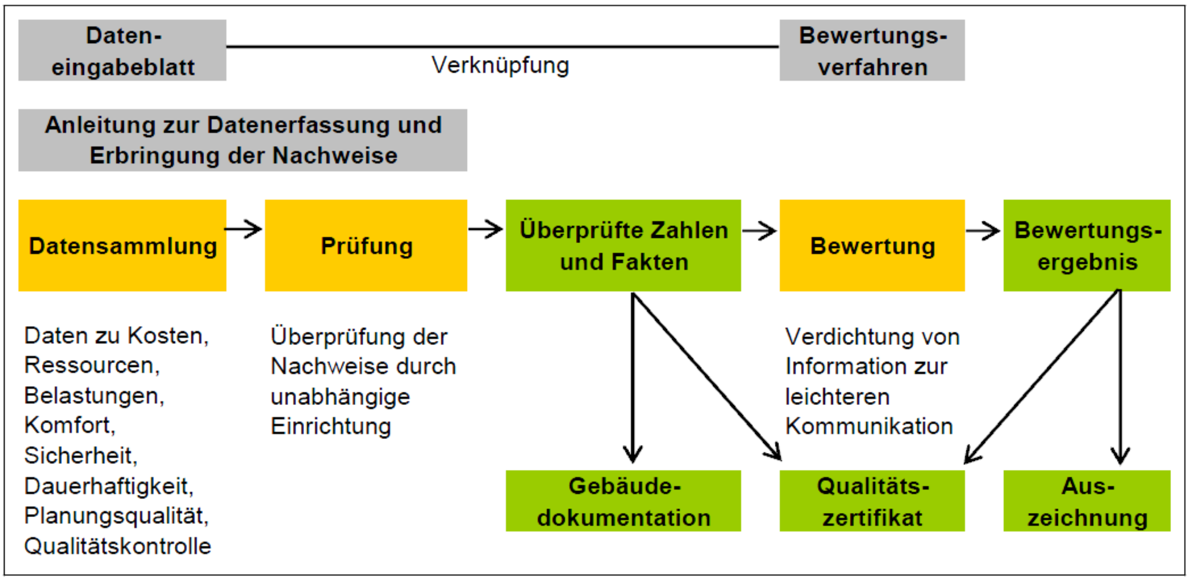
criterion of assessment	sub-criterion	planning target	prove
energy demand of a building	primary energy to raise a building	- reduction of effort of the primary energy to raise a building - requirement of primary energy for durable components <23kWh m²a	- creation of a mass extract and the input into the TQ-Excel Tool - software ECOTECH or LEGOE to calculate the primary energy after ISO 14040 ff.

[1] Bruck et al. 2002

After the working group *Total Quality (Arge TQ)* has controlled the data, two certificates will be awarded, which is a result of the integrated rating process in the planning phase and after the building has been completed. The working group Total Quality consists of the Austrian Institute of Ecology, the Austrian Institute of Building Biology and Building Ecology and the solicitor's office Dr. Bruck.[1]

The methodology of TQB is presented in the illustration below:[2]

Illustration 3: Methodology of TQB – building rating (Source: GEISSLER et al. 2004)



The controlled data and facts can be seen in the documentation of the building. They form a basis for information and assessment. The individual and assessment category's evaluation is conducted by means of a total evaluation. This evaluation comprises information of 25 pages and summarises the building award on four pages. The rating score "0" corresponds with the legal directives. The rating score "5" demonstrates a very challenging object. This resulting certificate of planning and completion is shown in illustration 7-4 below.[3]

[1] ÖGNB 2010b

[2] Geissler et al. 2004

[3] ÖGNB 2010c

Illustration 4: certification of completion, building rating system TQB (Source: ÖGNB, 2010d)

The certification makes the quality of the building very transparent, comparable and it can be easily categorized, offering advantages for selling user-friendly and environmentally friendly buildings. TQB certificates can be awarded for the building of a new residential building or the renovation of a residential building (detached houses or apartment buildings) or for the new building or renovation of office buildings.[1]

7.3. Program “IBO eco-pass (IBO Ökopass)”

The programme “IBO eco-pass” was developed by the Austrian Institute for Building Biology and Building Ecology (IBO). The building rating system is used for residential buildings in Austria. More than 9.000 residential units have already undergone an assessment.[2] The program was especially created for residential buildings.[3] The main target is to prove building-biology quality and building-ecology quality. Furthermore, an important objective is to benefit from sustainable building properties and to get an advantage in competition through real estate marketing. Utilization quality and ecological quality are the major “IBO eco-pass” categories. Table 5 gives an overview of the rating system criteria.[4]

[1] Geissler 2008

[2] ÖGNB 2010e

[3] IBO 2010b

[4] IBO 2010c

Table 7-6: Major categories and its criteria for the IBO eco-pass rating (Source: Modified after IBO, 2010c)

Category	Criterion
Utilization quality	✓ Thermal comfort in Winter/Summer ✓ Indoor air quality ✓ Sound insulation ✓ Daylight and Insulation ✓ Electromagnetic quality
Ecological quality	✓ Ecological quality of building materials and constructions ✓ Energy concept ✓ Use of water

Measurements and calculations for each criterion ensure a correct assessment, which consist of a pre- and final assessment. The "IBO eco-pass" classifies the building quality into 4 levels. The best assessment category is "excellent" and provides ambitious building technical solutions with high convenience and low operation costs. Furthermore, resource-saving procedures are included and the environment is protected. The lowest assessment category is "meet the demands". This standard fulfils the criteria and goes beyond the building regulations and directives.[1]

7.4. Green Building – National Implementation of a European Program

Green Building is a European Union program and awards office buildings. Above-average energetic quality buildings receive a "Green Building Award". The Green Building Program (GBP) is supported by the Austrian Energy Agency and wants to use existing energy efficiency potentials through information and sensitization of market participants. Furthermore, the program supports the transfer of profitable investments for residential buildings.[2]

„The most inquired rating system is Green Building in Austria. Green Building is a European Union programme. The Austrian Energy Agency is commissioned with the management and implementation of the program in Austria. The system is clearly arranged and attaches great importance to energy efficiency"(Geissler, January 2010).

[1] IBO 2010d

[2] Geissler 2008

7.5. Austrian Green Building Council (Die Österreichische Gesellschaft für nachhaltige Immobilienwirtschaft = ÖGNI)

The Austrian Green Building Council (ÖGNI) was founded in 2009 and is affiliated with the German Society for Sustainable Building (Deutsche Gesellschaft für nachhaltiges Bauen, DGNB). ÖGNI represents Austria in the World Green Building Council (WGBC), a global partnership organisation which gives building rating systems a voice and helps to open new markets (see chapter WGBS). The goal of the cooperation is to adapt the DGNB system for Austria and to further develop it into a European certification system. The DGNB board consists of the following persons:[1]

- ✓ Philipp Kaufmann (chairman)
- ✓ Michael Griesmayr (deputy to chairman)
- ✓ Gernot Wagner und Armin W. Rainer (secretary)
- ✓ Gunther Maier und Ralph Scheer (treasurer)
- ✓ Peter Maydl (co-opted)
- ✓ Andreas Oberhuber (co-opted)

The declared aim of the ÖGNI is to promote the sustainability of the Austrian real estate industry, which can contribute to climate protection and to attain emission-targets. The construction of a sustainable building is therefore environmentally friendly, saves resources and considers long-term economic and social requirements.[2]

"The issue is if it is possible for the first time to bring together all stakeholders of the business onto a platform and a willingness to identify with the system. This is why the project that we started is a revolutionary one by bringing together the industry and working on the content, which may possibly show a new way. This conceptual approach is different. Factors like life-cycle costs or life-cycle assessments will not be treated superficially any longer and will be integrated. In the planning documents are required now to consider recycling capability, life-cycle assessment, processes, how do I handle resources. To raise paradigm shift into public awareness is the actual goal of ÖGNI" (Kaufmann, June 2010)

The ÖGNI expert committee is working to adapt the DGNB-system for Austrian conditions. Different national criteria (profiles) are harmonised with the DGNB rating system in order to establish an international comparability of the results. At present some pilot projects are being certified in Austria. The ÖGNI certifications are carried out by independent auditors.

[1] ÖGNI 2010a

[2] ÖGNI 2010a

The society is confined to the development, adaptation and marketing of the system and it controls auditors and their certifications.[1]

Practical details of the ÖGNI rating system are not available yet, because the system is only in its initial stages and the profiles have to be adapted to the Austrian-specific circumstances. The ÖGNI rating system, which is right now in its implementation phase, is still very similar to the German rating system, DGNB, and is extensively treated in chapter 5.1.2.

[1] ÖGNB 2010b

8 Application of Existing Rating Systems Exemplified by the Austria House for the Olympic Games in Vancouver 2010

8.1. The Austria House

The Austrian Passive House Group (APG) has erected a passive house in Whistler, which is the venue for the 21st Olympic games and 10th Paralympics. Within the framework of the Nordic and Alpine competitions the traditional Austria house will make a contribution to the public awareness of environmental protection and the careful handling of resources. The local companies find a global platform during the Olympic winter games. The key message of all the parties involved is that a sustainable and energy-efficient erection and (secondary) use of buildings within and outside Austria can be a substantial contribution towards the solution of the global energy problem. Some further objectives of APG are to publicly raise the issue of climate protection and to promote the future export of technology by Austrian companies in the area of the environment and energy.[1]

The building was planned by APG and the town council of Whistler. The basis for the architectural design by Treberspurg & Partner Architects is a compact structure with a saddleback roof facing the south. As can be seen in 8-1 the uniform appearance is supported by the use of equally black fibre cement shingles, produced by the Eternit company, attached to the whole roof and façade. The public ground floor with bar and catering area and the terrace facing southward are popular meeting places for people working in business, politics, the media and sports. The continuation between the inside and the outside is reinforced by extensive glazing and constant space-building elements. A high user convenience is reached both in winter and in summer, because a lot of daylight enters the interior of the building due to extensive glazing. A staircase, which was built inside and outside of the building, leads to the operationally separate TV-studio on the first floor. The roof edge bent twice by the saddleback roof and the glazed staircase area lines the view towards Blackcomb and Whistler Mountain, which forms the background at TV broadcastings. After the Olympic winter games the building will be used in winter as a cross-country centre and in summer as a mountain bike centre.[2]

[1] APG 2010a

[2] APG Broschüre 2010

Illustration 8-1: South Façade of the Austria House in Whistler, British Columbia, Canada (AGP, 2010)

The object was built as a passive house in solid wood construction by Austrian and German companies and the Canadian company Dürfeld Log Construction Ltd. The 250 m² large building consists of ecological building materials and was erected using state-of-the-art technology and consumes 90% less heating energy than comparable Canadian buildings thus actively contributing towards climate protection and the security of energy supply. The foundation of the building rests on a perimeter-floor pan by the company Isoquick. A polystyrene sheet ensures the thermal insulation towards the ground. The U-value (the coefficient of thermal conductivity) in contact with the ground is 0,119 W/(m²K) and consists of Mendiger basalt, screed, impact sound absorption and reinforced concrete (Rainer, 2009).[1]

The company Sohm-Holzbau erected the building shell in the patented DD diagonal wooden dowel technique (Dialgonal Dübelholz Technik). The structure is held together exclusively by hardwood dowels without steel connections, adhesives and chemicals. The building is especially easy to recycle due to simple ways of dismantling it and its high degree of utilisation. The passive house windows certified by the passive house institute Darmstadt (PHI) with triple glazing and argon filling were produced by the Tyrolean window manufacturer Optwin. The frame and window casement insulations consist of the renewable resources wood and cork (APG brochure, 2010).[2]

The U_w-value (describes the thermal loss of a window, also considers the edge seals of

[1] Reiner 2009

[2] APG Broschüre 2010

insulated glass) of the window is 0,79 W/(m²K). The roof construction has a U-value of 0,79 W/(m²K) as a result of the 44 cm wide mineral fibre insulation. The outer wall has a U-value of 0,108 W/m²K, which is obtained by a 32 cm wide mineral fibre insulation (Rainer, 2009).[1]

The housing technology was delivered by the company Drexel and Weiss and was prized by the Passive House Institute. The installed compact unit aerosmart x2 consists of a ventilation module with heat recovery, a heat pump for space heating with low temperature circuit and the solar system regulating the heating of the service water in separate 300 litre hot water tanks. In addition, the compact unit is used for cooling in summer. The heat dissipation is done by draughts and low-temperature heating surfaces.[2]

The heating demand according to PHPP (Passive House Project Management Package), a project management tool that is applied by architects and planners, is 13 kWh/(m²a). The heating load is 17,6 W/m². Due to the highly insulated construction and the used quality products the annual heating costs of the Austria Passive House amount to about 350,- € for ventilation, heating and hot water (APG, DI Rainer, 2009). The building tightness was guaranteed by an air tightness measurement and is n50 = 0,31 h^{-1} (Rainer, 2009).[3]

A healthy indoor climate is made possible by the use of a glue-free timber construction and untreated wooden surfaces, by choosing resin-poor types of wood (local pine trees) and untreated natural stone flooring made of basalt by the company Mendiger as well as by the installing of the cork-insulated wooden windows. With the aid of product management building materials that contain PVCs or chemicals were not used. A number of APG partner companies with certified environmental products emphasize that a sustainable and efficient construction method was applied. The overall coordination of the project lies with DI Erich Rainer. The advertising agency “Zweiraum” supports the building companies in marketing activities and does public relations work.[4]

8.2. Differences between the Rating System klima:aktiv and the German Quality Seal for Sustainable Building

The Austria House was subjected to the sustainable rating systems to be able to better market the quality of the building. By the high planning and performance quality the advantages of a sustainable and ecological building style should be presented at the Olympic

[1] Reiner 2009

[2] Drexel und Weiss 2010

[3] Reiner 2009

[4] APG 2010b

winter games and should be underpinned with awards. Tables 8-2 and 8-3 show cross sections of the Austria House in Whistler.

Illustration 8-1: Cross Section: Austria House in Whistler (Source: Reiner, 2009)

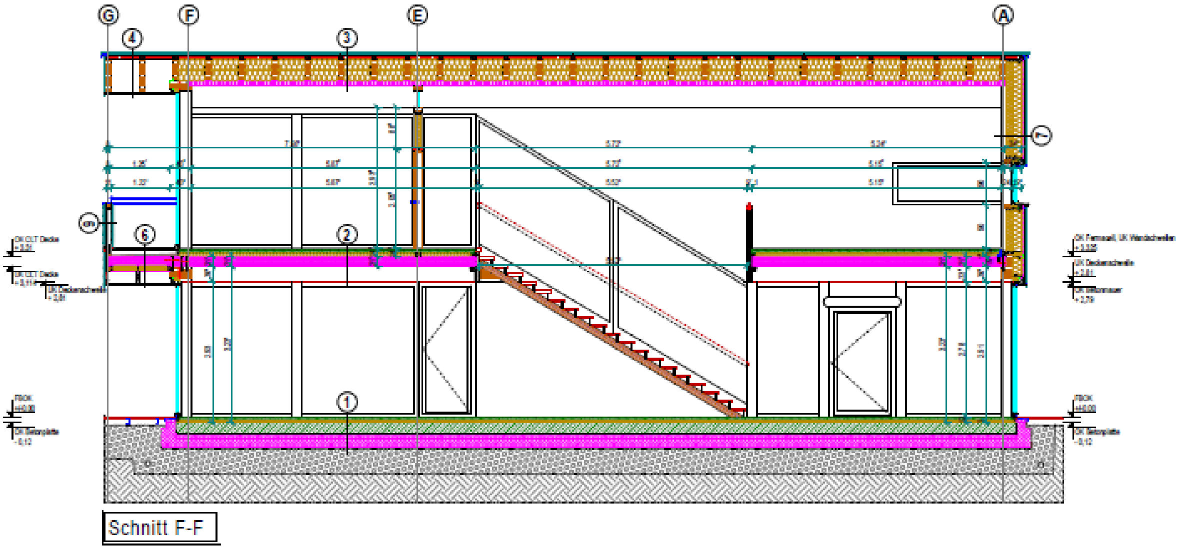


Illustration 8-2: Cross Section: Austria House in Whistler (Source: Reiner, 2009)

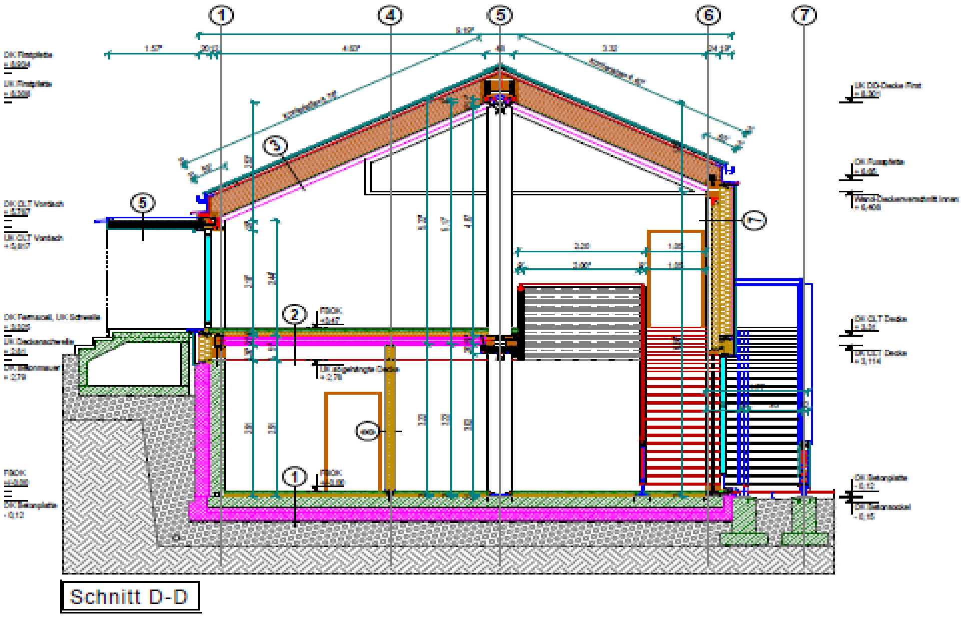
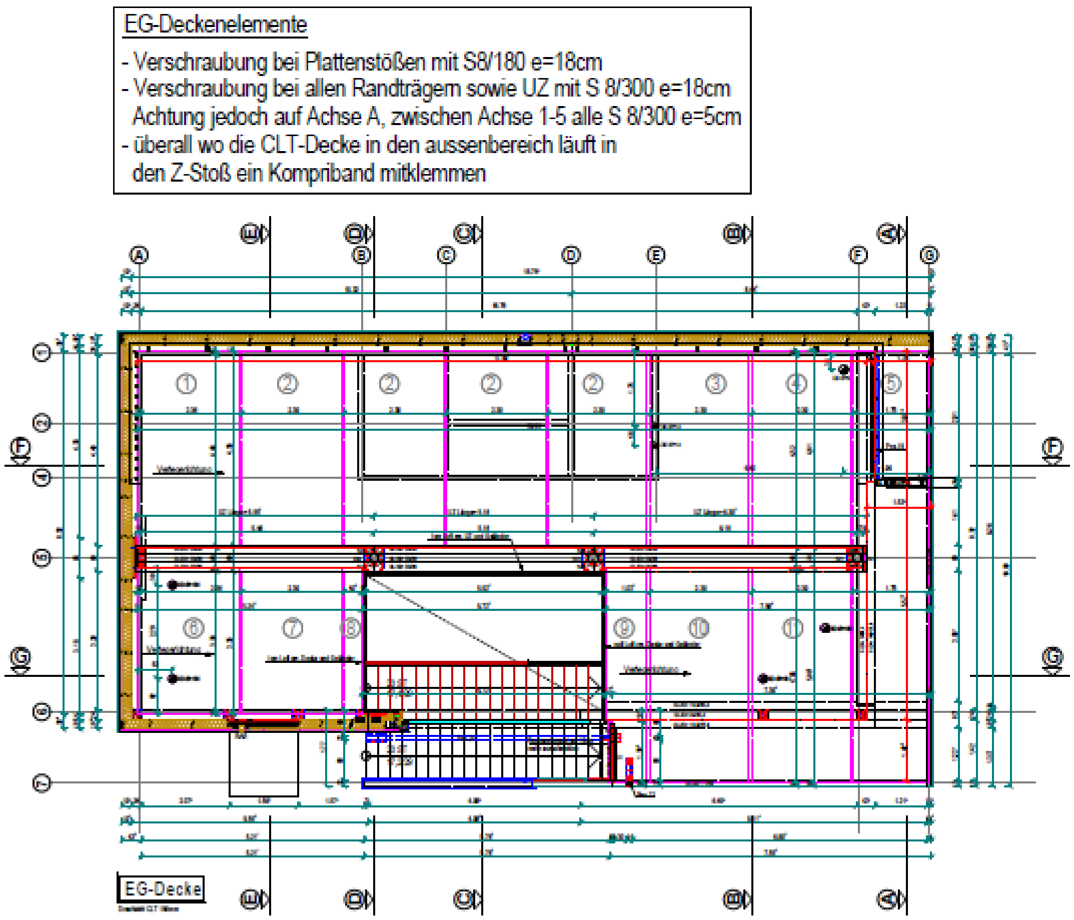


Illustration 8-2: Floor Plan – Austria House with EG-floor elements (Source: Reiner, 2009)



Table

8-4 shows the ground floor plan of the Austria House and the installed floor elements. Principal differences between the two applied sustainable building rating systems are listed in table 8-1. There are differences in the score and the choice of criteria. In addition there are conceptions regarding the complexity of the systems or the setting of priorities.

Table 8-1: Differences between the building rating systems klima:aktiv and the system of the German Society for Sustainable Building DGNB (Source: Smutny, 2010a)

	klima:aktiv	**DGNB**
objectives	evaluation tool concerning energy efficiency and climate protection	planning instrument and quality management tool
system variants	new residential building (STD and PH) and residential building renovation (STD and PH) **service and administrative building (STD and PH)**	**new office and administrative building** new trade buildings type 1+2 new industrial buildings type 1+2 residential buildings (in preparation)
mode	two-phase process; submission of the criteria catalogue by architects, engineers, technicians, etc. → checking by klima:aktiv and probably feedback and queries → certification	multi-stage process with pre-certification for objects in planning or under construction as well as certification for finished buildings; submission by auditor → conformity checking 1st round → feedback, queries and subsequent submission → conformity checking 2nd round → pre- or end-certification
complexity	relatively low (19 criteria): no need for a special training of the rating system	Very high (48 criteria): auditors must undergo a training programme for the rating system
priorities	energy consumption utilization phase (rate 60%), ecological building shell (rate 20%); planning & execution and convenience & indoor air quality (rate each 10%).	ecological, economic, functional, socio-cultural and technical quality (rate each 22,5%); process quality (rate 10%); location quality is listed separately as additional information
score	“scoreforgiving” the score total of the individual criteria is higher than the maximum attainable score in a main group → by this the missing points in one criterion can be supplemented by the point of another criterion knock-out criteria must be met (e.g.: avoidance of climate harming substances)	“scorestrict” the score total of the individual criterion is the same as the maximum attainable score of the main group → not reachable criteria are reflected directly in the main group no knock-out criteria
distribution of criteria	relatively homogeneous number of criteria in the main groups	relatively homogeneous number of criteria in the main groups apart from Economic Quality with only 2 criteria → these 2 are rated extremely highly

9 klima:aktiv – Award

The next chapter describes the “klima:aktiv” award of the Austrian House in Whistler.

„In fact, the value of a building assessment is the data acquisition and the data documentation. For me, the assessment is subordinated. If you assess building with LEED, ÖGNB or DGNB systems you will get varying results. An assessment of data is to interpret sociopolitical perceptions, which change over time. Nevertheless it is obvious that there is a market demand for an assessment result“ (Geissler, January 2010).

9.1 General Information for a klima:aktiv Assessment

The assessment of the Austrian House is made with the help of the catalogue of criteria for “New Services Buildings and Commercial Interiors Version 1.4.”(in our case in passive house quality).The catalogue of criteria was developed by the Energy Institute Vorarlberg with the collaboration of the Austrian Institute for Healthy and Ecological Building (IBO) and the Graz University of Technology. Their client was the Federal Ministry of Agriculture, Forestry, Environment and Water Management. The assessment is based on an ordinal point system. The maximum score amounts 1.000 points. There are four major rating categories[1]:

150 points for planning and realization
550 points for energy and supply
200 points for building materials and construction
100 points for comfort and indoor air quality

In each rating category there are different weighted criteria. Basically we have to distinguish between obligatory criteria and additional criteria. If the planners achieve all possible points of all criteria in the categories, they would reach more points than the maximum score of 1.000 points. Therefore the planner has a certain amount of leeway. A “klima:aktiv” passive house standard for „New Services Buildings and Commercial Interiors Version 1.4.” fulfils all obligatory criteria and achieves at least 900 points. The assessment of buildings is carried out by a combination between a declaration of the builder/planners and a plausibility check.[2]

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[1] BMLFUW 2009

[2] BMLFUW 2009

This combination is executed in two steps:

- ✓ At the time of submission
- ✓ At the time of building completion

9.2. Results of the „klima:aktiv“ Certification

The Austria House was awarded by the Federal Ministry of Agriculture, Forestry, Environment and Water Management as a “klima:aktiv” passive house standard. The audit of BOKU University (University of Natural Resources and Applied Life Sciences) resulted in an excellent rating concerning energy efficiency and building ecology. In total the Austrian House in Whistler achieved 983 points out of 1.000 obtainable points. By measuring the air quality the maximum score of 1.000 points can be achieved.

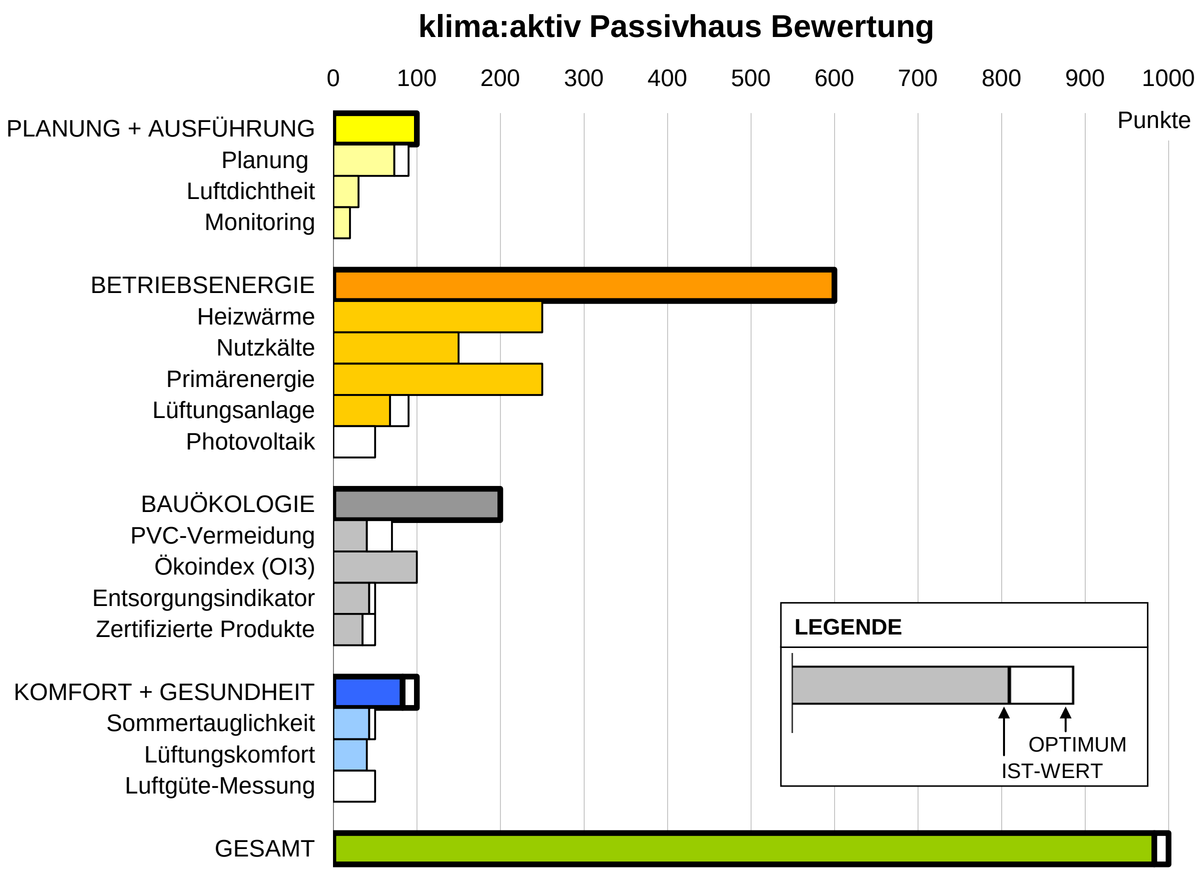
As it is shown in Table 9-1, the score of each major category is illustrated. Because of a missing check (measurement of air quality) the maximum score in the category convenience and indoor air quality cannot be reached.

Table 9-1: Major categories of klima:aktiv, number of criteria, weighting and degree of performance (Source: Modified after Smutny, 2010a)

klima:aktiv / Major categories	Number of criteria	Weightning in %	Achieved in %
Planning and realization	6	**10**	**10**
Energy and supply	5	**60**	**60**
Building materials and construction	5	**20**	**20**
Convenience and indoor air quality	3	**10**	**8,3**
SUM	19	**100**	**98,3**

The degree of performance for each criterion of “klima:aktiv” is shown in illustration 9-1. There is no photovoltaic system installed at the Austrian House. Furthermore, the prevention of PVC in water- and electrical installations cannot be controlled. From that perspective, some criteria (additional criteria) do not achieve the maximum score.

Illustration 9-2: Degree of performance for klima:aktiv criteria (Source: Smutny, 2010a)



9.2 Detailed results of the klima:aktiv certification

The major categories and their criteria are explained to obtain a detailed overview. The detailed results show the main targets and evidence which have to provided and give further information as well as background knowledge.

9.2.1 Planning and Realization

Table 9-3: Degree of performance for each individual critierion - klima:aktiv standard (Source: Modified after Neururer, 2010a)

A	Planning und Realisation					**max. 100**	**100**	
A 1.	**Planning**					**max. 90**	**73**	
A 1. 1	Avoidance of motorized individual transport					max. 40	x	23
A 1. 2	Simplified calculation of life cycle costs					max. 50		0
A 1. 3	Product management – Use of low emission building materials					max. 50	x	50
A 1. 4	Building shells: optimized thermal bridge	ΔU_{WB}		W/m^2K		max 30		0
A 2.	**Realization**					**max. 40**	**40**	
A 2. 1	Building shells airtight	n_{50}	0,28	h^{-1}	M	max. 30	x	30
A 2. 2	Registration of energy consumption				M	max. 20	x	20

A 1. Planning

A.1.1. Avoidance of motorized individual traffic

Proof is given by presenting plans (site map) and marking in a list of bus stations and infrastructure facilities (300 meter-radius as well as 500 meter-radius distance from the Austria House). Furthermore, timetables of public transport and additional plans (floor plan) depicting cycle parking areas for staff and visitors are presented.

A.1.2. Simplified calculation of life cycle costs

Simplified calculations of life cycle costs according to ÖNORM M 7140 / VDI 2067 / ISO 15686-5. The main target of the calculation is to avoid planning errors, which lead to high energy consumption, one-sided energetic optimizations and uneconomic energy concepts. In our case no calculation was carried out.

A.1.3. Product management – Use of low emission building materials

APG can avoid environmental damage if they anchor certified building materials and construction chemicals in tenders and consider this in the placing of the orders. Volatile organic compounds, formaldehyde and heavy metals, which contain carcinogenic, mutagenic and (reproductive) toxic substances, are consequently minimized. Wood materials and construction chemicals such as wall paint, (floor-)layer material or sealing material undergo an inspection. Product management means that a continuous quality assurance takes place at the building site. Hence, the use of building materials can be controlled. All construction chemicals and building materials (especially used in the interior and inner wall) are subjected to a product management process. “Baubook.at“ functions as a data based list of building products and is suitable for research in the planning phase. The implementation is documented in a summary report and is controlled by room air measurements after the building completion. Following the principle of sustainability and based on the principle of precaution and prevention the persons involved in the process have minimized substances that environmentally hazardous and dangerous to people’s health:

1. Low-emission wooden material was used.
2. No use of formaldehyde-containing binders in wooden material.
3. No use of resilient floor coverings.
4. No use of textile floor and bituminous compositions
5. No use of chemical construction in interior rooms.

A.1.4. Building shells: optimized thermal bridge

The main target is to avoid structural building damages caused by moisture and to reduce heat loss. Evidence can be shown by a graphic representation of relevant connection details on the scale of at least 1:20. The following connection details (lowest inner surface temperature and thus highest heating loss) have to be illustrated: storey ceiling, outer wall, inner wall, balcony, front door, windows, ridges or dormers. Here, the used materials and their thermal conductivity are obligatory. Quantitative evidence can also be supplied if a thermal bridge calculation according to **ÖNORM EN ISO 10211-1/2** with values from thermal bridges catalogues is used. In our case no calculation was carried out.

A.2. Realization

A.2.1. Building shells airtight

The main target is to avoid structural building damages caused by moisture. An air tightness test (Blower Door test) according to **EN 13829** has to be enclosed. Here a test series with top- and negative pressure has to be performed. The calculated value was n_{50}=0,31 h^{-1}. As a consequence the value meets the criterion.

A.2.2. Acquisition of energy consumption

A monitoring concept has to be created. This concept contains an illustration of relevant meter readings. All meter readings are in connection with an existing system and are integrated in an energy accounting system. In the planning phase the following meter readings need to be considered: separated collection of electricity, household electricity, compact device with (minimal) heating pump, geothermal energy use and cold water supply. The measurements have to be presented at a publicly available area. The energy consumption can be requested at an online platform.

9.2.2 Energy and Supply

Table 9-4: Degree of performance for each individual critierion - klima:aktiv standard (Source: Modified after Neururer, 2010a)

B	Energy and Supply					**max. 600**	**600**	
B 1.	**Energy demand (use)**					**max. 350**	**350**	
B 1. 1b	Heating demand (PHPP 2007)	HWB_{BNF}	12,0	kWh/(m2.a)	M	max. 250	x	250
B 1. 2b	Cooling demand (PHPP 2007)	$Q_{K,BNF}$	3	kWh/(m2.a)	M	max. 150	x	150
B 2.	**Primary energy demand**					**max. 300**	**300**	
B 2. 1b	Primary energy demand (PHPP 2007)		23	kWh/(m2.a)	M	max. 250	x	250
B 2. 2b	Ventilation system energy efficient					max. 90	x	68
B 2. 2b	Photovoltaic system		0	kW_{peak} pro m^2 BNF		max. 50	x	0

The assessment of the energetic performance is one of the main topics and can alternatively take place in two ways:

- ✓ Assessment according to calculation methods by the OIB directive 6 and the associated standards.
- ✓ Assessment according to Passive House Planning Package (PHPP). The PHPP includes calculating the U-values of components with high thermal insulation, calculating energy balances, designing comfort ventilation, calculating heat load or summer comfort calculations.

B.1. Energy demand (use)

B.1.1. Heating demand and cooling demand

The criterion heating demand targets the reduction of heating demand and is met if the heating requirement amounts to a maximum of **15 kWh/m²a.** The evidence was carried out with PHPP and is **12 kWh/m²a.** The criterion cooling demand illustrates the reduction of the cooling demand in a building and is met if the cooling demand amounts to a maximum of **15 kWh/m²a**. Proof is given with PHPP and is **3 kWh/m²a**.

B.2.b Primary energy demand

B.2.1b Primary energy demand

The total primary energy demand may not be higher than **100 $kWh/m^2_{WNF}a$** and contains the primary energy demand for heating, cooling, hot water preparation and auxiliary electricity for heating and ventilation as well as electricity for lighting and computer equipment. Is the criterion achieved, the building gets 250 points for the rating. The assumptions and guidelines of the Passive House Planning Package (such as interior heat sources, water demand, consideration of thermal bridge effects) apply to the calculation for heating and total primary energy demand. The criterien is achieved with PHPP and is lower than **23 $kWh/m^2_{WNF}a$.**

B.2.2b Ventilation system energy efficient

For evidence the following documents have to be submitted: calculation of ventilated area and net floor space. Furthermore, a test report of the ventilation system has to be submitted.

B.2.3b Photovoltaic system

For evidence the following documents have to be submitted: an appropriate program for calculating regional climatic data considering local shading, illustration of solar modules´ site and area, data sheets of selected modules and components. In our case, no calculations have been made because the non-photovoltaic system was installed.

9.2.3 Building Materials and Construction

Table 9-5: Degree of performance for each individual critierion - klima:aktiv standard (Source: Modified after Neururer, 2010a)

C	Building materials and construction		**max. 200**	**200**	
C 1.	**Avoidance of environmental pollutants**		**max. 70**	**40**	
C 1. 1	Avoidance of climate-damaging substances	M	0	x	0
C 1. 2	Avoidance of PVC	tlw. M	20-70	x	40
C 2.	**Use of ecological building materials and constructions**		**max. 170**	**170**	
C 2. 1	Ecological specific value of thermal building shells		max. 100	x	100
C 2. 2	Waste management indicator of thermal building shells		max. 50	x	43
C 2. 3	Certified products		max. 50	x	35

C 1. Avoidance of environmental pollutants

C 1.1. Avoidance of climate-damaging substances

It is matter of harmful substances which are found in the following product groups: XPS-insulation panels, PU-construction foams, PU-cleaners, products in pressurized gas packaging, PUR/PIR-insulation material. These products contain the following substances:

- **Halogenated chlorofluorohydrocarbons (CFCs)**
- **Partially halogenated hydrofluorocarbons (HFCs)**
- **Sulphur Hexafluoride (SF6)**

According to Austrian regulations these substances are already prohibited. In the „klima:aktiv“ standard the criterion avoidance of climate-damaging substances is a must-criterion. In our case, no climate-damaging substances were used in ceiling- and floor constructions. Evidence is proven if delivery notes, product data sheets, technical leaflets, certified products and certificates by the manufacturers are submitted.

Following materials were used:

- ✓ Polystyrol paving tiles insulation (Company: Isoquick, www.isoquick.de)
- ✓ Mineral fibre insulation of walls, ceilings, roof (company: ISOVER)
- ✓ Solid timber – passive house windows without synthetic insulation material (Company: Optiwin, www.optiwin.net)
- ✓ 3-times thermal protection glazing filled with argon gas (Company: Glas Trösch, www.troesch.de)
- ✓ A massive construction with untreated fir-timber, without adhesives (Company: Sohm, www.sohm-holzbau.at)
- ✓ Timber surfaces untreated, inwards visible installed (DD-Diagonaldübelholz)
- ✓ Strong construction-used parts of the building untreated with massive oak timber
- ✓ 3-layered massive wood plate
- ✓ Natural stone made out of lava-basalt material (Company: Mendiger-Basalt, www.mendiger-basalt.de)
- ✓ The under roofing lane is open to diffusion (Made of Sarnafil TU 222, www.sarnafil.at)
- ✓ Ventilated roof and facade made of Eternit (www.eternit.at)
- ✓ Consequent realization of wood protection measures
- ✓ Complete avoidance of chemical wood protection measures

C 1.2. Avoidance of PVC

The following materials have to be free of PVC (must criterion):

- Sealing sheets, foils, various sealing
- Floor coverings, baseboards, wall or floor covering (wallpapers)

Recommendation for the following materials to be free of:

- Material for electrical installations including cables, lines, pipes, boxes, etcetera.
- Windows, doors, shutters
- Water and waste water pipes, exhaust pipes, supply air

The Austrian Passive House Group dispenses of PVC-containing products. In all parts of the building shells as well as ceilings- and roof constructions no PVC-containing products such as sealing sheets or foils exist. It cannot be excluded that PCV-containing products were used in materials for electrical- and water installations. These installations were accomplished by local Canadian construction law requirements and therefore standard market products were installed.

C 2. Use of ecological building materials and constructions

C 2.1. Ecological specific value of thermal building shells (eco-index 3)

Ecological optimization is defined as the minimization of flows of material and emissions according to production processes of the building and building materials. This optimization process can be calculated in simplified terms with the ecological index of the thermal buildings shells (OI3 index). The ecological index calculates three important environmental categories such as primary energy demand of non-renewable energy, the global warming potential and the acidification potential. The ecological production efforts of a building accrue by production processes and will be immediately effective. The ecological using efforts, however, accrue in the course of the economic lifetime of a building. Therefore the ecological production optimization is immediately relevant for human-caused environmental damage such as climate change (for example CO_2 certificates for the building industry). A calculation of the OI3 index can be made with the help of the program “EcoSoft_Entsorgung” in the starting phase (later also with the programs Ecotech, Archiphysik, GEQ). In our case the OI3 index was calculated with Ecosoft WBF 1.2.

C 2.2. Waste management indicator of thermal building shells

The main target is to achieve good disposal properties for building materials and building constructions. The calculation and documentation of the disposal property figure can be carried out with the help of the program EcoSoft_Entsorgung (also with the programs Ecotech, Archiphysik, GEQ).

C 2.3. Certified products

The main target is to minimize harmful environmental impacts and effects on health. Therefore all building materials which are used in building shells and interior fittings have to fulfill high environmental standards. The following standards are recognized as being high for building products: Austrian Environment Label, natureplus, IBO-Prüfzeichen (test mark). For the building shells the following evidence is provided:

1. Baseplate: Company Isoquick with Certification, proof company Mendiger of nauturl stone floor, company ISOVER with insulation certification
2. Top ceiling: Company ISOVER with insulation certification
3. Proof company Sohm for building shells, company ISOVER with insulation certification
4. Windows: Certification and proof from the company Optiwin, proof company Sohm for building shells

9.2.4 Convenience and indoor air quality

An essential aspect for the satisfaction at the workplace is thermal convenience. Threshold values have to achieved and guaranteed according to work safety regulations. The optimal interaction between window areas, thermal mass, heating and ventilation system, shading and heat insulation enables comfortable temperatures for building users at any time of the year.

Table 9-6: Degree of performance for each individual critierion - klima:aktiv standard (Source: Modified after Neururer, 2010a)

D	Convenience und indoor air quality		**max. 100**	**83**	
D 1.	**Thermal convenience**		**max. 50**	**43**	
D 1. 1	Thermal convenience in Summer		50	x	43
D 2.	**Indoor air quality**		**max. 60**	**40**	
D 2. 1	Convenience ventilation system is optimized (CO_2-control, air filter, sound etc.)	M	40	x	40
D 2. 2	Compliance of standard values concerning indoor air quality		50		0

D 1. Thermal convenience

D 1.1. Thermal convenience in summer

Buildings with pleasant indoor climate conditions contribute to human well being and to an increase in the power of concentration. In administrative buildings planners face a particular challenge to secure thermal convenience, especially in buildings without installed cooling systems.

Proof is a dynamic cooling load calculation/simulation under defined climate conditions. Buildings with active cooling require standards according to **cooling load calculation ÖN H 6040 or VDI 2078**, **cooling requirements according to ÖN B 8110-6.**

D 2. Indoor air quality

D 2.1. Convenience ventilation system is optimized

The following requirements have to be achieved to guarantee an adopted air change rate:

- ✓ Dimensioning of the air volume – air quality classification 2 has to be reached **(ÖNORM EN 13779)**
- ✓ Relative humidity between 30 and 60%, temporary humidity of 20% is tolerable
- ✓ Control options of room occupancy/CO_2 content/humidity content

To avoid noise pollution the following target value should be observed:

- ✓ The A- evaluated sound pressure level is max. 30 dB(A) at workplace

The following requirements have to be achieved to guarantee hygienic regulations:

- ✓ Outside air filters at least F7 according to EN 779.
- ✓ Outside air filters´ prevention of moisture penetration

D 2.1. Compliance of standard values concerning indoor air quality

The easiest way to control product management efficiency is a random testing of indoor air quality of show rooms. As a consequence, the use of building products which influence indoor room quality can be proven. If such a measurement is performed, planners and builders get further clarification if VOC-containing and formaldehyde-containing products have been avoided. The proof is provided in accordance to an **inspection report, chemical analysis with gas chromatography and mass spectrometry ÖNORM M5700**. Measurements results have to be below the thresholds and are carried out by an independent laboratory.

10. ÖGNI / DGNB – Certification

In the following chapter the results of the ÖGNI/DGNB certification are introduced.

10.1 General information about the rating with the ÖGNI/DGNB System

A further award was given ceremoniously to the APG (Austrian Passive House Group) by the ÖGNI (Austrian Green Building Council): The international quality seal for sustainable building (DGNB) – the first award of this kind for an Austrian building. The building was assessed by the standards for new office and administration buildings. After submitting the required evidence and documents a pre-certificate is already issued at the planning phase if the regulations are met. After completing the building process a certified auditor awards the owner's building object provided the planned construction projects were carried out during the building process. The quality seal considers not only ecological and economical criteria but also socio-cultural and functional criteria. An additional main group of the DGNB rating system is the technical quality of the building. The main criteria group process quality (planning and completion of a building) completes the rating categories. Due to the variety of locations and the associated difficulties in comparing the quality of them the location of a building is in fact taken into account in the DGNB rating system but it is treated in a separate main criteria group and it is not included into the overall rating.[198]

10.2 Results of the Certification with the ÖGNI/DGNB System

The Austria House was awarded the silver medal and reached a degree of performance of 78,2%. This corresponds with an overall mark of 1,56. Table 10-1 gives a survey of this rating result.

Table 10-1: Survey of the Rating Results (Source: Universität für Bodenkultur, 2010)

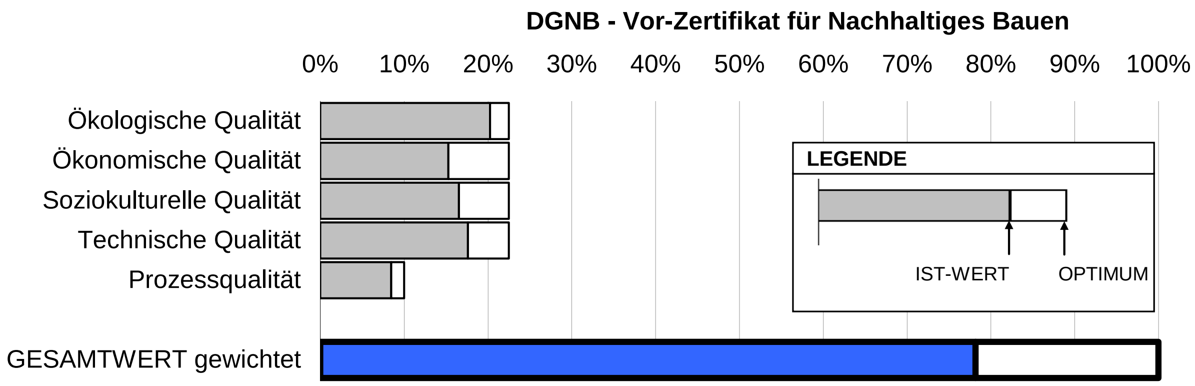
Hauptkriteriengruppen	Anteil Gesamtnote	Erfüllungs-grad	Note
ökologische Qualität	22,5%	90,0%	1,17
ökonomische Qualität	22,5%	68,0%	1,90
Soziokulturelle und Funktionale Qualität	22,5%	73,6%	1,71
Technische Qualität	22,5%	78,3%	1,56
Prozessqualität	10,0%	84,6%	1,35
Standortqualität	0,0%	71,2%	1,79
Gesamt-Erfüllungsgrad / Note		78,2%	1,56
Medaille		Silber	

As can be seen in Table 8-5 the borderline to a gold award is 80,0% and therefore the award in gold has narrowly escaped. The rating of the Austria House by the DGNB rating system confirms that the ecological quality of the house can be assessed as very good. Likewise the criteria for process quality are evaluated as very good. As can be seen by the blue bar in Table 10-2 the total degree of performance reaches 78,2%. Besides the technial equipment of the house the process quality is also rated with gold.

Table 10-2: Award Scheme of the DGNB Rating System

Mark of the Rating	Award	Degree of performance in %
Mark 1,0		95%
Mark 1,5	Borderline Gold	80%
Note 2,0	Borderline Silver	65%
Mark 3,0	Borderline Bronze	50%

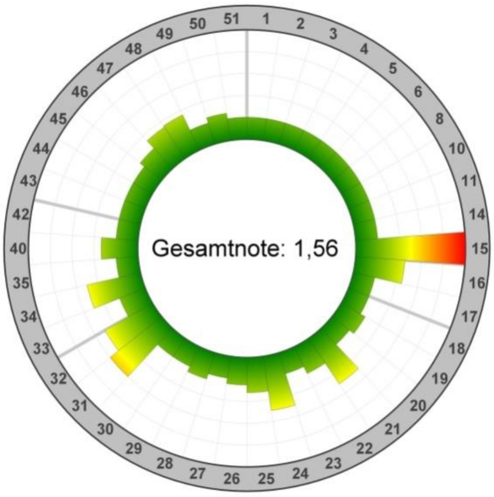
Figure 00-1: Graphic Presentation of the DGNB Pre-Certificate for the Austria House (Source: Universität für Bodenkultur, 2010)



The DGNB rating system is supported by a specific software that enables you to very closely inspect the results. The possibilities for improvements are illustrated in 10-3 by the ensuing transparency of the individual criteria. The consumption of settling area was rated in a relatively strict way as the settling area in Austria in contrast to Canada is a very limited resource. The economical quality of the Austria House was rated with silver, because the construction costs were relatively high. The causes for this can be found in the high costs for initiation , planning and completion as well as the low height of the building. Due to the small building volume there is a significantly unfavourable proportion of, mostly cost-intensive, building shell to created room volume. Small buildings are mostly considerably more expensive than large-volume buildings. Points are deducted at the criterion planning competition because a non-open planning competition was carried out. Furthermore, the building received no prize at an architecture award and no international competition was put out for tender. Although the minimal criteria are in compliance with the norm and an added performance of the norm as concerns external noise was achieved the criterion sound insulation did not get the maximum points. The reason for this is that an added performance of the norm could not be obtained in the interior of the building.

The DGNB rating system for new office and administration buildings comprises five main categories that are subdivided into 51 individual criteria. An additional diagram of these 51 criteria of the DGNB software illustrates the weaknesses of the building. All criteria are listed in the circle diagram. While the red highlighted bar indicates the weaknesses of the building the green highlighted bar reflects a very good rating result. The high demand for settling area (criterion 15) is shown in figure 10-4 and is rated negative.

Figure 00-2 Diagram with the DGNB rating with the overall mark (Source: Universität for Bodenkultur, 2010)



10.3 Detailed Results of the Certification with the ÖGNI/DGNB System

In order to obtain a comprehensive survey of the rating system ÖGNI/DGNB the criterion demand for drinking water and quantity of wastewater of the main category ecological quality as well as the criterion building site/building process of the main category process quality are specified. The criterion demand for drinking water deals with the ever more important consumption of resources. The criterion building site/building process measures the quality of the construction work. As you can see below for some criteria (e.g., criterion 14, drinking water consumption) there is a need for detailed information and exact mathematical calculations while for other criteria (e.g., criterion 49, building site/building process) evidence must be provided which, however, consist of qualitative sub-criteria and therefore the documentation of the building quality is more important.[1]

10.3.1 Criterion 15: Demand for Drinking Water and Quantity of Wastewater

The criterion is part of the criteria group consumption of resources and waste production and part of the main criteria group ecological quality. The goal is to reduce the consumption of drinking water and the production of wastewater by implementing suitable measures, to reduce the costs for providing drinking water and the costs for waste water treatment and to avoid the disruption of the water cycle as far a possible. The rating is done with a quantitative method in m^3/a. The less the demand for drinking water is and the less the expected wastewater quantity is the better the criterion is rated. For the rating of the demand for

[1] BNB 2010a

drinking water and quantity of waste water primarily measures are considered that can be influenced by planners. According to the number of employees, roof area, net floor area and planting the annual demand for drinking water as well as the production of wastewater is extremely diverse in buildings. Therefore dynamic threshold values, which are calculated with the following formulas, are set up with the individual conditions of buildings[1]:

- ✓ **for office buildings without shower facilities**

  G (m³/a) = (nMA*11,9 m³/aMA) + (ANGF*0,008 m³/m²a) + NV
- ✓ **for office buildings with shower facilities**

  G (m³/a) = (nMA*15,0 m³/aMA) + (ANGF*0,008 m³/m²a) + NV

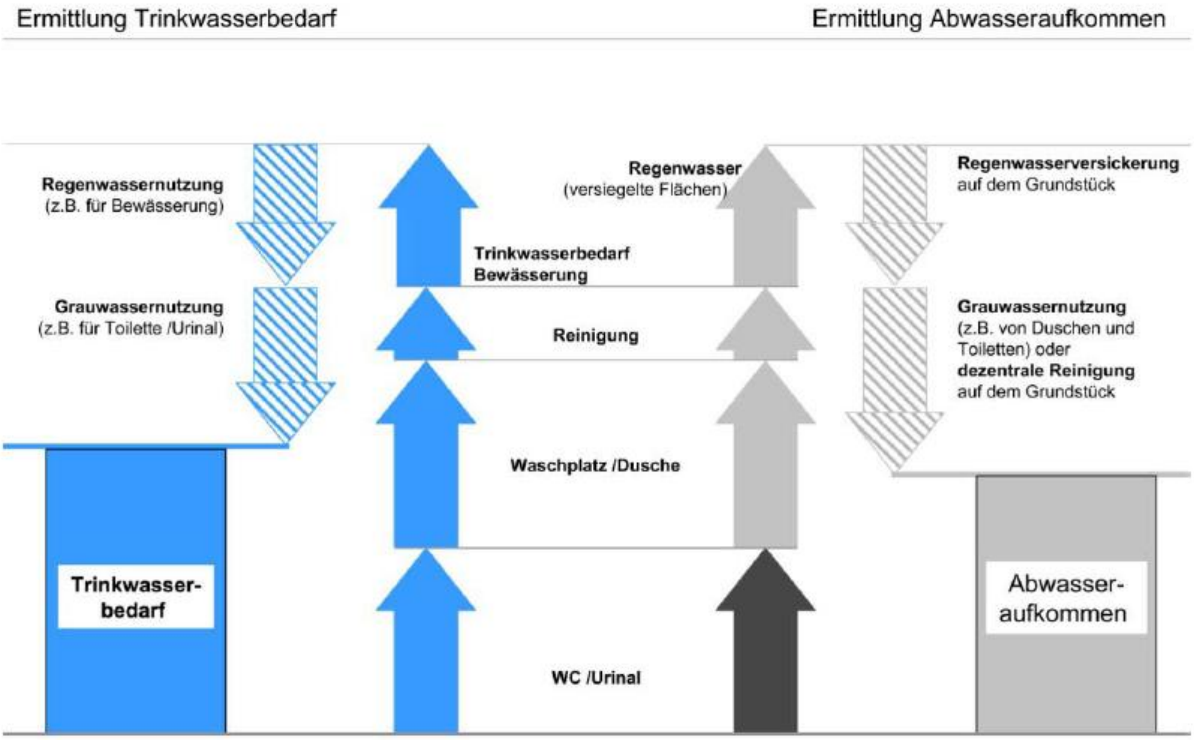
nMA = number of employees, NGF = net floor area, N_{V} = expected precipitation (roof area and sealed building plot area) in [m³/a]

By the utilization of rainwater and grey water the demand for drinking water can be reduced. Grey water is faeces-free, slightly polluted water that is, for example, produced when taking a shower, having a bath or when washing your hands (European Norm 12056-1) and by the implementation of water-recycling systems can be used a second time (e.g. cleaning of buildings or flushing toilets). If grey water does not enter the sewage system and water is saved when cleaning the demand for water can be reduced. The demand for drinking water and wastewater production flows are portrayed in figure 10-5. As a rule, however, the number of employees is the decisive factor. In the planning conditions are created that influence the demand for water regardless of user behaviour..[2]

[1] BNB 2010b

[2] BNB 2010b

Table 10-3: Diagram of the Demand for Drinking Water and the Quantity of Wastewater (DGNB 2010, New Office and Administration Buildings)



The lower the characteristic value for water use the better the rating for the house is. The characteristic value for water use W_{KW} is calculated as follows

[1]:

$W_{KW} = (WB_{MA} + AW_{MA}) + (WB_R + WA_R) + (AW_{RW} * f_r)$

WB_{MA} = demand for drinking water of the employees in m^3/a

AW_{MA} = wastewater production of the employees in m^3/a

WB_R = demand for drinking water by the employees in m^3/a

WA_R = wastewater production when cleaning in m^3/a

AW_{RW} = quantity of rainwater entering the sewage system in m^3/a

f_r = correcting reduction factor von 0,5*

The characteristic value for water use of the Austria House was calculated and is 64,97. In the following table the demand for drinking water and quantity of wastewater by the employees as well as the cleaning is shown. The demand of drinking water for the irrigation

[1] BNB 2010b

of the outdoor facilities was not calculated, because due to high precipitation there is no need for irrigation. In the following figure the calculations are explained.

1

Figure 10-4: Detailed Calculation of the Demand for Drinking Water and the Quantity of Wastewater (Source: Neururer, 2010b)

1. Trinkwasserbedarf und Abwasseraufkommen durch die Mitarbeiter

	n_{MA}	f_i	as_i	d/a	m³/a	
Handwaschbecken:	7	45,00	0,15	210,00	9,92	
WC - Spüle:	7	1,00	4,50	210,00	6,62	
Dusche:	7	30,00	0,25	210,00	11,03	
					27,56	WB_{MA}
					27,56	AW_{MA}

2. Trinkwasserbedarf und Abwasseraufkommen durch die Reinigung

	A_R	$wb_{R/A}$		
Fußboden (3x wtl.):	237,60	18,75	4,46	
Glasflächen (innen+ außen 6/a):	260,00	1,80	0,47	
			4,92	WB_R
			4,92	AW_R

3. Trinkwasserbedarf für Bewässerung

Es werden aufgrund des hohen jährlichen Niederschlages keine Außenanlagen künstlich bewässert

4. Abwasseraufkommen durch abgeleitetes Regenwasser

	A_D	e_D	A_V	e_V	S_{RW}	
Niederschlag:	156,00	1,00	0,00	1,00	1,33	207,64 $N_V = V_{RW}$

Das Regenwasser versickert am Grundstück	0,00	AW_{RW}

Grenz- und Zielwerte

	n_{MA}		A_{NGF}		N_V	
Grenzwert Büro mit Dusche	7,00	15,00	250,00	0,008	207,64	314,636

Referenzwert	207,66
Zielwert	**103,83**
X	0,66
Y	0,33

Summe alle WB AW	**64,97**	W_{KW}

[1] BNB 2010b

10.3.2 Comments as to the Calculations for the Demand for Drinking Water and Quantity of Wastewater

The demand for drinking water and quantity of wastewater by the employees amounts to 27,56 m^3/a. These values are composed by the variables number of employee n_{MA}, installation values (as_l = flow volume classes / purge volumes) and the installation-specific factor for water use f_l. The quantity of wastewater by the employees is also 27,56 m^3/a, because no wastewater is recycled by a respective treatment.

The demand for drinking water and quantity of wastewater for cleaning amounts to 4,92 l m^3/a. This number is obtained by the parameters $wb_{R/A}$ (area-related demand of water for cleaning for a specific cleaning area according to cleaning interval in l/m^2a) and A_R (specific cleaning area, i.e. to be cleaned floor coverings and window areas accordingly differentiated as regard cleaning interval in m^2). The demand for drinking water for artificial irrigation is non-existent, because there is enough precipitation. The rain water entering the sewage system AW_{RW} is zero (0,00), because no rain water is diverted into the sewage system. The quantity of the rain water that seeps into the ground (V_{RW}) is 207,64 m^3/a. This value is deduced from the considered precipitation and is calculated according to the following parameters [1]:

- ✓ AD roof area
- ✓ AV sealed plot area
- ✓ eD return coefficient of the roof space
- ✓ eV return coefficient of the sealed plot area
- ✓ SRW site specific annual precipitation

For office buildings with shower facilities there is a threshold value of 314,636 m^3/a, which is derived from the following formula[2]: $G = (n_{MA} * 15,0\ m^3/a_{MA}) + (A_{NGF} * 0,008\ m^3/m^2a) + NV$
Reference value and target value are a result of the reduction coefficients:

R = X*G = 207,66 und Z = Y*G = 103,83

The corresponding factors x and y are to be defined as follows

X = 0,66 and Y = 0,33

The **characteristic value** for the water consumption of the Austria House in Whistler is therefore **64,97 m^3/a.**

[1] BNB 2010b

[2] BNB 2010b

10.4 Criterion 48 Building Site/Building Process

In all the phases of the life cycle of buildings sustainable building strives to minimize the consumption of energy and resources. The execution of the construction work in general and the building process in particular are of great importance as the environment is directly affected. As a consequence the aim is therefore to minimize these negative effects on the environment and to simultaneously protect the health of all the people involved. The assessment of the criterion building site/building process comprises the sub-criteria low-waste building site, low-noise building site, low-dust building site and soil conservation at the building site[1].

10.4.1 Low-waste Building Site

When buildings are erected, renovated or demolished waste material such as rubble, excavated soil, leftovers, packaging material, scrap metals or waste wood are left behind. According to the life-cycle management and waste law these waste materials, which make up a great deal of the total waste production, shall be prevented and recycled. By preventing the resources are conserved. In addition lower disposal costs arise. Based on the tendering and bidding documents the requirements for the reduction of waste products are controlled. The following norms and guidelines for the fulfilment of the criteria are relevant[2]:

- ✓ Law for the advancement of the life-cycle management and the safeguarding of environmental waste-disposal
- ✓ Technical instruction for the recycling, treatment and other disposal of municipal waste
- ✓ Verification of waste disposal
- ✓ Waste Laws by the federal government

In the pre-certificate for the Austria House the following quality grades are planned: The legal minimal regulations of the life-cycle management and waste law are met. In addition, the people involved in the building process are specifically trained regarding waste prevention. The construction management controls the waste separation and the correct use of the

[1] BNB 2010c

[2] BNB 2010c

collecting points. The waste products are separated into mineral waste, recyclable material, mixed building waste, problematic waste and waste containing asbestos.

25/25 checklist points gained. Sub-criterion fully fulfilled.

10.4.2 Low-noise Building Site

According to the German „Bundesimmissionsschutzgesetz“ (Federal Immission Protection Act) every building site shall be planned and operated in such a way that noise is prevented according to the latest state-of-the-art technology. Measures must be taken which reduce the spread of unavoidable noise at sites to a minimum. Noise has a considerable influence on a human being’s quality of life and can damage people’s health. For the building rating it is therefore essential that either no construction noise is produced or will be reduced by suitable measures.[1] Based on the tendering and bidding documents the implementation of noise protection measures are controlled. The following documents, norms and guidelines are relevant in order meet the criteria [201]:

- ✓ § 27 of the Federal Immission Protection Act on May 14th, 1990
- ✓ Low-noise construction machines (RAL-ZU 53)
- ✓ Guideline for harmful emissions for the outdoor use of equipment and machinery (Outdoor – Guideline 2000/14/EG)

The following quality grades are planned for the pre-certificate of the Austria House:

The noise generated by the building processes is verifiably and constantly below the basic noise level of the surroundings or the requirements of the formulated tendering and bidding documents are controlled and documented. However, no quantitative measurements are carried out.

18/25 Checklist points gained. Sub-criterion almost fully fulfilled.

10.4.3. Low-Dust Building Site

An important contribution towards the protection of employees and other people at the building site is gained by the prevention of dust. What is more, the environment shall be

[1] BNB 2010c

protected against damage caused by materials. Generally, with dust you understand solid floating particles in gases or the air and their deposits. Each kind of dust regarding the material composition of the dust particles and the particle size can cause health problems and subsequent damages. Dust comes into existence at the building site when processing and treating materials in a myriad of activities. By reducing the amount of dust a valuable contribution is made to improve health protection. Based on the tendering and bidding documents the planned measures for dust protection are controlled. By a corresponding documentation the compliance with certain limits is controlled. The following documents, norms and guidelines are relevant for the fulfillment of the criterion[1]:

- ✓ Ordinance on Hazardous Substances
- ✓ Technical Rules for Hazardous Substances
- ✓ Guidelines for the operationalisation of immission-protective duties for the prevention and reduction of dust emissions at building sites

In the pre-certificate of the Austria House the following quality grades were planned:

At the tendering the following measures were demanded: machinery and equipment have to be fitted with effective suction, dust has to be collected and disposed of as completely as possible. The spread of dust onto unpolluted working areas is prevented as far as possible. The deposit has to be prevented. For the removal moist and wet processes are to be applied. The technical facilities for collecting are state-of-the-art and they are serviced and controlled regularly. The fulfillment of the requirements are not controlled and documented.

12/25 checklist point gained. Sub-criterion not fully reached.

10.4.4. Soil Conservation at the Building Site

The soil, vegetation and the ground water are to be protected against water pollutants and mechanical damage. The effects on the soil and the vegetation can be roughly divided up into mechanical and chemical ones. Mechanical effects are caused primarily by excavation and compaction measures. Chemical effects, which pollute the ground water to boot, are caused under normal building site conditions by certain working processes whereby gaseous, fluid and solid substances can get into the ground. The goal therefore is to return the ground to its original state and to clean up the polluted area. Based on the tendering and

[1] BNB 2010c

bidding documents the measures for the protection of the soil, vegetation and groundwater are controlled. The compliance of certain limits is controlled by a corresponding documentation. The following documents, norms and guidelines are relevant for the fulfillment of the criterion[1]:

- ✓ In order to protect the soil, vegetation and groundwater against harmful pollutants you have to prevent substances that endanger them. The labeling with R can be helpful in the decision process (R 50, for instance, is very poisonous for water organisms, R 54 is poisonous for plants, R56 is poisonous for soils organisms)
- ✓ Federal Soil Protection and Polluted Area Ordinance
- ✓ Information Platform Environmental Protection of the Ministry of the Economy Baden Württemberg
- ✓ Principles for the assessment of effects caused by building materials on soil and groundwater by the German Institute for Construction Technology (April 2005)
- ✓ Effective Soil Protection in Constructional Engineering of the Suisse Confederation, Federal Office for the Environment (advice and guidelines)

In the pre-certificate of the Austria House the following quality grades were planned:

It hast to be assured that the soil is not contaminated by chemical pollutants. The tendering and bidding documents explicitly refer to soil protection. It has to be assured that R-labeled substances can get into contact with the environment. Documentation by the construction management confirm the soil protection during the building process. The soil and vegetation are protected against harmful mechanical impacts (e.g. unnecessary compacting).

18/25 checkpoints gained. Sub-criterion almost fully reached. All in all, 73 out of 100 points were reached. This corresponds with a good rating in silver.

[1] BNB 2010c

11. Closing Words

Sustainability in the building industry and sustainability-oriented building rating systems is no contradiction to modern management methods and economical economy. While the different and groups and organisations create the framework conditions for a long-term role on the market the comprehensive rating system offers new approaches for an ecological, economical and social construction style. These systems are also a new integrated approach for planners and architects in the planning phase of a new building and the reconstruction or renovation of an existing building. Practicable and applicable building rating systems have developed by a supporting accompaniment of the construction work and by a monitoring of trained persons.

The goals of a sustainable building design are made step by step so as to give time to the building sector and the public sector and to raise the awareness so that the overriding goals such as the reduction of energy consumption or saving of resources can be actually reached. Besides an increased demand caused by an internationalization of the building rating systems LEED and BREEAM and stricter legal regulations there is a greater and greater implementation of these building rating systems. LEED and BREEAM focus primarily on energy efficiency and support their strategies by a sophisticated marketing system. The Suisse Standard MINERGIE is a very well applied sustainable building rating system in Switzerland, which excels in a cooperation of federal government, cantons and system providers. The organisations that back the respective building rating systems try to increase their market shares and to extend their sphere of influence by an internationalization of these programs. The German system DGNB is planning an extension of the system in Europe and captivates by a very comprehensive rating system and a good training and organisational structure. DGNB attempts to integrate all participants in the building sector into the sustainable rating system.

The building rating systems primarily serve the purpose of the documentation of buildings. Here all categories of buildings undergo a comprehensive planning and assessment thus showing possible strengths and weaknesses of a building. In all sustainable building rating systems great importance is attached to energy efficiency and the associated insulation of a building or the technical components for the demand of heating and cooling. Because of the rising standard of the energy efficiency of buildings there is a tendency to revert more and more to ecological and recyclable materials. As a consequence life cycle assessments and life cycle analyses are in harmony with these systems. The building documentation using excel-tools and other documentation aids can be regarded to be very good.

When assessing the Austria House in Whistler within the framework of the Olympic games only the assessing process is described. While all criteria of the building rating system are presented in more detail regarding the klima:aktiv assessment, this can only be carried out in a limited scope for the DGNB/ÖGNI assessment. On the one hand this is due to the non-publication of the profiles, on the other hand a detailed listing of the proofs and requirements would go beyond the scope of this thesis because of the comprehensive documentation. By carrying out this assessment not only the weaknesses of this house is portrayed, but also the very ecological construction method is made transparent. The Olympic Games offered an international stage to call attention to the high ecological and technical Quality and the high user convenience of the passive house in the German-speaking countries.

The answers of the people interviewed represent subjective opinions and assessments. Their experiences as leading managers in the construction industry, in the real-estate industry as well as the sustainable building assessment companies, can be used to substantiate the arguments, to get rid of inconsistencies or to reflect conflicting opinions.

11.1. Critical Appraisal

For a broad application of sustainable building rating systems there must be a reform of the construction industry towards integral planning thereby taking the reinstatement costs into account. The real estate industry will revert to these systems if there is a demand for sustainable building architecture by the user. People still need to be well-informed and instructed about regarding what sustainable building design actually means. The general public associate it with an increase of the construction costs. Furthermore, the advantages of sustainable building have to be better communicated.

'However, there must be innovative approaches to increase the demand for energy-saving, resource-saving, environmentally and health compatible as well as cost-effective and stable in value buildings, which also show a high degree of creative, technical and functional quality and urban planning' (Lützgendorf, November 2009).

Buildings are long-lasting goods, which in the course of their lifespan are subjected to sales and purchases and to object-related evaluation when making a balance sheet. Two buildings which were valued the same at the time of their erection and after five years, can have different values after ten years of their erection. As a rule sustainable buildings are more stable in value whereas traditionally constructed real estate objects can lose in value due to rapidly increasing energy costs or high vacancy rates. Sustainable buildings will only be valued higher than other real estate buildings if there is a relevant demand on the market.

However, the valuation is not suitable to develop a market, this has to be done with information-policy and economical steering and control methods.

Admittedly, it has to be remarked critically that the applied valuation methods do not value the building alone but always the combination of the building and its location, that is the property or real estate.

‘Systems for the description and certification of sustainable buildings are much more than isolated marketing instruments. On the one hand, in order to be efficient and manageable, they must be able to be categorized into an overall system of subsidiary basics. On the other hand, they provide detailed information, which can be used for risk analysis and valuation of real estate, next to aggregated assessment results. At the same time they are a prerequisite for the development of property funds, which concentrate on sustainable objects´ (Lütgendorf, November 2009).

Energy efficiency and user quality have not yet become integral parts of investment decisions. To overcome these barriers it is therefore necessary to solve valuation methodical questions alongside the development of design methods and technical solutions. As a consequence, the economical advantages of energy efficiency and environmental quality must be stressed and used as arguments for the support of a further market penetration.

‘To what extent the system effect the risk and real estate analysis remains to be seen. My understanding is that the system itself is principally suitable. Now it is rather up to the people carrying out the valuation and the risk analysis if these people are capable to gather information out of this system´ (Lützgendorf, November 2009).

The different trends in sustainable rating can be viewed from two different points of view. On the one hand two different assessments of a similar building documentation can enliven the market. In addition, a healthy competition can arise between the organisations if there is an adequate exchange of experience, which is ultimately beneficial for the systems. On the other hand, many experts in leading positions think that in a region with a relatively similar building culture and relatively uniform conception of quality standards one system suffices.

‘The system shall be made available for the market, the utilization itself does not cost anything. The system is accompanied by auditors, who then submit it to ÖGNI for certification. TQB does not provide the system for audit so as to let the process to be accompanied. I am fully convinced that the system we are talking about is one that we want to establish sustainable planning and building at the market. This is why architects, engineers and many people involved should be in a position to apply this system and to integrate the planning’ (Kaufmann, June 2010).

‘The DGNB rating system is by no means a simplified European standard yet. As the costs for the certification and licence fees are relatively high it is doubtful whether this system can become market-relevant (ÖGNB, IBO Magazin; 3/09).

Progress moves forward rapidly. As a result a moving towards one another is possible. The contrary is obviously the case in Germany. While DGNB keeps the profiles under lock and key the cooperation partner for the Federal Ministry of Transport, Building and Urban Affairs has published a first catalogue of criteria for a holistic view and assessment of sustainability aspects for buildings.

‘In Germany here we have had excellent experiences. On the one hand there is a round table (initiated by the Ministry of Building),which by involving all participants has aimed at developing this system (ecological building material information system) and providing basic data such as data bases for life cycle assessments or data bases for life spans. This round table has lead to a national consensus. On the other hand the DGNB focuses on the inclusion of the interests of their members. In Germany you can expect that the system in its general orientation towards energy efficiency, climate protection and resource conservation is broadly supported´ (Lützkendorf, November 2009).

Conflicting aims among the demands of the three sectors society, economy and environment as well as among singular criteria of a sector cannot be avoided. An important element of the planning process for a contribution towards sustainability is to point out these conflicting aims and to weigh up in order to set priorities.

11.2. Conclusion and Outlook

Sustainable building ratings are developed further and further. The ever rising awareness of the building users and planners for a holistic, integral and sustainable construction style will strengthen the trend towards a sustainable building development and will bring success. In Austria those organizations that have developed a building rating system try to establish themselves on the market.

‘Many surveys suggest that the boom in sustainable building ratings will increase again in the coming years. My goal has always been to integrate what we today call sustainability into the normal description of buildings’ (Lützkendorf, November 2009).

‘The building ratings undergo a boom at present. This has several reasons. On the one hand legal framework conditions have are responsible for that. In the renewal of the guideline, for instance, special emphasis is laid on the reduction of the cooling demand. The indoor climatic conditions have to be specially attended to. As a consequence, not only the energy efficiency of a building will be considered to a larger extent in the future but also user convenience. Judging from the legal framework you can see that there is an extension of the term building quality towards a reduction of the resources and a rise in user convenience. Therefore the economy would do well to adjust. On the

other hand, the development in the USA influences also our market. By intensive marketing which is a reason that these certificates are asked for by building owners and investors' (Geissler, January 2010).

Administrative authorities develop modules and systems to integrate sustainable building criteria at the tender phase. Administrative authorities cooperate with universities to speed up the integration of energy-relevant aspects in architectural competitions. Owing to the bad budgetary situation of the federal states and persistence of some civil servants to the status quo the implementation of sustainable building rating systems will only be gradually possible. Ultimately, the political decision-makers will be called upon to implement sustainable building rating systems at a large scale by public funding, cooperation and assistance.

'Given all the new legal requirements for sustainable aspects a certain resistance in the building sector is noticeable. The building practice cannot keep pace with the theory and requirements (there is always something new and stricter). As it is a voluntary instrument which cannot be legally claimed the advantages have to be worked out by informational and advisory activities' (Kernöcker, June 2010).

Energy efficiency, environmental quality and the sustainability of buildings respectively have not yet developed into becoming integral parts of investment decisions. To overcome existing obstacles it is required – apart from the further development of design methods and technical solutions - to also clarify assessment-methodological questions. An approach is to point out the economical advantages of energy efficiency and environmental quality of buildings and to use them as arguments for supporting a further market penetration.

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