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BBSR-Berichte KOMPAKT

Sustainable Building

Strategies – Methods – Practice

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Introduction

Sustainability is the guiding principle of the future worldwide. Acting sustainably means taking into account ecological, social and economical criteria equally in order to leave subsequent generations with an intact structure. In civil engineering the topic is also becoming more important in light of climate change, the rise in energy prices and the fall in the availability of resources. The focus in this case is on construction in order to fulfil the basic needs of habitat and infrastructure, which are combined with great economic and environmental expenditure; also, buildings cause more than 30 percent of the energy and material flow through their creation, edification, utilisation and facility management, as well as the global effects.

Under the overall control of the Federal Ministry of Transport, Building and Urban Development, the word sustainability was defined for civil engineering and realised in terms of practice at the end of 1990. Based on the experience made by the energy commissioner for federal buildings during the relocation of the government, exemplary frameworks could be made for sustainable building for the energy efficiency and resource saving areas. In 2001, the Federal Ministry of Transport, Building and Urban Development published a Guideline for Sustainable Building for the first time – a practical aid for the planning, the construction, the structural maintenance, the operation and the utilisation of federally owned properties. This guideline was made obligatory for the Federal Government. The goals and requirements formulated in the guideline display their effects far further than the regulatory area.

Figure 1
Guideline for Sustainable Building 2001
(Ed.: BMVBW)



Technical developments, changes made to the requirements in regulations and norms and new scientific standards, measurement and detection techniques made it necessary to fundamentally review the guidelines. At the beginning of 2011, the comprehensively reworked Guideline for Sustainable Building was published by the Federal Ministry of Transport, Building and Urban Development and introduced by edict. For the first time, the Federal Building Authorities have a method of assessing the quality of the sustainability of the administrative buildings, using the Bewertungssystem Nachhaltiges Bauen (BNB) (Assessment System for Sustainable Building for Federal Buildings). This scientifically founded and planning based system of evaluation distinguishes itself by the comprehensive observation of the entire life cycle of buildings. At the same time it views the ecological, economical and socio-cultural aspects alongside the technical, functional and procedural aspects. The BNB enables a transparent, objective and comprehensible evaluation or qualification of the sustainability.

The present publication of Federal Institute for Research on Building, Urban Affairs and Spatial Development BBSR-Berichte KOMPAKT offers an overview of the future sustainability strategies for federal buildings and of instruments of sustainable building in Germany. The publication focuses on the current Guideline for Sustainable Building and the national Assessment System for Sustainable Building. Above and beyond that, the publication provides advice on practical tools for sustainable building and report of evaluation on the use of the system. The current status of the system's development for other categories of buildings is represented in exemplary fashion.

Development of Sustainability Strategies for Constructural Engineering

The principle of sustainable behaviour can be traced back over centuries. An example can be found in the German forestry around 300 years ago, where the rule was established that only enough trees could be felled that could be replaced by afforestation. The goal was, even at that point in time, to obtain an equilibrium between use and regeneration of the resources available. The first oil crisis of 1973, which made the dependence of the industrial nations on finite, fossil resources blatantly obvious, revived again more strongly the term "sustainability" in the consciousness of people.

Brundtland Commission

In 1983, the United Nations with the World Commission on Environment and Development (Brundtland Commission) founded an independent specialist commission, which drafted the guidelines for sustainable development for the first time. The current definition of sustainability is taken from the future report "Our Common Future" from 1987. The report defines sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs".¹

A further challenge in the Brundtland Report was the equal integration of social and ecological aspects, according to which the economic development was orientated. In 1992 the community of states recognised the guidelines for sustainable development in the UNO conference in Rio de Janeiro and paved the way for the global implementation of the concept of sustainability in the 21st century with Agenda 21, a groundbreaking programme. In 1997, as a result of the world climate summit in Kyoto, the industrial nations who took part in the Kyoto-Protocol obligated themselves to reduce the emissions of six greenhouse gases² by 5 % of the level of 1990 by the end of the commitment period of 2008 to 2010.³

Sustainability Strategy for the Federal Government

The decisions made in Kyoto led to Germany's decision to begin the National Climate Protection Programme⁴ in 2000, in which the guidelines for climate protective political behaviour were laid down in order to achieve the reduction in greenhouse gases stated in the Kyoto protocol. The German sustainability politics have since then been based on the definition of sustainability in the Brundtland Commission. Before the conference in Rio, the German Bundestag had

introduced the committee of inquiry “Protection of People and the Environment – Ways of sustainably handling with flow of material and substances” in February 1992, which continued their work as of 1995 under the title “Goals and General Conditions of a sustainable development”. The focus of the work was the area “building and habitation” used to apply the discussion about sustainability onto a concrete area. In 1998 the final report⁵ published by the commission called for the equal integral assessment of the ecological, economical and social dimensions in one process – the three column model – for the guidelines of a sustainable development.

In 2002 the Federal Government passed the national Sustainability Strategy⁶ under the title “Perspectives for Germany”. Alongside measures and projects, the strategy includes political guidelines for sustainable development in the areas of generational equality, quality of life, social cohesion, international responsibility and the management of sustainability. By means of 21 indicators, the sustainability will be constantly observed and assessed in terms of the development of economy, environment and society. Regular reports will inform us of the results and set new targets. Since November 2004 the Federal Government has monitored its sustainability strategy on the basis of the progress report⁷, published every four years. The Statistische Bundesamt (Federal Agency for Statistics), working on behalf of the Federal Government, has documented the progress of sustainable development in Germany in the indicator report published biannually since 2006. The guiding principle of sustainability was also anchored and further described in the coalition contract of 2009. According to the contract, the Federal Government should “fulfill her exemplary function in the future for building culture and sustainability in her building activities”.⁸

Lead Market for Sustainable Construction

At a European level, sustainable construction was declared a lead market to be encouraged as part of the Lead Market Initiative⁹ announced by the European Commission in December 2007. The Lead Market Initiative was to help strengthen markets at an EU level, which had the potential to more than double their economic volume by 2020 and create more than one million jobs. Sustainable building was appointed a lead market in which environmental protection aspects, health issues and the comfort of the users play a leading role.

The EU Commission intends to

- extend the scope of applicability of the guidelines over the entire efficiency area of buildings,
- introduce energy efficiency targets for newly erected and newly renovated buildings,
- initiate the development of European standards which encourage and consider sustainable development.

The job and goal of the leading market for sustainable construction were put together in an action plan – the “Action Plan for Sustainable Construction”.

Bodies and Instruments for the Implementation of Sustainability Politics

Diverse bodies and instruments have been used and introduced as part of the Federal Government’s Sustainable Building Politics.

Council for Sustainable Development

In practicing the sustainability politics, the Federal Government is advised by the Council for Sustainable Development¹⁰, founded in 2001. The council is to contribute to the further development of sustainability strategies with the elaboration of goals and indicators, as well as suggesting concrete fields of activities and projects for implementation. The Council for Sustainable Development, a member of the European Environment and Sustainable Development Advisory Council Network (EEAC) employs 13 people from different areas of the public sector. It holds the dialogue with political, economical and societal actors and shows the consequences of political dealings and imparts to the broader public the concrete meaning of sustainability politics. It is also responsible for the determination of quantifiable sustainability targets and assessing indicators. The council develops concrete recommendations for action, e.g.

- in energy efficiency and research,
- to reduce land use,
- to prevent the uncontrolled use of natural resources,
- to modernise public procurement
- and to aid commercial responsibility in a globalised world.

Committee of Governmental Secretaries for Sustainable Development

The central driving element in the Federal Government's sustainability politics is the Committee of Governmental Secretaries for Sustainable Development (Green Cabinet)¹¹; the job of whom is to implement the national sustainability strategy, to develop its content further and to assess its implementation regularly. Above and beyond that, the committee is the main person of contact for the governmental advisory council for sustainable development¹², for the Federal States and the national local-authority organisations. As discussed in the Committee of Governmental Secretaries for Sustainable Development meetings from December 2008 until June 2009, building blocks for a future, sustainable government programme have been drafted. For the areas of construction and habitat, the sustainability of buildings (...) multiplied over the entire life cycle – from the production of raw materials through the erection to the dismantling – by considering ecological, economical and social aspects is to be identified in a transparent, measurable and assessable way – while simultaneously considering the design, planning and functional quality. The assessment is to be based upon the recognised, scientific methodology of the life cycle assessment and costing.

Roundtable Sustainable Building

To support the Federal Ministry for Transport, Building and Urban Development (BMVBS) in implementing sustainable building activities, the Roundtable Sustainable Building was founded as an advisory body for the ministry in December 2001. It consists of representatives from the building trade, industry, chambers of architects and engineers, the relevant building authorities and the science. At the roundtable, subjects such as reworking the Guidelines Sustainable Building are discussed and the most important relevant research results are presented. The roundtable has founded working groups to refine diverse specialist subjects and received intensive scientific support for a research programme since 2003; this has enabled the roundtable and the working groups to prepare its contributions and the resulting recommendations for action for actual implementation to be compiled. The information gained is used for example in the update of the guideline and the Assessment System BNB. The roundtable is organised for the Federal Ministry of Transport, Building and Urban Development by the Administrative Office for Sustainable Building in the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR).

Administrative Office for Sustainable Building

The division II 5 – Sustainable Building – in the BBSR fulfils the duties of the Administrative Office for Sustainable Building. It supports the BMVBS in specialist and organisational issues, for example in implementing and developing the Assessment System for Sustainable Building, but also by representing the BMVBS in advisory board meetings, in public relations and the maintenance of the Sustainable Building Information Portal (www.nachhaltigesbauen.de). The web site contains

- Explanations and advice for sustainable construction,
- Federal guidelines and practical aids,
- Information regarding the BNB evaluation system for sustainable building,
- Comprehensive data basis for the assessment of sustainability,
- Information regarding research projects and events,
- Exhibition of good examples of sustainable building,
- a platform for the members of the roundtable.

The division also conducts experiments – amongst other things – to further develop the BNB and to transfer the system to other building categories. Beyond that, the division supports diverse research projects in the cluster “Sustainable Building” as part of the research initiative “Future Building” and supports the BMVBS in scientific political counsel and public relations.

Figure 2
Sustainable Building Information Portal



International Standardisation

Similar to Germany, a series of solution attempts have been published internationally in previous years to describe, evaluate and communicate the quality of sustainability of buildings: guidelines, checklists, databases and planning and evaluation aids. Approaches, methodological and data technical bases and the criteria and indicators used are sometimes considerably different; this, therefore, requires the alignment of the International or European bases and approaches – also in the sense of the quality, transparency and comprehension of information and evaluation results. For this, the standardisation projects as part of the ISO/SC 59/CS 17 “Sustainable Construction” among others are relevant, which form the basis of the European standardisation project CEN/TC 350 “Sustainability of Buildings”. The description and evaluation of sustainable effects of buildings are currently regulated on national (DIN German Institute for Standardisation), European (CEN) and International levels (ISO). The approach concentrates on the creation of a mutual basis for an adjustment of principles for sustainable development of the observation and evaluation subject “individual building” and the provision of suitable indicators and basis for invoices.

Beyond that, the bases for the description of characteristics and properties relevant to health and the environment of construction production and the description, evaluation and representation of the environmental quality of buildings are to be worked out in the various working groups. In Germany, the specialist work of standardisation is carried out by working committees in the DIN. The standardisation committee NA 005-01-31 AA Sustainable Construction (Sp ISO/TC 59/SC 17 and CEN/TC 350) represents the German mirror committee to the international committee of the ISO/TC 59/SC and CEN/TC 350.

BMVBS Guideline for Sustainable Building

As a result of the constantly developing political and societal goals, the Guideline for Sustainable Building from 2001 was reworked and reintroduced at the beginning of 2011 by means of decree in the revised form¹⁴. This version of the guideline describes the methods and processes to implement the sustainability aspects in civil engineering. Alongside that, the guideline describe the targets which are to be adhered to for the planning of new building projects and building extensions in the regulations of the Federal Building Authority or the “Guidelines for the Realisation of Federal Building

Figure 3
Guideline for Sustainable Building 2011
(Ed.: BMVBS)



Measures” (RBBau)¹⁵. The addition of “Use and Management” and “Building Inventory” have made the reworked guideline into a complex action manual for sustainable building. The entire life cycle of a building in the sense of DIN EN 15643-2 (Sustainability of Buildings – Evaluation of the Sustainability of Buildings: general conditions for the evaluation of environmental qualities)¹⁶ is considered as a temporal system limit; as a spatial system limit, the building itself is taken as a basis, as stipulated in the guideline.

Dimensions and Qualities of Sustainability

In general, the classical understanding of sustainability is based on three dimensions: ecology, economy and socio-culture, which are to be considered over a long period of time. The goal is to observe and to evaluate the entire useful life of a building – colloquial referred to as the life time of a building. For the actual observations of the life cycle, the first 50 years of a building are worked into the calculations.

The main goal sought in the ecological dimensions is primarily the protection of resources by optimally using construction materials and products, minimising use of space for media (e.g. heat, electricity, water and sewage).

All requisite energy and material flows from the gain through the refinement and transport to the installation or disassembly alongside the global and local effects on the environment made by the energy use of the construction materials or the buildings will be considered. Generally, this reduces environmental pollution at a local and global level. The most

different methods of analysis, e.g. risk analysis, analysis of the material flow, the material analysis and the ecological balance, are to be applied to objectively assess the environmental compatibility of construction products and the variations in building this brings.

The costs which go above and beyond the mere costs of purchase and assembly – especially the life cycle costs are considered in the economical dimensions of sustainability. This places the focus on life cycle costs relevant to the building, the economic viability and the value stability. As practice has shown, the life cycle costs can by far exceed the costs of construction. By analysing the life cycle costs, considerable opportunities for saving money during planning can be identified. As Life-Cycle-Costs (LCC), the costs of construction (DIN 276), the construction use costs (DIN 18960) and the demolition costs are additionally considered.

In addition to the question of functionality, the question of esthetic design, the health aspect and comfort are relevant points in considering the social and cultural dimensions of sustainability, the soft factors of which are considerably more difficult and therefore are presently quantified by simplified supposition. Winter and summer heat insulation contribute to comfort just as much as the noise protection or a deliberately chosen type of construction material (e.g. the use of emission free products). Construction designs, choice of material, building construction and technology are to be interpreted to that effect and to be optimised, if needed. At the same time the construction design is to be made flexible enough that it can be easily adapted to the changing parameters e.g. change of use/user.

Protective goods and goals of sustainability can be extracted for the construction sector for the three dimensions of sustainability, as shown in Figure 4.

Alongside the ecological, economical and sociocultural aspects, the functional and technical properties (technical quality), the planning and implementation (process quality) and the, in part, local characteristics are decisive for the description and value of a building. This has extended the hitherto three columns of sustainability to five quantifiable qualities of sustainability – informatively supplemented by the local characteristics (cf. Figure 5). The various aspects of sustainability interact directly with each other, so that the goal becomes a holistic and simultaneous assessment of every aspect.

Figure 4
Protective Goods and Targets of Sustainable Building

Sustainable Building			
	Ecology	Economy	Socio culture
PRO-TECTIVE GOODS	Protection of Natural Resources Global and Local Environment	Capital / Values	Health User-Satisfaction Functionality Cultural Value
PRO-TECTIVE TARGETS	<ul style="list-style-type: none"> • Protection of Natural Resources • Protection of the Ecosystem 	<ul style="list-style-type: none"> • Minimisation of Life Cycle Costs • Improvement of economic viability • Conservation of Capital / Value 	<ul style="list-style-type: none"> • Health Protection, Safety and Well-Being • Verification of Functionality • Verification of Design and Urban Quality

Structure of the Guideline for Sustainable Building

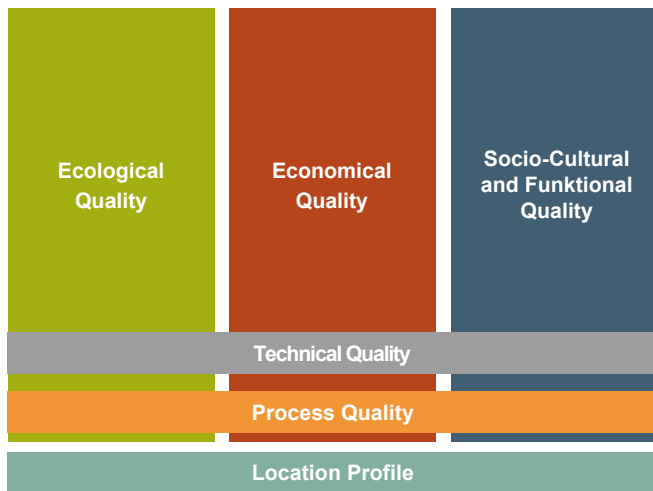
The Guideline, written as an instruction book for the federal building authorities, is structured as follows:

- General part with the scope of regulations of the guideline,
- Part A Basic Principles of Sustainable Building.
- Part B New Buildings,
- Part C Operation and Maintenance,
- Part D Building Stock.

As the Guideline, in its use, directly refers to the Assessment System for Sustainable Building, the parts A and B have been made obligatory in a first step for new governmental buildings. The completion of the evaluation methodology will, in a further step, introduce the part C and D. The overall goal of the Guideline is the transparent representation of the interaction between the individual sustainability criteria, concurrent with the individual phases of planning. Here it is irrelevant, whether the building is for public or private use, since the approaches can be compared.

Part A of the Guideline presents the general guiding principles and methodology of sustainable building. These can be used both for public and private construction projects. Principles, dimensions and qualities of sustainable building and the general instructions for the assessment of sustainability.

Figure 5
Quality of Sustainability – Main Criteria Groups (BBSR)



Part B New Buildings describes the basic principles, scenarios, bases for planning new building projects and for larger building projects on inventory buildings (e.g. construction extensions). They orientate themselves to the chronological progression of the planning phases according to the “Guidelines for the Realisation of Federal Building Measures” (RBBau) or the performance phase of the Honorarordnung für Architekten und Ingenieure (HOAI) (German Fee Scales for Architects and Engineers)¹⁷.

The Guideline for Sustainable Building is both available online and in hard copy. Cross references and references to other practical and decision-making aids are highlighted in the hard copy; in the digital pdf-version of the Guideline these are provided as a hyperlink to the Sustainable Building Information Portal. This method enables a constant update of the Guideline and ensures that it is absolutely current in regards to the general recognised standards of technology. The Guideline provides, on the one hand, planners with a tool to sustainably plan the construction; on the other hand it provides those responsible for the project an instruction book to examine the described sustainability aspects.

The quality of sustainability is to be presented transparently when using the BNB. The minimum requirements for every individual criterion of the system of evaluation are to be fulfilled and proof of this is to be provided in the planning phase according to the RBBau. This enables federal buildings to be constructed to the highest quality of sustainability, which will have an exemplary effect on other buildings.

Consideration of the Sustainability Criteria in the Planning Process

In the early planning phases, the way is paved for the quality of a building’s later sustainability. Optimising this, with regard to sustainability aspects is indispensable from today’s point of view. These aspects have to be considered in every planning, construction and management process, in order to create (new buildings), maintain (buildings currently in use) and improve (inventory buildings) the quality of the building.

Architects’ Competition

In the future, the ecological, economical, sociocultural and functional aspects will be taken into account during the competition process in addition to technical quality and process quality – alongside the hitherto usual questions regarding innercity and design quality. Also estimations regarding the green balance and life cycle costs, and sociocultural questions are to be defined and become an obligatory requirement for the planning competition. The guideline will become the main criteria for consideration in the competition, the use of which will enable the implementation of the requirements of sustainability can be examined at such an early stage. The later examination of the implementation of the requirements determined in the competition are guaranteed by the performances offered and conducted, the results are to be documented accordingly. Important aspects here are the relationship of individual competition criteria to each other and the assembling of the specialist jury in regards to prior knowledge of the stated sustainability quality. In the case of Federal building projects, the competitions are planned and held by the Federal Building Agency responsible.

Particularities of Public Building Projects

The Federal building projects are subject to the “Guidelines for the Realisation of Federal Building Measures” (RBBau). The RBBau provides that the Guideline for Sustainable Building for new buildings, renovation work and extension work (RBBau parts E and D) is obligatory. Furthermore it provides that the building authorities draw up Draft Documents “Construction” (DD-Cons) according to which the basis for decision (DE Cons) by the upper technical level will be recognised and fall into the budget of the Federal Ministry of Finance.

The DE Cons, consisting of material requirement planning, variant design to meet the requirement with costing and complete documentation according to § 24 BHO (Bundeshaushaltsordnung – Federal Budget Law), will be used to set the boundaries again regarding larger new buildings, renovation work and extension work, according to section E RBBau. In the material requirement planning for the DE Cons, the user and owner/consumer will formulate their quantitative and qualitative requirements of the building. The determined and agreed upper boundary for costs is binding for further planning and building concepts.

The DD Cons is equivalent to phases 2 (preplanning, in part), 3 (design planning), 4 (permit planning) according to HOAI and serves the creation of a complete draft and permission planning. As far as is required – dependent on the construction requirements on the building – parts of the implementation planning can be used in the DD Cons. When creating the DD Cons, material definitions from the DE Cons are binding. In the DD Cons the qualitative and quantitative requirements from the material requirement planning will be implemented in an actual construction design. In this planning phase, concepts are to be developed, which integrate the aspects of sustainable construction into the draft planning and the special requirements of the sustainability from the material requirements planning can actually be implemented. The DD Cons is to contain the following design documents, according to RBBau:

- Design and Permit plans (a.o. an overview, cadastral survey, map of the area, design and permit plans),
- Explanatory Report,
- Cost calculation,
- Proof (Supporting Structure Planning, Fire Protection, EnEV (the German regulations on energy saving), noise protection).

The regulations regarding the provision of proof during the planning phase serves the assurance of, on one side, the quality of the planned building and on the other side, the adherence to the agreed costs. In terms of sustainability, the uniform forms of proof provide public buildings the chance to anchor the chosen sustainability qualities in the DD and DE Cons and to examine them in further planning stages.

Assessment System for Sustainable Building (BNB)

Worldwide, systems for the evaluation and certification of buildings have been developed, in order to promote ecological and energy efficient development. Therefore at the moment there are a number of systems – one hears of “First Generation Systems” in which chosen aspects of sustainability are assessed at a very high level. Amongst them are for example LEED (Leadership in Energy and Environmental Design) in the USA with branches in Canada, India, China and the Far East or Green Star in Australia, but also systems with comprehensive approaches such as BREEAM (Building Research Establishment Environmental Assessment Method) in Great Britain, HQE (Haute Qualité Environnementale) in France, Minergie in Switzerland, Casbee in Japan and HK-Beam in Hongkong. To promote sustainable building, the activities as part of the international (ISO) and European Norms (CEN) for a holistic approach were abandoned with the involvement of the five qualities of sustainability presented in Figure 5. Based on that, the first systems of certification for the second generation have been developed in previous years, which assess the sustainability of buildings by means of a holistic approach to observation. This will offer investors and planners not only a comprehensive overview of sustainable construction, but also tools which will simplify the planning and implementation of sustainable aspects.

At the same time, Germany promoted the development of a national system of evaluation which is based upon the national environment, legal regulations and norms etc. and can be interpreted for construction in Germany. After a two year BMVBS co-operation period with the German Sustainable Building Council, the first proposition for national sustainability criteria, including calculation and assessment methodology could be presented to the specialist public. This system uses a holistic assessment procedure which considers the life cycle of a building and a comprehensive quantification.

Figure 6
Logo Sustainable Building
BNB (BMVBS)



For the scope of regulations for the Federal buildings, the BNB was derived and further developed as an additional instrument to the Guideline for Sustainable Building for the promotion of sustainable development. It became obligatory for Federal buildings with the guiding principle, first of all for the departments Office and Administration Buildings. Significant bases founded many research projects, financed by the BMVBS research initiative “Zukunft Bau” (Future Building). The BNB provides scientific, well-founded and planning based evaluation processes for offices and administration buildings. The goal is to describe and evaluate the quality of the sustainability of buildings and annexes and their complexity. This is to obtain a higher quality of construction using the planning, beginning with the building construction, operation and maintenance, repair up to the demolition of buildings and annexes. Evaluation is conducted using transparent and objectively comprehensible regulations. The BNB is publicly available online under www.nachhaltigesbauen.de. The system of evaluation primarily follows the interests of federal buildings. For other clients, the use of the BNB to describe and analyse the quality of the sustainability of buildings and annexes is voluntary. For use outside the national borders or for other types of building, the individual environment for the relevant country, the climate zone or for type of building are to be extracted and the system is to be adapted accordingly.

- Planning, production of raw materials,
- Manufacture, erection,
- Use including repair work and renovation
- and demolition, utilisation and disposal.

Sustainable building is intended to optimise a building over its entire life cycle. The goal is to minimise the use of energy and resources, reduce environmental pollution and improve the total economy. The conventional planning of buildings has been hitherto limited to the observation of individual aspects, without considering any possible interaction. The integrated planning approach, however, incorporates the entire life cycle of a building “from cradle to grave” and the planning steps are linked with a view to their interaction with each other and augmented sensibly.

The intention is to develop an objective and quantifying method of assessment for the comparison of different types of building design, in order to attain a high quality building with minimal pollution to the environment. Further use, or re-use, however, offers the advantages vis-à-vis new buildings and building on land that they require, in general, significantly less energy and material flows. Using the inventory and adapting to the user requirements by means of specific repair and renovation work minimises the use of resources and protects the environment.

Consideration of the Life Cycle

Since buildings are usually used for long periods of time, only the considerations made on the entire life cycle of the building can shed light on the actual quality of the building. The life cycle of a building consists of the following phases especially:

Methodology

As part of the assessment using the Assessment System for Sustainable Building, the five main criteria groups of sustainable building: the ecological, economical, sociocultural,

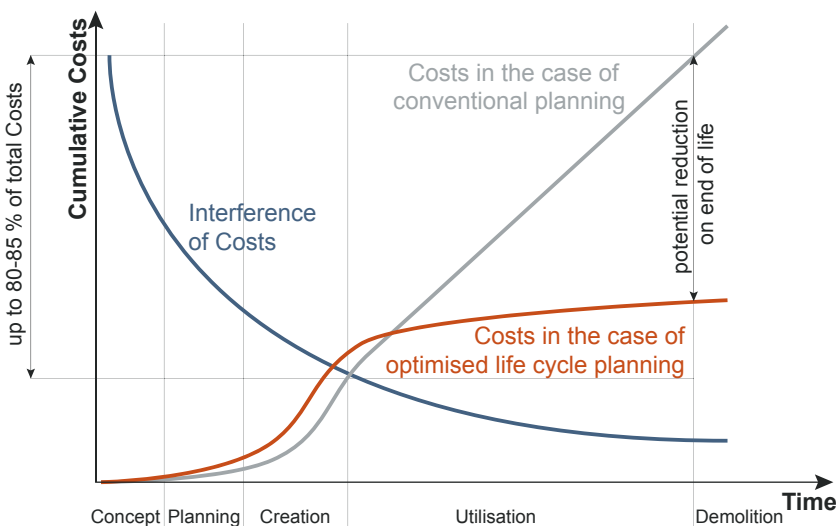


Figure 7
Development of Life Cycle Costs and its Interference

Source: Jones Lang LaSalle: Green Building – Nachhaltigkeit und Bestandserhalt in der Immobilienwirtschaft (2008)

Figure 8

Sustainability Criteria with Percentage Share of overall Result and Factors of Relevance, BNB Version 2011_1 (BBSR)

Sustainability Criteria	Percentage Share of overall Result Individual Categories	Factors of Relevance	Percentage Share of overall Result Main Criteria Groups
Ecological Quality			22,5%
Effects on Global and Local Environment			
1.1.1 Global Warming Potential (GWP)	3,375%	3	
1.1.2 Ozone Depletion Potential (ODP)	1,125%	1	
1.1.3 Photochemical Ozone Creation Potential (POCP)	1,125%	1	
1.1.4 Acidification Potential (AP)	1,125%	1	
1.1.5 Eutrophication Potential (EP)	1,125%	1	
1.1.6 Risks to the Local Environment	3,375%	3	
1.1.7 Sustainable Logging / Wood	1,125%	1	
Demand of Resources			
1.2.1 Primary Energy Demand Not Renewable (PE _{nre})	3,375%	3	
1.2.2 Total Primary Demand (PE _{tot}) and Amount of PE _{re}	2,250%	2	
1.2.3 Fresh Water Demand and Quantity of Wastewater	2,250%	2	
1.2.4 Demand of Space	2,250%	2	
Economical Quality			22,5%
Life Cycle Costs			
2.1.1 Building-related Life Cycle Costs	13,500%	3	
Performance			
2.2.1 Stability of Value	9,000%	2	
Socio-Cultural and Functional Quality			22,5%
Health, Comfort and User Satisfaction			
3.1.1 Thermal Comfort in Winter	1,607%	2	
3.1.2 Thermal Comfort in Summer	2,411%	3	
3.1.3 Indoor Air Quality	2,411%	3	
3.1.4 Acoustic Comfort	0,804%	1	
3.1.5 Visual Comfort	2,411%	3	
3.1.6 Influence of the User	1,607%	2	
3.1.7 Building-related Outdoor Qualities	0,804%	1	
3.1.8 Safety and Incident Risks	0,804%	1	
Functionality			
3.2.1 Barrier-free Building	1,607%	2	
3.2.2 Space Efficiency	0,804%	1	
3.2.3 Capability of Conversion	1,607%	2	
3.2.4 Public Accessibility	1,607%	2	
3.2.5 Bicycle Comfort	0,804%	1	
Ensuring Design Quality			
3.3.1 Design and urban Quality	2,411%	3	
3.3.2 Art in Architecture	0,804%	1	
Technical Quality			22,5%
Technical Execution			
4.1.1 Sound Insulation	5,625%	2	
4.1.2 Heat Insulation and Protection against Condensate	5,625%	2	
4.1.3 Cleaning and Maintenance	5,625%	2	
4.1.4 Dismantling, Separation and Utilisation	5,625%	2	
Process Quality			10,0%
Management and Design			
5.1.1 Project Preparation	1,429%	3	
5.1.2 Integrated Design	1,429%	3	
5.1.3 Optimisation and Complexity of Planning	1,429%	3	
5.1.4 Sustainability Issues in Tender and Placing	0,952%	2	
5.1.5 Requirements for an Optimal Utilisation and Management	0,952%	2	
Building Construction			
5.2.1 Building Site / Building Process	0,952%	2	
5.2.2 Quality Assurance of the Building Construction	1,429%	3	
5.2.3 Controlled Commissioning	1,429%	3	
Location Profile			0,0%
Location Profile			
6.1.1 Risks at the Micro-Site	--	2	
6.1.2 Conditions at the Micro-Site	--	2	
6.1.3 Image and Character of Location and Quarter	--	2	
6.1.4 Public Transport Connections	--	3	
6.1.5 Vicinity to Use-Specific Services	--	2	
6.1.6 Supply Lines / Site Development	--	2	

functional, technical and process quality, are reflected quantitatively according to different individual criteria. Regardless of whether the five qualities are in close interaction with each other, or not, they will be evaluated separately and will be considered with their determined priority in the end result. This offers the possibility of presenting excellent quality in one or several part areas, as well as separately. With the help of the end result, the sustainability of the building can be objectively presented and quantified so that evaluated or certified buildings can be compared. The local characteristics upon which the planning can only have a limited influence, are separately evaluated from the objective qualities and shown as additional information.

The five main groups of criteria are defined exactly in the Assessment System for Sustainable Building Version 2011_1 with currently 46 criteria files (cf. Figure 8) and can be measured or evaluated according to quantifiable amounts. The criteria can be prioritised within the superior main criteria groups according to their relevance for the protection goal by use of a factor of importance from 1 to 3 (low to high amount of importance). The factors of importance are determined in close agreement with the Roundtable Sustainable Building working groups and the BMVBS.

The files – a manner of instructions for the assessment of individual criteria – are fundamentally ordered according to:

(A) Description of the Individual Criteria

- Relevance for the establishment of goals
- Description
- Assessment
- Methodology
- Relevant regulations
- Specialist Information and Use Aids
- Interaction with further criteria

(B) Standard of Measurement

(C) Appendices

- Table of Costs of Use
- Legal bases
- Definitions
- Checklists

The individual criteria are assessed according to determined rules. In total, each criterion can receive a maximum of 100 points, according to the relevant rules of calculation, whereby the value 100 always corresponds to the defined target value. The main groups of criteria will be assessed separately and

collated, using the determined priority to form a total grade of performance and with that a final result. In the title stating the results of the evaluation, the building will be presented alongside the individual values which lead to the end result. The building can be award the quality levels of bronze, silver and gold dependent on the total grade of performance. The evaluation is carried out by an auditor and will be subject to a test of conformity.

The continual development of the system is ensured by the adaption of the criteria catalogue to the actual research results and the changes in legal stipulations, norms etc. The publication is carried out by the Roundtable Sustainable Building and the Information Portal Sustainable Building. This provides contact persons and regulations for carrying out audits, for the conformity assessment and the documentation of certification and modalities for the training of auditors.

Figure 9 Example for the Criteria Profile, Part A (BBSR)

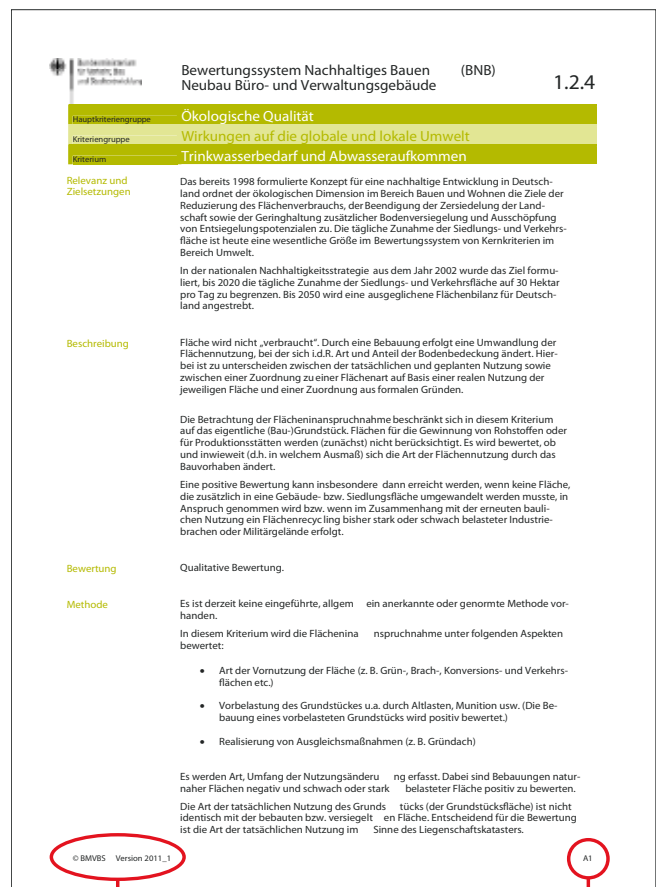
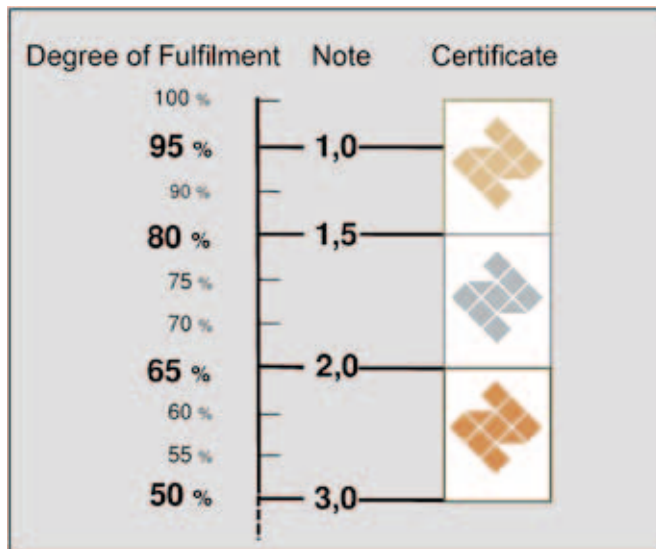


Figure 10
Levels of Certification in gold, silver, bronze (BNB)



Practical Aids and Tools

The holistic assessment and evaluation of the sustainability aspects in civil construction requires the most diverse basic data. The BMVBS has therefore initiated the requisite projects using the Roundtable's actors in the past. Now, a series of requisite basic principles and practical aids is available. That amongst other things is an aid for the life cycle analysis (green balancing, life cycle cost analysis). In addition this ensures that the sustainability aspects are included in the planning and construction phases and that this is comprehensively documented.

Web-based Ecological Building Material Information System (WECOBIS)¹⁸

A substantiated assessment and choice of construction products during the planning and construction phases is the core job for sustainable plans, construction and management of buildings, which more and more architects are confronted with. The provision of all information necessary for this formed the main preoccupation of "ECOBIS 2000", which the Bavarian Chamber of Architects successfully made marketable in 2000 as part of a co-operation projects with the BMVBS. WECOBIS has provided users with a comprehensive update since 2009. The system offers online links with further sources of information and data. WECOBIS offers comprehensive,

structured, neutral information to health and ecological aspects of construction products. The system supports the observation of life cycle phases with information regarding the choice of raw products, creation, treatment, use and re-use. The WECOBIS administrative offices have been set-up in the BBSR, division II 6 – Civil Engineering – Materials and Construction.

Environmental Product Declaration (EPD)

Environmental Product Declaration are manufacturer-orientated green balances for an ecological life cycle, which is examined by a third party and therefore creates a reliable and secure source of data for environmental and health related issues for construction products. In Germany, the examination is conducted by the Institut für Bauen und Umwelt e.V. (IBU). The systematic and standard data basis – currently available for national buildings – enables an ecological evaluation of a building in a building block system of declarations of individual constructions. Use of resources and emissions in the environment are included into the entire manufacturing process. The declaration testifies to what measures a product contributes to the greenhouse effect, acidification, overfertilization, destruction of the ozone layer, smog and the use of energy and resources. As well as that, details regarding technical properties are stated, which are requisite for the estimation of the construction product's performance in the building, e.g. lifespan, heat and noise insulation or influence on the quality of the interior air. In the middle term, the reconciliation of the EPD for the European market is being prepared.

Ökobau.dat

The Ökobau.dat, the development of the first German building material database for the determination of global, ecological effects, provides a simplified basis for data for the ecological evaluation of buildings. As part of a Zukunft Bau project¹⁹, the researcher had developed a number of data records in XML format for the further use in existing life cycle calculation tools with the support of the Deutsche Baustoffindustrie (German Construction Materials Industry). Using so-called style sheets, currently around 650 construction materials or construction and transport processes are described in terms of their effects. For every data entry, alongside the ecological details, details are also given regarding the source data such as reference unit, validity, data quality etc. The further development and status of the database is organised by the BBSR, division II 6.

Use Life of Construction Parts

For the evaluation of sustainability in buildings during the life cycle, the use lives of construction parts to be used are very decisive, since they shed light on the frequency a construction part has been exchanged within a specified observation period. The details of the life of the Guideline for Sustainable Building from 2001 were adapted and augmented for the future observation of lifecycles. They can be used as an orientation aid or recommendations, should no exact details be available from the planners or the product manufacturers. The guidelines are based, currently, on textbook calculations, expert interviews and statements from building product manufacturers and their societies. The information is published on the Internet Portal Sustainable Building. For the evaluation of federal buildings according to the BNB system, the details stated in the table are to be used. At the same time, attempts were initiated to standardise the regulations for calculation when determining the lifespan of specific parts of construction, so that, in the long term, a simplified calculation process could be available.

Practical Experience

After introducing the Guideline for Sustainable Building 2001, the BMVBS had the implementation of the recommended qualitative criteria for sustainability evaluated in 2004. It showed that certain aspects of the Guideline, for example the implementation of “Ecological Evaluation of Depth” were only to be implemented at great economic cost. As part of the evaluation, the extent of the Guideline’s use in planning new buildings was investigated. This showed that the Dessau Environment Agency – an intensively observed project – had considered all requirements labelled in the guidelines. This in turn, caused the BMVBS to submit the Federal Environment Agency to a sustainability evaluation or certification in retrospect as part of the pilot use of the scheme “Seal of Quality for Sustainable Building” in 2008.

First Pilot Phase

The assessment system, developed in cooperation with the German Sustainable Building Council (DGNB) “Seal of Quality for Sustainable Building” was applied to 16 buildings in total, during a pilot phase in 2008, among which were five buildings from the public sector (cf. Figure 11). In a process which lasted several months, the buildings were evaluated according to this

system, which – for the most part – corresponded to the BNB. The results of this pilot phase were presented to the specialist public in the BAU 2009 and the buildings were appraised accordingly.

Federal Environment Agency Dessau

The Federal Environment Agency in Dessau, erected after the completion in 1998 from 2001 to 2005, was awarded the grade of “very good”, 1.3 in terms of the object itself and “good” in terms of location. The reasons for this can be found in the consequential adherence to the Guideline for Sustainable Building in the planning phase, the high energy requirements, the detailed green balance studies, the material declaration and the accompanying monitoring, among other things; in addition innovative ideas from planners and users, which went above and beyond the requirements in the Guideline, could be implemented. All measures were considered in the sustainability evaluation.

The Federal Environment Agency lies in the centre of the so-called Gas Quarter in Dessau and penetrates the facade with its colour and characteristic form. A four-story line of offices and functional rooms encloses an open forum and an atrium reserved for employees. The main building is made of a steel concrete skeleton with a wooden facade. Both atriums are covered by a glass ceiling in which a textile sun shade and a photovoltaic array have been embedded. The location was chosen according to the aspects of sustainable city construction. Contaminated areas were renovated, inventory buildings were integrated into the building and a large part of the free complex is used as a public parking space. The building shows the interaction of compact form and great exterior wall insulation with intelligent domestic engineering and the use of regenerative energy. The building has a large air and geothermal heat exchanger, a photovoltaic array and thermal solar pannels. The embedded materials were chosen according to ecological aspects.

Paul-Wunderlich-Haus

The Paul-Wunderlich-Haus in Eberswalde, a new building for the local administration and the land district administrator of Barnim, received 1.2 in the object evaluation and 1.6 for its location, the best results so far. This is surely due to the intensive consultations during the planning phase. The project was subsidised as part of the Federal Ministry for Economy

Figure 11
Buildings of the public Sector in the initial Pilot Phase

<p>Gold</p>  <p>Paul-Wunderlich-Haus, Eberswalde</p> <p>Bauherr: Kreisverwaltung Barnim Eberswalde, Brandenburg Architekt: Thomas Winkelhauer GAP mbH Berlin Auslöser: Holger König, Dr. Günther Lohse, Prof. Thomas Lötterschert Fertigstellung: 2007 BGF: 22.218 m²</p> <p>Gütesiegel in Objektbewertung: Gold Standardbewertung: 1,2</p>	<p>Gold</p>  <p>Umweltbundesamt Dessau</p> <p>Bauherr: Bundesrepublik Deutschland Architekt: Nasserbach Hutson, Berlin Auslöser: Dr. Günther Lohse, Prof. Thomas Lötterschert, Prof. Alexander Radtzycki Fertigstellung: 2005 BGF: 36.623 m²</p> <p>Gütesiegel in Objektbewertung: Gold Standardbewertung: 1,3</p>	<p>Gold</p>  <p>Neues Regionsbüro Hannover</p> <p>Bauherr: M&AN Vermietungs-gesellschaft mbH & Co. Dienstleistungen GmbH, Hannover Architekt: Dr. Kati Herzog Auslöser: BGF Fertigstellung: 2007 BGF: 8.441 m²</p> <p>Gütesiegel in Objektbewertung: Gold Standardbewertung: 1,4</p>	<p>Silber</p>  <p>Institutsgebäude TU Darmstadt</p> <p>Bauherr: Land Hessen Architekt: Knoke Architekten BDA, Leipzig Auslöser: Prof. Carl-Alexander Grawert Fertigstellung: 2004 BGF: 4.794 m²</p> <p>Gütesiegel in Objektbewertung: Silber Standardbewertung: 1,9</p>	<p>Bronze</p>  <p>Institutsgesamtheit Chemnitz</p> <p>Bauherr: Freistaat Sachsen Architekt: SB Zentraler Dresden (Dünnes Architekten AG, Regensburg) Auslöser: Nicolas Kere Fertigstellung: 2008 BGF: 25.864 m²</p> <p>Gütesiegel in Objektbewertung: Bronze Standardbewertung: 2,2</p>
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Umweltbundesamt Dessau (Federal Environment Agency Dessau): Urban Space Situation (Photo: Busse)



Foyer
(Photo: BBSR)

and Technology during the programme “Energy-optimised Construction”, enabling the integration of the necessary specialist planner and an intensive comparison with different planning approaches. The relatively low life cycle costs also show that, with proper planning, sustainable construction can be economical.

High energy efficiency was a central requirement in the competition description. Heating, cooling, airing and lighting were set at less than 100 kWh of primary energy per square metre per year, which is around a third of the entire energy demand of comparative governmental buildings. The guidelines were implemented with a compact construction form and the accompanying reduction in heat transferring enveloping surface, along with a building technology which consequentially uses the potential of passive climatisation. In an existing building gap in the market place of Eberswalde, four three to four story buildings will be built with highly heat insulated facades made of wooden elements with cellular insulation techniques and a tinted glass turntable. The building is aired with a ventilation system with heat recovery. Alongside ecological and energetic aspects, the attractiveness of working places and the urbanistic qualities were given greater importance according to the holistic planning approach.

To further consolidate and evaluate the assessment system, the information gained from the first pilot phase for the public buildings was examined as part of the Zukunft Bau research project and concrete suggestions were made for system development and stabilisation. Taking these results into consideration, the BNB was derived by the BBSR working on behalf of the BMVBS for the new administrative buildings.



Paul-Wunderlich-Haus: Urban Space Situation
(Photo: Landkreis Barnim)



Foyer
(Photo: Martin Duckek, Ulm)

Second Pilot Phase

Due to the still small number of evaluated buildings in the commencing phase, a simultaneous continuation of the pilot phase was decided upon in 2009 in which three further federal buildings were evaluated according to the now consolidated version 2008:

- The Federal Authority for Radiation Protection Berlin,
- The Ministry of Health Bonn
- and the Chief Customs Office Rosenheim

Chief Customs Office Rosenheim

The certification of the extension on the Chief Customs Office in Rosenheim, completed in 2007, was conducted by the BBSR. The building received a 1.9 in the object evaluation and a 1.7 for its location, a very satisfactory result, even though the new building was not explicitly planned for a sustainability evaluation.

The extension was built as an annexe to the existing building in Rosenheim, an angled, four story wing with a raised top-structure. The steel concrete skeleton was extended using light stud walls, which guarantee flexibility for necessary interior alterations. Continuous, horizontal hinges offer optimal protection from sunlight and the best possible ratio of open and closed facades. A stationary sun protection serves to constructively insulate against heat, every room is connected to the central air conditioning system which enables a natural cooling of the building during the night. The flat roof is turfed and precipitation is used for the building's toilet facilities.

Planning Monitoring

The accompaniment of the planning phase will be a decisive factor in the future for the implementation of sustainable building alongside the evaluation of already existing buildings. Specifically for the project management of federal building projects, the questions remain, how can the total quality of a building be optimised, how do the criteria interact and what proof needs to be provided. In answer to those questions, the BBSR has commenced its first pilot project in consideration of the BNB, in order to gain further experience in operation and the practicality of the system of evaluation.

Federal Environment Agency Berlin-Marienfelde

The sustainability consultation as part of the planning of a new building for the Federal Environment Agency in Berlin Marienfelde, taken on by the division "Sustainable Building" in the BBSR is an ambitious pilot project. The Federal Environment Agency intended to build a new administrative building with consultation rooms, social rooms and approx. 30 places of work as a "no energy house". "No Energy" is taken to mean a balance between heat and electricity use, which is why all energy required is to be created by or through the building itself. To that end, the BNB system is used to accompany the planning, so that the total grade of fulfilment



Hauptzollamt Rosenheim
(Chief Custom Office Rosenheim): Urban Space Situation
(Photo: Staatliches Bauamt Rosenheim, Schellmoser)



Hauptzollamt Rosenheim
(Chief Custom Office Rosenheim): Old and new
(Photo: Staatliches Bauamt Rosenheim, Peter Lio)

is determined to DD-Con and DE-Con and the building is continuously optimised. After completion of the building, it will be evaluated.

The practical use of the system shows that optimisation of sustainability is not “thinking in boxes”, but rather that individual concepts have to be implemented. This makes “high-tech buildings” deviate completely from standard

buildings. Due to the optimised enveloping construction and the low u-values, the transmitted heat loss in the hot periods is no longer a problem for these buildings. However low heat transmissions in the cooler periods can lead to the building overheating. Solutions still need to be found which, on the one hand, enable a large use of regenerative raw ingredients, thereby greatly influencing the total green balance of the building and on the other hand providing a thermal mass for the retention of superfluous heat. Concepts need to be developed which allow the greatest possible amount of daylight use and yet still avoid solar heat input. Generating environmental energies greatly depends on the building’s potential to produce the necessary auxiliary energy directly on the building. Therefore location and building greatly influence the creation of electricity and environmental heat and ultimately decide on a project’s feasibility.

In total, there are highly complex requirements for planning, which can only be solved by the early involvement of architects, specialist planners, customers, examining engineers and sustainability experts.

Public Relations – Fairs and Specialist Events

The exchange of views regarding sustainable building serves Construction and Specialist Fairs such as the Bautec Berlin, Bau Munich or the Deubau in Essen during which the BMVBS regularly presents the newest developments together with the BBSR. Selected events are held internationally such as Expo 2010 in Shanghai which focused on the sustainability week promoted by the BMVBS. Above and beyond that, national and international fairs offer a good platform for the exchange of scientific information, to present goals, instruments and experiences for sustainable building and to get in contact with international, interdisciplinary experts.

The conference series “World Sustainable Building” which takes place every three years in another host country, is seen as one of most important events. After 2008 in Melbourne, the WSB 2011 will be held in Helsinki in October 2011. The BMVBS, the BBSR and the German specialists contribute with workshops, lectures and exhibitions.



SB10 Prag – Central Europe Sustainable Building Conference (Photo: Martin Vonka, Prag)

Prospects

In June 2010, after a meeting of the Committee of Governmental Secretaries for Sustainable Development with foreign sustainable development experts, the Federal Chancellor's Office announced that the Federal Government will align the national sustainability strategy with their long term goals.²⁰ Here, the Federal Government will commit themselves to transferring the BNB to current inventory buildings and develop it further to other buildings.

In the third quarter 2009, the work group "Nachhaltiger Wohnungsbau" (sustainable residential construction), in co-operation with the housing industry, joined the transfer of the BNB to the residential construction – commencing with the new construction of apartment building. The scientific accompaniment has been ensured as part of the research initiative "Zukunft Bau". In December 2010, the five objects were assessed as part of a field survey on the basis of the profiles developed by the working group. The results of the pilot phase will be included in the closing developments of the evaluation system.

Above and beyond that, a workgroup "Unterrichtsbauten" (educational buildings) has dealt with the transferability of the evaluation system for school and educational buildings since the second quarter of 2010. The Guideline for Sustainable Building will be augmented accordingly. Since the implementation of Sustainable Construction is to be ensured over the entire life cycle of a building, the requirements for the "use and maintenance" will be described, on the one hand; on the other, the section "measures taken for inventory buildings" will be added to the Guideline. Within the framework of the Guideline and the BNB's implementation, further training will be offered to users in the respective operative building authorities and for those whom it may concern.

Foot notes

- (1)
cf. UNO (1987)
- (2)
Carbon Dioxide, Methane, Nitrous Oxide, hydroflourocarbons, perflourocarbons and sulphour hexaflouride
- (3)
cf. UNO (1997)
- (4)
cf. BMU (2005)
- (5)
cf. Deutscher Bundestag (1998)
- (6)
cf. Federal Government (2002)
- (7)
cf. Federal Government (2008)
- (8)
cf. Federal Government (2009)
- (9)
cf. EU (2007a) and EU (2007b)
- (10)
www.nachhaltigkeitsrat.de
- (11)
The Committee of Governmental Secretaries for Sustainable Development is an important panel for the sustainable politics in the Federal Government. Its duties include the implementation of the national Sustainable Development Strategy, to further develop its content and regularly examine the status of implementation. The Head of the Federal Chancellery is responsible for the management of the Committee of Governmental Secretaries, which represent all natural reserves.
- (12)
The parliamentary Advisory Council for Sustainable Development was founded on 21st January 2010 after the Bundestag decreed their use on 17th December 2009 (17/245). The Council consists of 22 members and is intended to parliamentary support the Federal Government's sustainability strategy and the European sustainability strategy and offer recommendations.
- (13)
cf. Committee of Governmental Secretaries for Sustainable Development
- (14)
BMVBS (2011)
- (15)
RBBau (2009) Guidelines for the Realisation of Federal Building Measures (RBBau), Federal Ministry for Transport, Construction and Urban Development, 19th Exchange, Circular Note from 09.03.2009
- (16)
cf. DIN EN 15643-2 (2009)
- (17)
HOAI (2009))
- (18)
<http://wecobis.iai.fzk.de/cms/content/site/wecobis/Home>
- (19)
www.bbsr.bund.de/BBSR/DE/FP/ZB/zukunftbau__node.html
- (20)
cf. Bundesregierung (2010) www.nachhaltigkeitsrat.de/news-nachhaltigkeit/2010/2010-06-24/regierung-will-mehr-langfristperspektive-in-nachhaltigkeitsstrategie/print/ vom 28.06.2010

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