The BNK Assessment Tool for the sustainability performance of small residential buildings in Germany – Lessons learnt

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Abstract. Several instruments for the assessment of the sustainable building performance such as BREEAM (Great Britain), LEED (USA) and DGNB or BNB (Germany) have been developed in the last years. These methodologies have the same intent - advancement of the sustainable building performance. These systems focus mostly on commercial buildings. However the sustainability assessment of the residential sector is getting more important. Giving that around 115,000 owner-occupied detached houses are built up per year in Germany, a new assessment method (BNK system) for small residential houses was developed on behalf of the Federal Ministry for the Interior, Building and Community (BMI) in 2015. To ensure the suitability of the assessment system, the BNK method was tested in a pilot phase and from 2016 on it is available for general use and the assessment is financially supported by public funds (KfW Banking Group). To date more than 100 of small residential buildings have been certified with BNK. This paper will show the development and experience with the sustainability assessment of buildings in Germany in general, as well as the intents, indicators and real case projects of the BNK-Tool for small residential buildings (up to five dwelling units) and its further development.

1. Introduction
If future generations are to have a quality of life comparable to the one we enjoy at present, then we need to act sustainably towards our environment. This applies to everyone, including the construction industry. Up until now, the term “sustainable construction” has been associated mainly with efforts to reduce the impact a construction project has on the environment, and to improve its energy efficiency. In fact, however, this is only part of what sustainability means [2].

At least in relation to the construction industry, sustainability is actually much more complex than that. Sociocultural, functional and economic aspects, and the building’s technical and process and location specific characteristics, are also important. To build sustainably, it is therefore not enough just to follow a rigid set of guidelines.

Special concepts, solutions, alternatives and measures need to be developed, all tailored to the construction project in question. Sustainability quality labels are important as a tool for achieving and assessing sustainability in a building: they ensure that all of the above aspects are given equal attention during the planning process, and they take into account all stages of the building’s life cycle. In recent years, numerous labels and certificates of this kind have been developed around the world, all designed to allow a building to be assessed as a complete system. They draw on existing planning tools and aspects of sustainable construction, and complement existing national standards and legislation. They give planners and clients an assessment of their project during its very early stages, which can be used in drawing up sustainable planning objectives and improving the building’s
sustainability credentials right from the planning stage. Building certificates are additionally an easy-to-understand way for users and operators of finished projects to obtain information on the building’s level of sustainability. Certification systems do not only assess the sustainability of the building as it stands, but it also provides added quality assurance by requiring the compilation of suitable building documentation [2] [3].

2. Sustainability Assessment Methods for Buildings

2.1. Methods for Assessing Sustainability – International
The established international methods for assessing the sustainability of buildings are the British system BREEAM (BRE Environmental Assessment Method), the American method LEED (Leadership in Energy and Environmental Design) and the German DGNB certificate. BREEAM and LEED were both developed in the 1990s. In 2009 two systems were launched in Germany – the Sustainable Construction Evaluation System (BNB) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), and the DGNB certificate of the German Sustainable Building Council (DGNB), that, unlike previous methods, did not focus solely on the building’s environment-friendliness and energy efficiency, but instead considered its entire life cycle [2].

Thanks to their successful marketing strategy aimed at promoting the “green building” concept, the American LEED and the British BREEAM system are currently the best-known certification systems worldwide. This is shown also in the number of certifications, like 100,100 LEED and 18,800 BREEAM certified buildings [4] [5]. BREEAM owes this success also to the fact that the British government has enshrined sustainability standards for the UK construction industry in law [6]. Notable documents are the 2006 “Sustainable Procurement Action Plan”, according to which all new and refurbished government buildings must achieve the “BREEAM Excellent” standard, and the “Code for Sustainable Homes”, which since May 2008 has required that all new residential buildings be built according to specific sustainability standards, and subsequently rated [6].

2.2. Methods for Assessing Sustainability – in Germany
In 2007, the German Sustainable Building Council (DGNB) was set up with the aim of developing a German quality label for assessing the sustainability of buildings. At the same time, the Federal Ministry of the Interior, Building and Community (BMI, former BMVBS Federal Ministry of the Interior, Building and Community) started work on a method for the evaluation of sustainable buildings. The DGNB and the former BMVBS soon decided to join forces and worked together in this area. In 2009, on the basis of past experience, international and European standards for sustainable construction such as the international standard ISO TC 59 SC 17 (Sustainability in building construction) and the European standard CEN/TC 350 (Sustainability of construction works), and the results of the “Round Table on Sustainable Construction” and “Guideline for Sustainable Building” of the BMI, the first list of criteria for the “German Certification Method for Sustainable Building” was published [2] [7].

There are now two systems in Germany based on that original joint list of criteria: firstly the DGNB certificate, which is mainly for commercial buildings in the private sector. The DGNB itself is responsible for promoting the system internationally. Over 1,500 buildings have been certified to date under this system [7]. The BNB system from the former BMVBS (now BMI), on the other hand, is for all buildings that are of significant relevance to the general public, for example federal buildings. So far 25 buildings have been certified under this system [8].

3. Sustainability Assessment Method for Small Residential Buildings in Germany – the BNK System

3.1. Why detached and semi-detached houses?
Up until now, it has been almost exclusively buildings such as office buildings, schools, industrial buildings and large residential buildings (i.e. those containing six or more dwelling units) that have
been assessed for sustainability in Germany. Insufficient attention has been given to smaller residential buildings ranging from detached houses to apartment blocks with up to five flats, even though these buildings represent a large share of total residential new build – up to 60 percent [9]. The former BMUB has tackled this problem, together with Munich University of Applied Sciences (MUAS) and other building experts and researchers, by developing a list of criteria specifically for these smaller residential buildings. A wide range of industry players were subsequently called upon to fine-tune this list, which was then subjected to pilot test to test its suitability for the market. These included housing construction industry associations, architects, engineers, and the prefabricated house industry [1].

Outside Germany, residential buildings have long since been assessed against sustainability criteria. Some 1,700 residential buildings (more than 426,000 dwellings) have so far been assessed under the BREEAM “Code for Sustainable Homes” system, for example. This is thanks to the UK government’s decision in 2008 to enshrine in law the sustainability assessment of buildings [5] [10]. More buildings are being assessed with other systems as well, under the LEED quality label 28,900 single and multifamily homes and under the Swiss Minergie label (21,800 detached and semi-detached houses as well as 20,900 multifamily houses) [4] [11].

In Germany, the Sustainable Housing Construction Quality Label (NaWoh) and individual system variants of the DGNB certificate are available for assessing residential buildings, although the formers are only available for structures containing six or more dwellings [7] [12]. However, the list of criteria of both systems is very complicated and costly to implement. With an average of 120,000 new detached and semi-detached houses being built each year in Germany, a cost-effective, lean, simple assessment system for residential buildings that all clients can apply, and that is designed to encourage sustainability in small residential buildings, is essential [13]. Therefore, the BNK system was developed and is available on the market since 2015 [1].

3.2. BNK-System: Criteria for sustainable small residential buildings

The list of criteria for sustainable small residential buildings is divided up into the four categories

- Sociocultural and functional quality
- Economic quality
- Environmental quality
- Process quality

Figure 1. Sustainability qualities of BNK [1]
broken down into a total of 19 criteria [1]. Figure 1 shows a summary of the qualities for small residential buildings, Figure 2 the 19 BNK sustainability criteria.

The system is based on the Sustainable Construction Evaluation System (BNB). However, due to the importance of the social aspects in determining the sustainability of small residential buildings, the category of “Sociocultural and functional quality” comes first in the list of criteria for detached and semi-detached houses, rather than environmental quality, which is the top category for the other building types. Each of the four categories accounts for 25% of the overall result [14].

3.2.1. Sociocultural and functional quality. Social aspects are particularly important in determining the sustainability of small residential buildings. In the category of “Sociocultural and functional quality” the aspects of quality of life, comfort, safety, security and adaptability are assessed. The level of comfort is determined by measuring the characteristics of the building from the building physics point of view. This is based on a number of calculations regarding thermal, acoustic and visual comfort and by assessing the inherent level of air hygiene inside the building. Because the system takes into account the aspects of safety and security, accessibility, and the user-friendliness of the building services, it helps to enhance residents’ quality of life.

3.2.2. Economic quality. The goal of the “Economic quality” category is to determine selected costs incurred during the building’s life cycle, and to assess its long-term viability. The calculation of life cycle costs is based on the standard DIN 276 (Building costs – Building construction). Long-term viability is based on the assessment results for various criteria such as accessibility and thermal insulation in summer, and the extent to which the building’s energy efficiency figures exceed those demanded by the German Energy Saving Regulation, the degree to which the rooms are designed in a neutral way to allow for alternative uses, and the extent to which the client has been briefed to enable them to maintain the building’s value over time.

3.2.3. Environmental quality. The environmental quality of a detached or semi-detached house is assessed by carrying out a life cycle assessment (LCA). The LCA is prepared using the online tool “eLCA” provided by the BMI and the BBSR (German Federal Institute for Research on Building, Urban Affairs and Spatial Development) [15]. The LCA looks at the building’s entire life cycle, this include the building fabric and the building services. The most important indicators used are Primary Energy Consumption and Global Warming Potential. Other aspects such as recyclability, the use of local or certified wood, measures taken to reduce drinking water consumption, and the efficient use of space in order to minimize soil sealing are considered.

3.2.4. Process quality. The main aim of the “Process quality” category in relation to residential buildings with up to five dwellings is to ensure the quality of planning, construction and documentation, and to provide a building dossier including a user manual. The building dossier includes the latest plans, energy performance certificates, measurement records, safety certificates, data sheets, care instructions, and all documents relevant to the operation and maintenance of the building. Process quality also includes having the quality of construction verified by an external assessor.

3.3. BNK-System: Assessment Methodology and Certification Authority

For each criterion there is a description of the assessment method and indicators, general information, an assessment scale, and the documents required as evidence of adherence to that criterion. The result of the assessment is represented by a score between 1 to 5, and its percentage. The scores and percentages relate to one another as follows [1] [14]:

- 80% or more: score of 1.5 or better
- 65% or more: score of 2.0 or better
- 50% or more: score of 3.0 or better
The building owner will receive the BNK certificate, in case one point in each criterion is achieved. The certificate will be proved and over given by BiRN (Bauinstitut für Ressourceneffizientes und Nachhaltiges Bauen GmbH). BiRN is the official certification authority for the BNK system and is accredited by the BMI. Furthermore BiRN is responsible for the training of BNK auditors and for the development of the BNK system [16].

3.4. BNK System: Further development

To ensure the practicability and user-friendliness of the sustainability assessment of small residential buildings in the long term the intents, the standards, methodologies and benchmarks referring to the BNK system are updated and developed at regular intervals.

In 2018 the results of the research project "Further development of the criteria indoor air hygiene, pollutant emissions, dismantling and dismantling friendliness and resilience of the BNK system" was published by BiRN. This research project was developed by BiRN in close collaboration with building experts from all over Germany [17]. It was funded by the research initiative "Zukunft Bau" of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). In addition to the revision of already existing criteria, new aspects of sustainability were taken up.

These criteria have been proofed in real case studies involving building owners, developers, project managers, architects and engineers. A pilot study was carried out in order to check the suitability of the new and overworked criteria on real detached and semi-detached houses. Around ten single family housing have taken part. In the following the four new developed criteria will be shown:

- Criteria “Indoor hygiene and risk-based emissions of construction products”:
  New assessment processes and methodologies were added to the existing criterion. Further on benchmarks of the existing indicator were revised. Originally the listing of used construction products was sufficient for assessing small residential buildings. In the new version
benchmarks and parameters for "Volatile Organic Compounds" (VOCs) and other risk-based substances were defined and added. For this purpose, different digital tools have been developed to implement the new assessment methodology in a simple and practicable way.

- Criteria “Consultation, agreeing objectives and risk assessment against natural hazards”:
  The methodology for assessing the risks for natural hazards has been newly integrated into this criterion. Natural hazards, like wind, heavy rain, hail, lightning, snow load, flood, radon and earthquake will be considered now. The assessment was divided into three risks classes "low", "medium" and "high" risk.

- Criteria “Building dossier including user manual, demolition and dismantling-friendliness”:
  The topic of deconstruction, separation and the re-use of buildings product was taken into account. Aspects for resource-efficiency and waste-minimizing of buildings were extensively overworked. A new process for the preparation and evaluation of dismantling concepts was integrated into the criteria. Therefor a component catalogue with dismantling and separation option was developed that includes the mass balance of building products coming out from Life Cycle Analyses (LCA).

- Criteria “Quality assurance in planning, construction and use”:
  In addition to an editorial revision, the benchmarks were adjusted in this criterion during the research project.

4. Outlook and Benefits of Assessing Building Sustainability

Since April 2015 the BNK system is available for general use as a simple and cost-effective assessment system for small residential buildings. Assessments are carried out by “Sustainability Coordinators” who hold a specialist qualification in sustainable building by BiRN and who monitor the project during planning and construction. To ensure that all certificates are of a suitably high quality, the assessments are checked furthermore by BiRN [16]. From 2016 the KfW Banking Group is providing financial support to help projects achieve the sustainability certificate for houses with one to five dwellings, similar to the support it offers for those seeking to achieve the Efficiency House standard.

Based on the results of the research project the new criteria will be integrated in the BNK system in a new version at the end of 2019. Furthermore the system will be extended to cover residential buildings with up to five dwellings; in future it is conceivable that it will also allow the assessment of refurbishment work on existing residential buildings.

Summarizing the abstract - the advantages of applying sustainability tools and criteria for small residential housing are the follows [2] [3]:

- benchmarks help to reduce and monitor the building’s impact on the environment,
- allows quality of different buildings to be compared,
- helps in setting sustainable planning objectives (e.g. checklists),
- improves the transparency of planning and construction work,
- provides a project management tool for ensuring that sustainability is achieved,
- better building documentation (e.g. building passport),
- more competitive at all stages of life cycle.

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