# Sustainable buildings in Austria – TQB assessment scheme to promote sustainability in the construction industry


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## Summary

Building assessment systems can serve as powerful agents of change in efforts to reduce the environmental impact caused by the building sector. In Austria, the TQB building assessment scheme has been in place since 2001. This conference contribution describes the development of the TQB assessment scheme, and presents an overview of TQB buildings, certified in the period from 2001 to 2010. It summarises the experiences gained and lessons learnt during the past decade, and outlines requirements for further development in the future.

**Keywords**: sustainable buildings, building certification, energy efficiency, renewable energy, sustainable development, green building assessment scheme

## 1. Introduction

Energy consumption in the building sector accounts for more than one-third of energy consumption in Austria. In order to reduce heating and cooling energy consumption in the building sector, and to optimise buildings as a whole in terms of sustainability, several policy instruments have been applied, among others, the social housing scheme. The social housing scheme has a long tradition, and has been a driver for sustainable buildings in the residential sector.
Green building assessment schemes address residential buildings outside the social subsidy scheme, and - even more importantly – also address the non-residential sector. The application is voluntary and requirements are more ambitious than those of the building code and social housing scheme.
Green building assessment schemes offer the opportunity to substantially facilitate the transition towards a sustainable building sector by setting up performance requirements regarding energy, materials, water, land, indoor air quality, emissions, and many others. Therefore, building assessment systems can serve as powerful agents of change in efforts to reduce the environmental impact caused by the building sector.

## 2. Total Quality Building - TQB assessment scheme

In 1997, Austria joined the Green Building Challenge, an international platform for the development of green assessment schemes for buildings (successor organisation IISBE - International Initiative for a Sustainable Built Environment). It soon became evident that data generation, collection, and examination had to be adjusted to the Austrian planning and construction practice, in order to avoid high transaction costs.

In 2001 the Total Quality (TQ) assessment scheme was developed, and after a testing phase went into full operation in 2003. In 2009 the system was revised based on lessons learnt and renamed as Total Quality Building (TQB) assessment scheme.
Although the assessment scheme was developed according to developers' needs, market up-take was quite slow, and especially the use of the assessment results in marketing communication was lacking. It turned out that estate agents did not know how to use the assessment result in the selling or renting process, largely because they were not trained in aspects such as indoor air quality, primary energy consumption of materials or $CO_2$-emissions. Furthermore it seemed as if the barrier for the construction sector was too high, with exception of a few innovators. Therefore, since the full implementation of the EU Directive 2002/91/EC (EPBD) in 2009, a step-wise system has been in place. TQB assessment builds on the mandatory energy certificate. The combined model was chosen to lower barriers for companies to become familiar with environmentally conscious design and construction. It was the objective to make use of the dynamism stemming from the EPBD, and to facilitate market penetration of eco-buildings by linking the voluntary building assessment schemes with the mandatory energy certificate.

Since 2009, the ÖGNB – Austrian Sustainable Building Council runs the TQB assessment scheme and the third party certification. ÖGNB also provides a platform for further developing the criteria framework and a platform for creating innovations in the construction sector and associated industries, which are activated by the performance requirements.

## 3. Conclusions and outlook

The TQB building assessment scheme plays an important role in the field of research and demonstration, and is widely accepted among innovators. However, broad market uptake has not been achieved yet. TQB assessment is carried out voluntarily, and currently only few property valuators and building owners require building certificates. Yet, building owners, architects and designers do use the assessment scheme as guideline for optimisation during the design and construction process, and developers use TQB as internal quality control system.
If a builder sells a property for the first time and presents the building certificate, buyers rarely validate the certificate. Nevertheless, attitudes are changing, and owners increasingly recognise the value of the certificate if the property is about to be resold. In this case the building certificate represents a source of independent and thus credible information about the property, which is very much appreciated by potential buyers.
Regarding market uptake it is rather disappointing that the certificate is far from being an established part of the valuation process, although the TQB assessment system considers exactly those aspects which will influence the property valuation results if they are properly taken into account: income from rent, operating costs and future risks influence the valuation result substantially, depending also on the quality of indoor climate, the level of energy consumption and security of energy supply, as well as on the amount of whole life costs. However, even if the relation between technical building performance and economic impact on valuation is clearly displayed, at the end of the objectively performed valuation the result will always be weighted according to the actual market demand for sustainable buildings, and market demand is not yet satisfactory in this respect.
Potential buyers do not fully understand the advantages of sustainable buildings and estate agents cannot explain them very well. Building certificates could provide the required information, but lack acceptance because they are either too simple ("gold standard") or too complex (list of technical parameters), and thus do not provide "ready to use" information for most realtors and also most clients.

Therefore, the ÖGNB – Austrian Sustainable Building Council has been seeking cooperation with this group, to further develop the TQB-tool and ensure useful results for both realtors and estate agents. The aim is to strengthen the position of the building certificate on the market and to enhance demand for sustainable buildings.

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## Summary

Building assessment systems can serve as powerful agents of change in efforts to reduce the environmental impact caused by the building sector.
Building assessment systems provide building performance information such as that regarding energy consumption, materials used, and operational costs. Assessment systems define various levels of performance within the marketplace, above and beyond the minimum defined by codes and standards. As a consequence, building assessment results can be utilised as a marketing instrument, thus increasing the demand for cost-efficient, user-friendly, and environmentally sound buildings. At the same time, they produce a substantial reduction in environmental impact.
In Austria, the TQB building assessment scheme has been in place since 2001.

This conference contribution describes the development of the TQB assessment scheme, and presents an overview of TQB buildings, certified in the period from 2001 to 2010. It summarises the experiences gained and lessons learnt during the past decade, and outlines requirements for further development in the future.

**Keywords**: sustainable buildings, building certification, energy efficiency, renewable energy, sustainable development, green building assessment scheme

## 1. Introduction

Energy consumption in the building sector accounts for more than one-third of energy consumption in Austria. Residential buildings represent the majority of the Austrian building stock: according to statistical analysis carried out by Statistics Austria, in 2001 there were 2.05 million buildings and approximately 3.86 million dwellings. Three quarters of all Austrian buildings are single-family houses and detached houses, and 14% are non-residential buildings. Concerning the number of flats, the distribution is more or less equal between single-family houses and detached houses, and apartment buildings. 21% of residential buildings were constructed before 1919, and 47% were constructed in the period between 1945 and 1981. [1,2,3] The latter portion is most important in terms of constructed buildings as well as in terms of energy consumption and thus also energy saving potential.

While energy use for space heating and energy use for domestic hot water is predominant in residential buildings, energy consumption patterns are more diverse in non-residential buildings, depending on the purpose of the building: hospitals, shops, offices, schools, etc., and there is little statistical information. However, it is evident, that electricity consumption is increasing dramatically, mainly due to cooling needs. Studies carried out to analyse the impact of climate change on Austrian regions show that the number of days with temperatures above 30°C will increase fourfold in the East of Austria. [4] As a consequence, electricity consumption is likely to skyrocket if no precautionary measures are taken.

In order to reduce heating and cooling energy consumption in the building sector, and to optimise buildings as a whole in terms of sustainability, several policy instruments have been applied in Austria, among others, the social housing scheme.
The social housing scheme has a long tradition, and has been a driver for sustainable buildings in the residential sector. Criteria are set up in way so that the majority of Austrians is eligible to apply. For many years, the social housing scheme has been extended towards including energy efficiency criteria, addressing renewable energy systems, and subsequently also to criteria targeting ecological materials. The social housing subsidy scheme provides additional money upon condition that energy and other ecological criteria are met. Heating energy consumption has been decreasing due to defined heating energy indicators required by subsidy schemes, and since 2009 also by the revised building codes, as required by the Energy Performance of Buildings Directive (EPBD).

Green building assessment schemes offer the opportunity to substantially facilitate the transition towards a sustainable building sector by setting up performance requirements regarding energy, materials, water, land, indoor air quality, emissions, and many others. Green building assessment schemes address residential buildings outside the social subsidy scheme, and - even more importantly – also address the non-residential sector. The application is voluntary and requirements are more ambitious than those of the building code and social housing scheme. Therefore, building assessment systems can serve as powerful agents of change in efforts to reduce the environmental impact caused by the building sector.

## 2. Total Quality Building – development of TQB assessment scheme

In 1997, Austria joined the Green Building Challenge, an international platform for the development of green assessment schemes for buildings (successor organisation IISBE - International Initiative for a Sustainable Built Environment). At that time, the BRE Environmental Assessment Method (BREEAM, developed in UK) was in place and experiences delivered valuable input for establishing an international platform for green building assessment. However, in terms of practical implementation it soon became evident that data generation, collection, and examination had to be adjusted to the Austrian planning and construction practice, in order to avoid high transaction costs. In Austria, small and medium-sized companies are predominant, and it was the objective to provide a cost-efficient tool for widespread application. In 2001 the Total Quality (TQ) assessment scheme was developed, and after a testing phase went into full operation in 2003. [5,6]
In 2009 the system was revised based on lessons learnt and renamed as Total Quality Building (TQB) assessment scheme.
Since 2009, the ÖGNB – Austrian Sustainable Building Council runs the TQB assessment scheme and the third party certification. ÖGNB also provides a platform for further developing the criteria framework and a platform for creating innovations in the construction sector and associated industries, which are activated by the performance requirements.

Development of the TQ assessment scheme was based on a survey conducted among developers, which clearly pointed out that performance criteria limited to energy efficiency measures, renewable energy technologies, and ecological materials would lack acceptance. However, developers were willing to apply a comprehensive building assessment scheme, which includes aspects such as noise protection, indoor air quality, flexibility, and others besides environment-related criteria.

Furthermore, the assessment scheme should be useful as a quality control tool as well as a marketing instrument.
Therefore, the TQB assessment scheme was composed of a comprehensive set of criteria to be applied at the very beginning of a project and to adjust design targets according to the criteria to achieve a good assessment result.
In order for buildings to pass the TQB assessment, checks are made twice, first at the end of the planning stage and then after completion of construction. The objective is to ensure that the building was constructed in compliance with the design, which will be especially important if the building is designed in an integrated way. In this case, architectural aspects and energy technology aspects are intertwined and small changes during construction to reduce costs will result in substantial problems concerning comfort and energy performance during building operation. After the planning phase, drawings and calculations are checked, and after completion the compliance with the design is examined, and measurements are carried out.

The next figure shows the concept of the Austrian building assessment scheme.

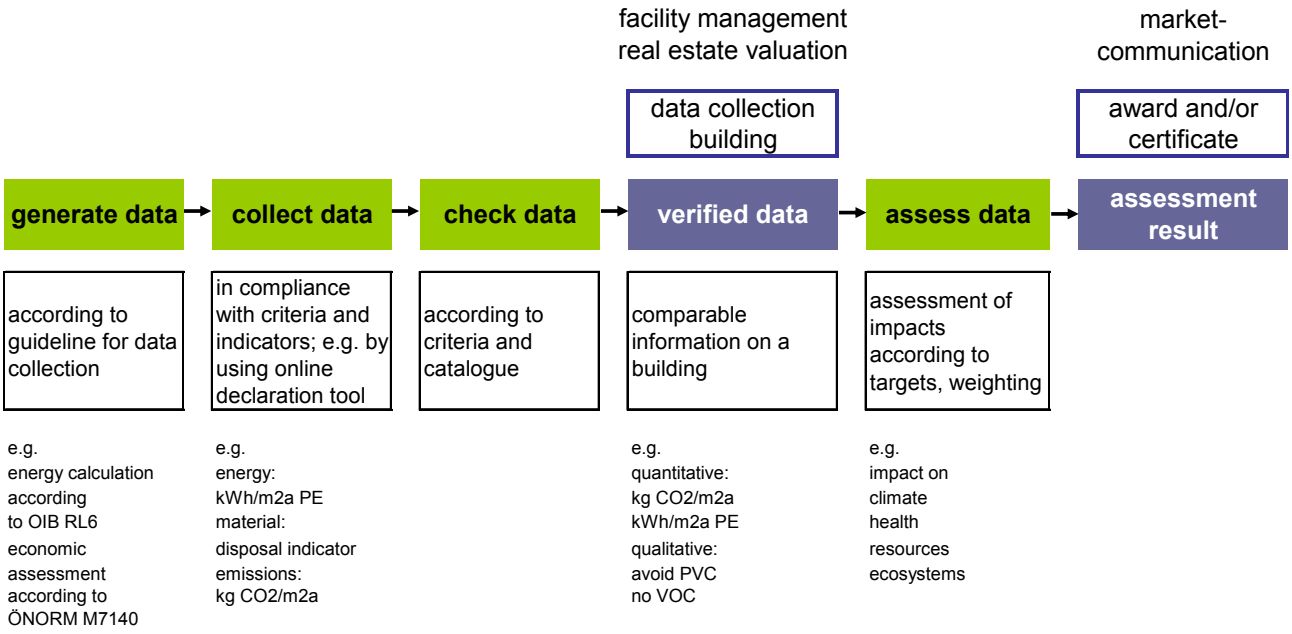



*Fig. 1 The concept of the Austrian TQB green building assessment scheme*

Since 2010, the TQB assessment is based on an internet-tool, which is free of charge and publicly accessible at www.oegnb.net. The tool consists of an assessment framework with a detailed description of assessment criteria, a description which data have to be provided and a guideline how to achieve the best score. The tool is for free because it is the objective to encourage architects, designers and building owners to use assessment criteria for design optimisation and quality control during the design and construction process. Only if the building owner demands for a third party certification, costs will arise for the certification procedure.

The TQB system does not assess architectural quality, but technical parameters that have to be taken into account during the process of designing the building. At the beginning of the design process, the design team and the client define the design targets for the building by means of criteria for the assessment framework and the scores they want to achieve; after assessment, a group of independent experts certifies that all the information used for assessment is correct.

The next table shows the latest version of the assessment criteria for residential buildings.

*Table 1 TQB-Assessment categories and criteria (overview residential buildings, category and first level criteria, version 2.2, december 2010)*

| | **Category and criteria (German original)** | **English translation** |
|---|---|---|
| **A** | **Standort und Ausstattung** | **Location and amenities** |
| A.1 | Infrastruktur | Infrastructure |
| A.2 | Standortsicherheit und Baulandqualität | Security |
| A.3 | Ausstattungsqualität | Amenities |
| A.4 | Barrierefreiheit | Accessibility |
| **B** | **Wirtschaftlich und technische Qualität** | **Economical and technical quality** |
| B.1 | Wirtschaftlichkeit im Lebenszyklus | Life cycle cost assessment |
| B.2 | Baustellenabwicklung | Construction site management |
| B.3 | Flexibilität und Dauerhaftigkeit | Flexibility and longevity |
| B.4 | Brandschutz | Fire prevention |
| **C** | **Energie und Versorgung** | **Energy and water** |
| C.1 | Energiebedarf | Energy consumption |
| C.2 | Energieaufbringung | Energy production |
| C.3 | Wasserbedarf und Wasserqualität | Water consumption and water quality |
| **D** | **Gesundheit und Komfort** | **Health and comfort** |
| D.1 | Thermischer Komfort | Thermal comfort |
| D.2 | Raumluftqualität | Indoor air quality |
| D.3 | Schallschutz | Noise protection |
| D.4 | Tageslicht und Besonnung | Daylight and sun |
| **E** | **Ressourceneffizienz** | **Resource efficiency** |
| E.1 | Vermeidung kritischer Stoffe | Avoidance of harmful substances |
| E.2 | Regionalität, Recyclinganteil, zertifizierte Produkte | Quality of products (local production, recycling material, certified products) |
| E.3 | Ökoeffizienz des Gesamtgebäudes | Eco-efficiency of the entire building |
| E.4 | Entsorgung | Demolition and disposal |

Although the assessment scheme was developed according to developers' needs, market up-take was quite slow, and especially the use of the assessment results in marketing communication was lacking. It turned out that estate agents did not know how to use the assessment result in the selling or renting process, largely because they were not trained in aspects such as indoor air quality, primary energy consumption of materials or $CO_2$-emissions. It seemed as if the barrier for the construction sector was too high, with exception of a few innovators. Therefore, green building assessment was integrated in the climate protection programme "klima:aktiv", launched by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management in 2004. The programme targets a substantial reduction of $CO_2$-emissions and a substantial increase in energy efficiency in the building and transport sector, in industry, and households, by funding comprehensive activities such as the production of information material, consulting services, network development, and the elaboration of quality control procedures. [7]

The sub-programme "construction and refurbishment" offers the klima:aktiv building standard for residential and non-residential buildings, and for new build constructions as well as for refurbishments. This standard consists of selected criteria of the TQB standard with focus on outdoor and indoor environment, to communicate individual benefits along with the reduction of $CO_2$-emissions.

The criteria system comprises the following categories:

- A Design and Construction
- B Energy and Supply
- C Materials and Structure
- D Comfort and Indoor Air Quality

## 3. To lower the barrier with a step-wise system: energy certificate - klima:aktiv - TQB

Since the full implementation of the EU Directive 2002/91/EC (EPBD) in 2009, a step-wise system has been in place. The combined model was chosen to lower barriers for companies to become familiar with environmentally conscious design and construction. It was the objective to make use of the dynamism stemming from the EPBD, and to facilitate market penetration of eco-buildings by linking the voluntary building assessment schemes with the mandatory energy certificate. [8,9] Therefore, the klima:aktiv category “B Energy and Supply” fully corresponds with the energy certificate. On the way towards a sustainable building, the first step is a good energy performance documented by the mandatory energy certificate. If the developer or building owner seeks good performance beyond the energy sphere, the klima:aktiv criteria “A Design and Construction”, “C Materials and Structure”, and “D Comfort and Indoor Air Quality” can be fulfilled, and after a plausibility check the klima:aktiv label will be awarded. If the building owner or developer is ready to document that the building achieves high quality also in terms of noise protection, flexibility, and other criteria, then there exists the option to build upon the klima:aktiv data and to extend the data collection in order to receive the TQB certificate. As a condition, the building must pass a detailed check of data carried out by authorised staff.
klima:aktiv was developed based on a study commissioned by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, and TQB was developed based on studies commissioned by the same ministry, the Austrian Federal Ministry for Transport, Innovation and Technology, and the Austrian Federal Ministry of Economy, Family and Youth.
Since 2009, the ÖGNB – Austrian Sustainable Building Council has been involved in both building assessment schemes. [10]

## 4. The role of research and demonstration

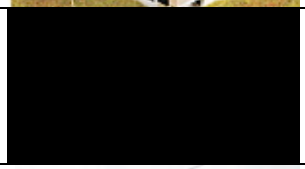
The Austrian research programme “Building of Tomorrow” is an integrated research program, which supports the process of change towards sustainability by funding research projects, prototype development, and demonstration building projects. Since 1999, numerous projects have been funded, among others the development of the TQB building assessment scheme. The building assessment scheme has served as a guideline on performance criteria and how to achieve them, and as a tool to make the building quality visible in the form of a building certificate.

Sustainability requirements resulted in development of new products and technologies, such as: [11]

- Thermal flat collectors to be used as 'facade collectors', which can be installed without any back ventilation onto facades. The new component represents a high architectural quality and style element for facades, and can be recycled after the lifetime has ended.
- Photovoltaic modules for building integration. PV-modules provide energy and at the same time take over additional functions such as building covering or shading. They can be manufactured on demand in various sizes, and due to their “break-through security” the modules are applicable for facades as well as overhead glazings.
- Single-stage adsorption chiller working with water as cooling agent and silica gel as adsorbent agent for a low range of performance (2 to 50 kW refrigerating capacity), and based on energy supply with hot water, provided by solar panels or district heating.
- Product development for the inside thermal insulation for houses designated as having special historic status, with restrictions concerning the insulation of outer walls.

Demonstration buildings were constructed using new concepts, products and technologies developed in the research programme. All demo-projects have been assessed and evaluated with the TQB-tool and are easy to be found with the “Buildings of Tomorrow” roadmap, which is available on the programme website. [12] TQB assessment results are available at www.oegnb.net.

*Table 2 Buildings assessed with TQB (2009, examples)*

| | | |
|---|---|---|
| Giefinggasse, Wien:<br>ENERGYbase<br>Client: Wiener Wirtschaftsförderungsfonds | Office building with research infrastructure<br>New construction |  |
| Innsbruck, Tirol:<br>Josef-Franz-Huter-Straße / Sieglanger<br>Client: WE Wohnungseigentum Tiroler gemeinnützige Wohnbau GmbH | Residential building<br>New construction |  |
| Niklasdorf, Steiermark:<br>Eine Welt Handel AG Betriebsgebäude<br>Client: Eine Welt Handel AG | Whole sale store<br>New construction |  |
| Linz, Oberösterreich:<br>Passivhaussanierung Markartstraße<br>Client: GIWOG | Residential building<br>Renovation |  |
| Ludesch, Vorarlberg:<br>Gemeindezentrum Ludesch<br>Client: Marktgemeinde Ludesch | Community centre<br>New construction |  |
| Kierling, Niederösterreich:<br>Passivhaussanierung Kierling Planung<br>Client: BUWOG | Residential building<br>Renovation |  |
| Schwanenstadt, Oberösterreich:<br>Passivhaussanierung Schule Schwanenstadt<br>Client: Stadtgemeinde Schwanenstadt | School building<br>Renovation |  |
| Stadl-Paura, Oberösterreich:<br>ChristophorusHaus<br>Client: MIVA | Multifunctional building<br>New construction |  |

## 5. Conclusions and outlook

The TQB building assessment scheme has an important role in the field of research and demonstration, and is widely accepted among innovators. However, broad market uptake has not been achieved yet. TQB assessment is carried out voluntarily, and currently only few property valuators and building owners require building certificates. Yet, building owners, architects and designers do use the assessment scheme as guideline for optimisation during the design and construction process, and developers use TQB as internal quality control system.

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This paper is also based on the following papers published 2010:

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