

# A certification scheme for operation of buildings with well-planned and ambitious environmental improvements

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**Abstract.** The development of environmental certification schemes has increased rapidly during the last twenty years and are often used as benchmarks during design of new buildings or reconstruction. However, for management of our existing buildings the members of Sweden Green Building Council request for clear guidelines and a certification scheme. Therefore, a new certification scheme called Miljöbyggnad i drift has been developed within close cooperation with branch actors through interviews, workshops and suggestions for consideration. The scheme will be launched in spring 2020. The new scheme act as a guidance tool for the property sector to meet the environmental quality objectives. Today many of our existing buildings do not even meet the requirements within our regulation called “Miljöbalken” and many tenants are suffering with health problems due too low indoor environment qualities in their homes, in schools or at work. Therefore, high focus is on indoor environment and occurrence of dangerous substances but also aspects that consider improved health. Use of energy and resources are considered to reduce the impact of global warming. Building’s status is evaluated in order to make deliberate environmental improvements. Eighteen environmental aspects are assessed with about 250 statements that should be answered with yes in order to give one score. With the scores the building owner will get a good identification of the worst parts of the building and which measures that directly will give substantial results. The aim is to give a clear presentation of the building’s status, irrespective of building category or age, and to inspire for a well-planned and ambitious environmental improvement with gamification.

## 1. Introduction

The housing and service sector is responsible for than one third of Sweden’s total final energy use, and meeting the long-term environmental quality objectives requires an overall reduction in energy use as well as an energy supply with low environmental impact [1]. At the same time, 1.2 million adults have health problems that they relate to one or more indoor environmental factors in the home, school or workplace. As many report that they live in homes with visible damp damage, mould or a mouldy smell, and thousands of people suffer respiratory problems as a result [2]. The ventilation in Swedish homes is often poor [3], which can lead to health problems. Examples of serious health problems, and in the worst-case death, include lung cancer caused by radon exposure and Legionnaire’s disease caused by legionella bacteria. Less serious problems such as poor thermal climate, noise disturbance and lack of daylight are also important. Health problems can also arise from chemical exposure to materials indoors [2], and chemical substances in the indoor environment can pose a health risk of respiratory illnesses and allergies in children [4]. The main substances pointed out are formaldehyde-emitting materials, softened plastics (phthalates) and newly painted surfaces. There is a national environmental quality

objective for 'an environment free of poisons' [5]. Still relatively little has improved in the last decade regarding the environmental problems connected to the buildings.

To improve this situation and support meeting the environmental quality objectives set by the Bygga-bo dialogue (a partnership between the property and construction sector, authorities and academia [6]), a national environmental classification scheme was produced in 2009. The aim was to provide a strong incentive for building contractors, property owners, property managers and users of the buildings to speed up development towards a sustainable property and construction sector through a practically applicable and well-established method for environmental classification of buildings. In 2011, the method was developed into a certification scheme called Miljöbyggnad (Environmental Building) and in 2017 a new version, Miljöbyggnad 3.0, was introduced [7]. The certification involves a third-party inspection of documents to prove the environmental rating that is applied for. Miljöbyggnad is a voluntary scheme of environmental certification for buildings considering energy, indoor environment and material issues. It is used for homes and offices, for new building, renovation and existing buildings. Miljöbyggnad has become the dominant environmental certification in Sweden, with more than 1500 certified buildings [8]. However, only less than 12 % of the certified buildings are existing buildings. This is despite the fact that new construction counts for less than 3 % [9] of the total building stock meaning that in order to reach the environmental objectives large efforts are needed for the existing buildings. The improvements in different environmental indicators assessed by the National Board of Housing, Building and Planning [10] show that the improvement work for the building sector is slow compared to the targets.

To improve the environmental quality of the existing buildings the members of Sweden Green Building Council, that consist mainly of the property and construction sectors, requested for a new certification scheme to assess existing buildings and inspire for improvements with clear guidelines. In 2017 the work started with development of Miljöbyggnad in operation. The main aim with the new scheme is to inspire building owners to improve their existing buildings stock and thereby clearly contribute to meeting national and international environmental objectives.

## **2. Development work**

The new certification scheme has been developed within close cooperation with property owners, specialists, inspectors, researchers, operating contractors and trade associations through interviews, workshops and referral versions. The implementation and anchoring of the development work started in 2017 and has included the following activities:

- Work seminars in three locations around Sweden. The basic criteria for Miljöbyggnad were further developed that have governed the development work for the new scheme.
- Examination and analysis of international certification schemes for existing buildings was carried out with respect to content and structure.
- Several proposals for scheme structures were analysed with respect to established principles for certification and the requirements of property owners.
- A prototype of scheme structure and scoring schemes was tested in 16 pilot projects in autumn 2018.
- Open referral on method, requirements and scoring was suggested together with hearings in three locations.
- Implementation of results from pilot projects and comments from hearing for final formulation.
- Comments from the project's reference group have been continuously collected and processed.
- A referral version was published in November 2019.
- Final version is planned for spring 2020.

### **2.1 Basic Criteria for Development Work**

During the development work of Miljöbyggnad 3.0 [7] six work seminars were conducted to identify basic criteria that can be used to relate to during the development work. These basic criteria were further elaborated in the beginning at the development work of the new certification scheme. These basic criteria

have governed the development work in choosing what in the building and administration to be assessed, how the requirements are formulated, how the scoring system is designed and the method of checking that requirements are met. They will also form the basis for interpretations when the certification scheme is in operation. The basic criteria applicable to the new certification scheme and how they are met are as follows:

- Support the work of property owners on the Swedish environmental objectives linked to existing buildings and its management. The Swedish environmental quality objectives are central for the new certification scheme with directly or indirectly links to many of them. The objective Good built-up environment is central but also clear links to the objectives Limited climate impact, Fresh Air, Non-toxic environment, Protective ozone layers, Safe radiation environment and Groundwater of good quality.
- Be cost effective. To make it easy and to minimise extra costs, the documentation required to verify the requirements should, as far as possible, be the same as that normally used for the building and management process. On-site review provides the possibility of direct communication with the reviewer and reduces the risk of misunderstanding. The mandatory requirements can be verified without comprehensive investigations and measurements. The property owner's own ambition determines the extent since the applied rating determines how many requirements need to be checked.
- Be adapted for Swedish conditions. The certification scheme should comply with existing laws, rules and regulations in order to avoid duplicating work that would result from a separate set of rules and regulations. There would also be a risk of two sets of rules and regulations conflicting. Therefore, the certification scheme is based on Swedish laws and regulations, adapted for Swedish building tradition and technical solutions and formulated so that it fits Swedish building management practices.
- Be easy to understand and use. The certification is designed to make it easy to understand and easily be used by people working in the property sector. The requirements are formulated for those who do the actual work. Standardized and familiar concepts, terms and methods are used for professional roles normally in property management.
- Being implemented regardless of the size or owner of real estate companies and management organization. The certification scheme can be used regardless if the owner is public or private, how large a real estate company is or how the operation and management are organized.
- Provide observed environmental benefits. Characteristics assessed in certification are clearly linked to noted environmental problems in existing buildings. Among other things, Swedish authorities accounting of environmental status and environmental problems in the existing building stock has served as a basis for the selection and design of requirements.
- Focus on what the property owner can influence. The certification scheme focuses on the building itself and how it is managed and to some extent on the plot. Certification ratings are independent of the building's geographical location and infrastructure. Users have a major impact on a building's environmental impact. The scheme encourages property owners to engage users in environmental work, however, no checks are carried out on users' compliance and thus the building rating is not affected. Instead the building owner's cooperation offers with users and information given to the users are rated.
- Be formulated as functional requirements. The requirements are formulated as functional requirements to give the property owner the freedom to choose technology solution, execution or formulation of documents that suit the building in question and the organization best. Requiring specific technology solutions or wording in documents slows innovation and initiatives in administration.
- Independent and reliable assessment. The auditors have high and relevant expertise and experience in their professional field supplemented by knowledge of the certification scheme. The reviewer shall be independent of the organisation whose building shall be certified and they are quality assured with a sampling procedure.

- Requirements required are verifiable. As it is meaningless to set requirements that cannot or will not be verified, it must be possible for all criteria to be verified at a reasonable cost. An approved requirement shall be verified with, for example, a photo, measurement protocol, drawings, descriptions, instructions, governing documents or measurement results.
- Compulsory to meet requirements in all environmental areas. There are mandatory requirements in all environmental areas to ensure that a certified building meets a minimum level in all environmental areas.
- All environmental measures are important. The certification scheme is designed with a large number of optional points so that all environmental measures carried out by the property owner will be rewarded.
- Increase knowledge, inspire and guide to environmental improvement. The certification scheme is based on a points system where building scores are determined by the number of approved points. The scheme encourages and drives improvement work by allowing improvements to give higher grades. The ratings can be illustrated in charts showing where improvement potential is available, for example within the building, building services, operation, management or building owner's environmental offer. The rating can also be illustrated in charts where you can see how many points have been achieved in different environmental areas and where there is potential for improvement. Unfulfilled requirements show where there is an improvement potential.

### **3. A certification scheme for environmental management of existing buildings**

The idea of the certification scheme is that property owners can find out their building's environmental status in the form of environmental points, get advice about improvement measures and get inspired to perform the improvements. The base of the scheme is a tool first used as inspection protocols and later to plan improvement measures. It consists of a number of point requirements, the more the building and the administration can meet the more points can be added to the building's environmental status. There are three types of protocols for either; residential buildings, non-residential buildings and non-residential buildings with comfort cooling system.

#### **3.1 Assessment in Environmental areas and Environmental aspects**

Environmental impact from building and management is assessed in following five environmental areas:

- *Indoor environment*, which comprise the users' direct experiences of comfort.
- *Health*, which refers to the building's long-term impact on user health.
- *Climate impact*, which refers to how the building's energy use and power needs affect the climate.
- *Resources*, which relates to environmental impact caused by materials in the building and measures to reduce resource use and waste.
- *State*, which refers to the condition of the property through analysis of building parts and installations.

Each environmental area is divided into environmental aspects. There are 18 environmental aspects that all have a connection to government requirements that property owners need to ensure that they are met. The requirements are formulated in environmental legislation, such as the Environmental Code and the Planning and Construction Law, and in government regulations, for example from the Swedish Work Environment Agency, the Swedish Public Health Agency, the Swedish Radiation Safety Authority, the Swedish Environmental Protection Agency, the Swedish Energy Agency and the Swedish National Board for housing Building and Planning. Each requirement is linked to these environmental aspects and thus also to the noted environmental problems in the existing building stock. The 18 environmental aspects are:

- Indoor environment
  1. Air quality
  2. Thermal comfort winter
  3. Thermal comfort summer

- 4. Acoustic
- 5. Daylight
- Health
  - 6. Moisture safety
  - 7. Radon
  - 8. Legionella
  - 9. Healthy life and considerations
  - 10. Possibilities for good cleaning
- Climate impact
  - 11. Energy use
  - 12. Power need
  - 13. Emission of greenhouse gases
  - 14. Heating load by the sun
- Resources
  - 15. Environmental and hazardous substances
  - 16. Waste and reuse
  - 17. Water use
- State
  - 18. Internal and external

### 3.2 Point requirements

Each point requirement relates to an environmental property or function that has an impact on an environmental aspect. The requirements have been chosen and formulated on the basis of basic criteria and are formulated so that they are directed to the professional role that does the actual work. The point requirements are mainly formulated as a statement that can be confirmed by yes or no. A statement that can be answered with *yes* gets a point and one answered with *does not know* or *no* gets zero points.

Some point requirements relate to several environmental aspects or environmental areas and then receive a point for each environmental aspect on which the fulfilment of the requirement has an impact. For example, if a building meets the requirement that *the ventilation system is adjusted according to the current need for airflow in each room*, five points are obtained. One in each environmental aspect; Air quality, Moisture safety, Healthy life and considerations, Energy use and Power needs. Some point requirements also have different assessment levels that provide different points

The requirements include the building and building technical parts, installations including control systems, instructions to operating staff, the manager's environmental work and the property owner's additional environmental offerings.

#### 3.2.1 Mandatory and optional point requirements

There are mandatory and optional point requirements. Mandatory requirements shall be approved in order for the building to be certified. The mandatory point requirements meet environmental authority requirements for existing buildings and property ownership. There are a few mandatory requirements that are only required for the Silver and Gold grades.

The majority of the point requirements are optional. The property owner chooses which, and how many, of the optional point requirements, to be assessed and thus how extensive the certification will be. The higher the rating, the more optional requirements must be approved. There are many optional point requirements available so that different environmental-enhancing properties that are improved by the property owner can be rewarded.

### 3.3 Rating

A building can be certified according to three grade levels; Bronze, Silver and Gold. The number of approved points determines the grade. The picture below describes the number of mandatory point requirements that must be met and how many points that are needed for each grade. Note that points and point requirements are not the same. Many optional point requirements give more than one point if they are met and this means that the individual measures needed can be significantly fewer than the number of points. For each grade, both the relevant mandatory requirements and the requirement for points must be approved.

	Number of requirements points				Achievable
	Mandatory points	BRONZE	SILVER	GOLD	
Residential	39	50	120	190	319
Non-Residential	40	55	125	195	341
Non-Residential with comfort cooling	41	60	130	200	364

The new certification scheme has three different score levels: Bronze, Silver and Gold. Bronze corresponds to the authorities' requirements and regulations. Silver provides significantly higher environmental performance than Bronze. Gold is the best function that can be obtained with good maintenance and goal-oriented management and operation. Gold should be challenging but achievable, as the main aim of Miljöbyggnad is to get many property owners to raise their ambitions significantly. By influencing many in the right direction, a bigger contribution is made to meeting the environmental quality objectives than a few individual cutting-edge projects, which can be rewarded in other ways.

For buildings with mixed activities, the number of points needed is weighted based on the temperate area ( $A_{temp}$ ) for each activity. In the event of mixed activities, mandatory point requirements shall be met for both types of activities.

### 3.4 Preparation for an audit

Prior to an audit the building's environmental status is mapped by the property owner either with its own staff, with an operating contractor or external specialists. An inspection protocol is filled in to determine the building's status but also to identify appropriate environmental improvement measures. This means, in short, to find out which of the mandatory points requirements and the optional ones that can be approved directly and which needs to be supplemented.

For each point requirement, supporting document is prepared that proves that the point requirement is met. Documentation that can be used is for example contracts with an operating contractor, contracts with tenants, compilations, instructions for tenant adaptation, template for procurement of contractor, radon measurement, energy certification protocol, operation and maintenance instruction, protocol of ventilation inspection and certificate, moisture inventory, inventory of environmentally disruptive substances, tenants questionnaire results, self-control according to the Environmental Code, energy, water and waste management invoices. It shall be clear that the supporting document relates to the present building. When photo is used as supporting document, it should be supplemented with information that the building in question otherwise meets the requirement. It should state where in the building the photo is taken.

### 3.5 On-site audit

An auditor checks that the point requirements applied are met by on-site inspection of the building and the management. In order for the audit to be carried out reliably, it is necessary that auditors have the right and sufficient competence and are independent in relation to property owners and managers. The audit is mainly without sampling. The audit normally involves two people; one that is an expert in building technology and one in building services. In addition, any of these should be an expert in energy use in existing buildings.

The audit checks that the building, installations, management documents and operating instructions meet the point requirements applied. The audit report shall show whether the point requirements applied are met and any comments on discrepancies. The auditor's assessment of fulfillment of the point requirement includes:

- **Relevance**, that is, that supporting document is consistent with, for example, present building, floor plan, use, technology solutions and activities.
- Content **in principle** compared to the requirement. For example, instructions, calculations, measurement results, measurement reports, etc.
- Protocols from experts should always be followed by a **statement** on the relevance of present building, use and activities. The auditor shall assess whether the expertise of the experts is relevant. Requirements for expertise and experience of experts vary with the building's activities and complexity. An expert in sound, moisture and environmental disruptors for new production does not automatically have the competence to assess existing buildings.
- **Availability** and **clarity** of supporting documents regarding instructions and procedures.
- That instructions **are complied**, for example that activities are recorded with date and signature.

If the auditor uses personal communication with, for example, management, operating personnel or users as supporting document, type of communication should be described, be dated, contain name, role and contact details to all those who participated and clear links to the present building.

For discrepancies, 10 % of a certain number, certain area or certain amount is accepted if nothing else is described in the point requirement. To most of the requirements there are instructions on which and how large discrepancies that can be accepted, there may also be rules for which rooms that discrepancies are not accepted. All discrepancies should be noted and justified.

It is necessary for the auditor to have access to all rooms at the site-visit. This does not mean that all rooms should be checked, the auditor assesses which floors and rooms that need to be examined. The inspection protocol should show which floors and rooms that have been inspected and motives for other rooms and floors that have not been inspected. Denied access to a room is deemed that the points requirement is not met and handled as a discrepancy.

### *3.5.1 Application areas*

To quickly orient among all the point requirements, each of these is marked with where it is applied, see the list below. This is another way to sort the point requirements for an effective on-site inspection. 1. Building envelope, 2. Building services and meters, 3. Ventilation systems, 4. Control systems, 5. Instructions for operation staff, 6. Follow up of key figures, 7. Room functions, 8. Wet room, 9. Inventory of experts, 10. Outdoor and environmental rooms 11. Information for users, 12. Critical rooms, building parts and building services, 13. Maintenance plan, 14. Adjustments for the tenants and purchase, 15. Agreements, cooperation and offers. 16. The manager's own control.

## **4. Discussion and conclusions**

Miljöbyggnad has become popular for certification in new construction and now the interest in certifying existing buildings is increasing. One reason may be that more and more banks and loan institutions are providing more favorable loan terms, known as green loans, for environmentally certified buildings. Approximately 95% of all buildings in Sweden are existing and the potential for reduced environmental load is great if they are improved. Therefore, a new certification scheme, called Miljöbyggnad i drift has been developed in collaboration with property owners, specialists, inspectors, researchers, operating contractors and trade associations. The aim is to expend Miljöbyggnad to be the property sector's own scheme also for existing buildings to ensure that the quality of a building meets legal and authority requirements or the property owner's higher ambitions.

The new certification scheme set requirements for 18 important environmental aspects for a building with simple and direct statements that address the professional role that are responsible for fulfilling the statement. The number of compliances with statements, or so-called point requirements, are collected in a point-counting system where the building's rating are determined by the number of approved points. In connection with the audit on-site, the property owner receives a summary of the status of the building and how it is managed. At the same time the point requirements that are not fulfilled show where there is a potential for environmental improvement.

The environmental status can be illustrated with points and charts showing where there is potential for improvement – the building, building services, operation, management or the building owner's environmental offer. Environmental status can also be illustrated with points and charts in which environmental areas there are potential for improvement – indoor environment, health, climate impact, resources and state.

These environmental improvement measures can in turn be divided into simple measures that can be implemented directly and in measures that need to be planned by being included in the maintenance plan. The property owner can, from this information, set up a work plan on, for example, which parts of the building or management that are decided to be improved. In this way, the property owner is informed and encouraged to drive the improvement work and will get a confirmation of achieved results in the form of more points.

The scoring number can be used to:

- compare buildings within the property owner's entire or part of its building stock to determine needed for investments in different areas,
- compare their scores with other property owners to assess property value and
- set scoring goals with the possibility of monitoring internal environmental work
- and show tenants what environmental efforts are being carried out.

This simple gamification system may lead to many using the certification scheme and can thereby contribute to the aim for which the system was originally produced, namely to clearly contribute to meeting national and international environmental objectives.

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