BERGISCHE UNIVERSITÄT WUPPERTAL
Fachbereich 11 - Bauingenieurwesen
Lehr- und Forschungsgebiet Bauwirtschaft - Institut für Baumanagement (IQ-Bau)
Univ.-Prof. Dr.-Ing. C. J. Diederichs
Dipl.-Ing. Stefanie Streck

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Development of a rating system for economical and ecological renovation and modernisation EES

Abstract of the research project Az.: Z 6-5.4-01.05 / II 13-80 01 01 - 05

1 Aim and proceedings

During the last years a sustainable development is also demanded in the construction sector. Housebuilding should not only be economical but also ecological. At the same moment it should also be socially acceptable. For new buildings these demands are already mostly realised. But in the existing buildings there is a backlog. Nowadays, a rating system for renewal measures considering economic and ecological criteria equally does not exist. The developed rating system EES closes this gap. It connects both economy and ecology and, in addition, social aspects are also taken into consideration.

The purpose of the research project was to develop an integrated rating system which supports building owners, designers and authorities in the economical and ecological renovation and modernisation of residential buildings. In addition, it should be an aid for construction designers and building owners to be able to estimate the effects of their decisions in economic and ecological regard.

The rating system EES was built up on the “rating system for new buildings EEB” which was also developed by the developers of EES. After completing the rating system, it was tested at two examples. In addition, a survey was carried out among potential users. To simplify the application a rating software was developed.

2 Structure of the rating system EES

The system provides a rating within three steps. The first rating takes place after the conceptual design is made. The second rating is made after the design for the building permit is accomplished. Before the beginning of construction, the execution design is also checked . The rating for every step is made up of four levels which are introduced in figure 1. The results from the preliminary step are taken over into the next step.

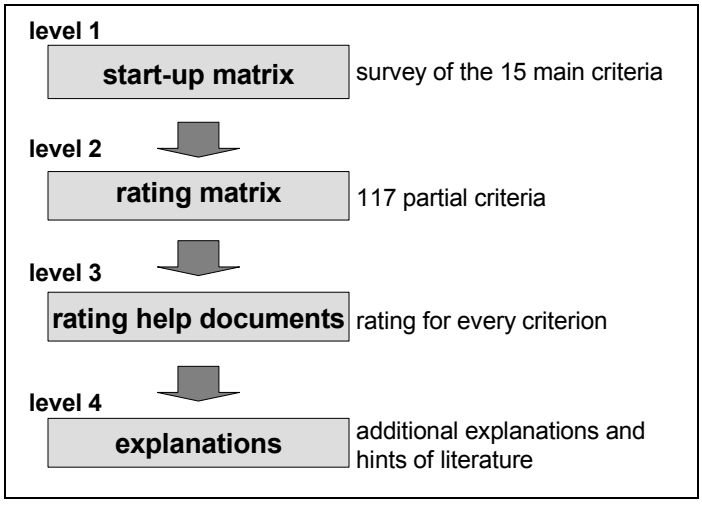

figure 1: Survey of the four levels of the rating system EES

The criteria are weighted to appreciate their different importance for the success of the building project. The authors give a proposal for the weights. Nevertheless, the user of the rating system can change them and adapt it according to the priorities of the decision maker.

A total of 1,000 points of weight are spread. Thereby it is proposed that the economical and the ecological criteria have the same weight counting 400 points. The constraints are taken into account with 120 points and the design concept with 80.

2.1 Level 1: start-up matrix

The source matrix provides a survey over the 15 main criteria (figure 2). They are divided into boundary conditions, economic and ecological criteria as well as the planning concept. The main criteria are subdivided into 58 partial criteria.

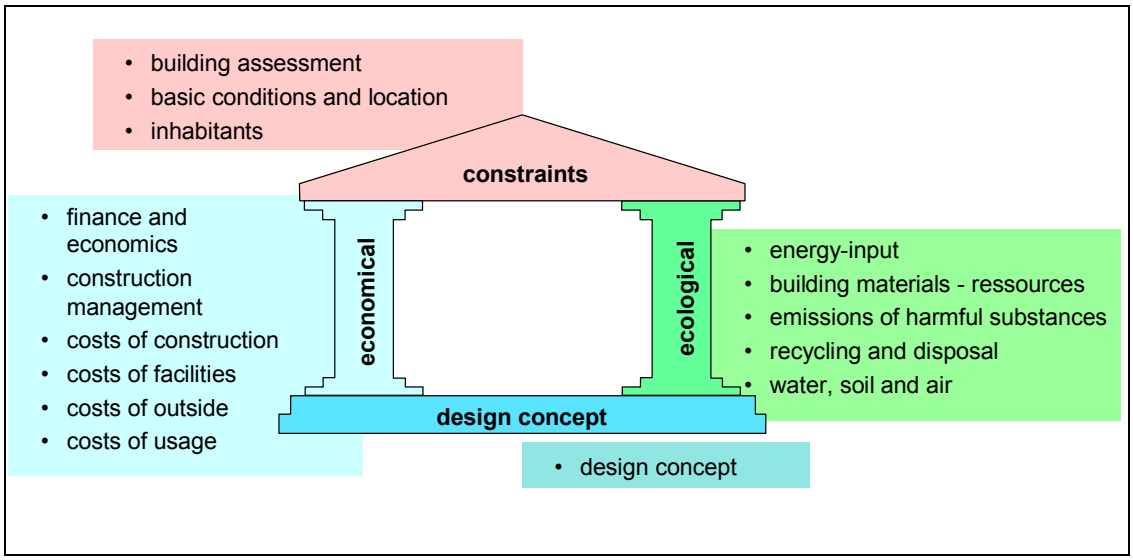

figure 2: Survey of the 15 main criteria of the rating system EES

2.2 Level 2: rating matrix

To every main criterion there is in the second level a rating matrix (figure 3).

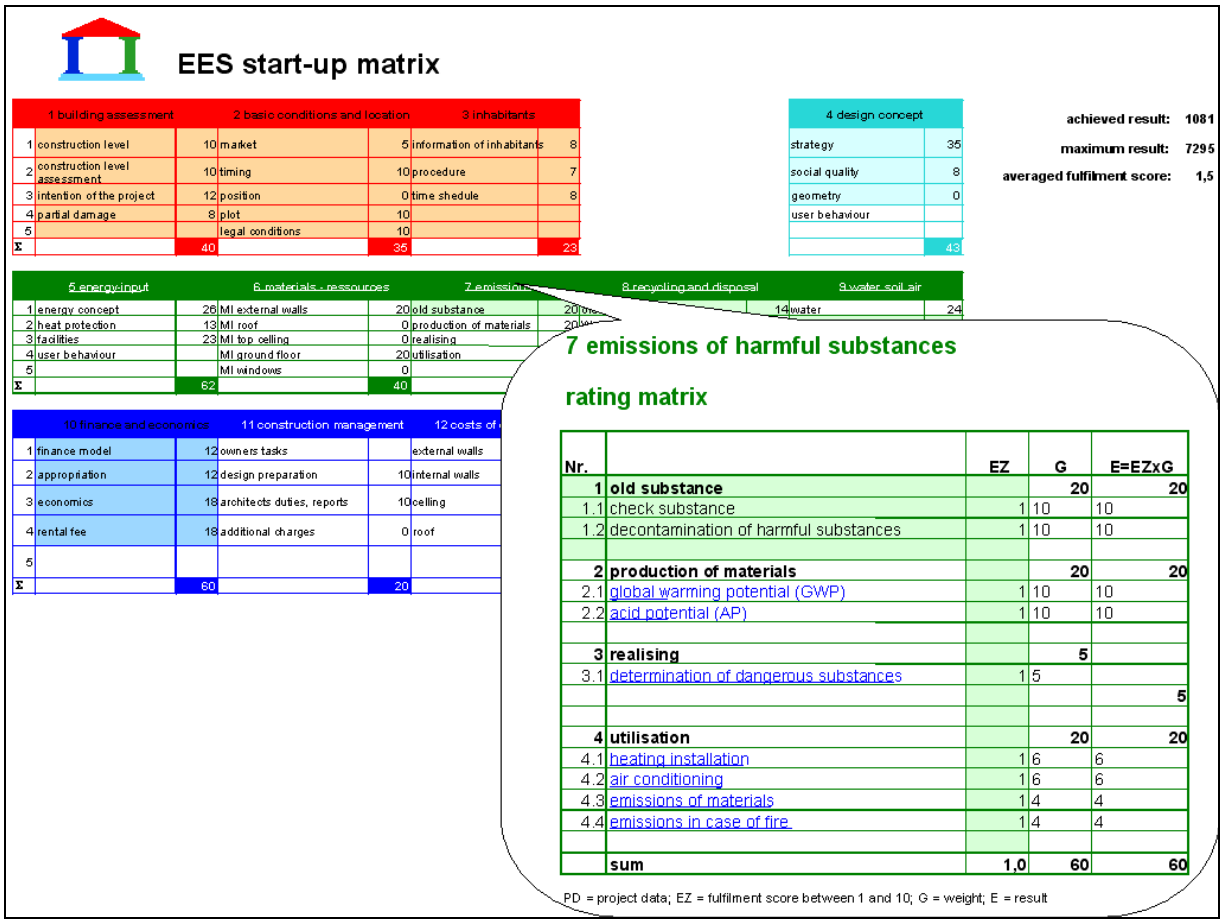

figure 3: start-up matrix and rating matrix

On total there are 117 partial criteria in the second level. In the third level each criterion is compared with the reference values and the corresponding fulfilling points are registered. By multiplication with the weight, the result is calculated.

2.3 Level 3: rating helps

The third level offers a rating help for every criterion. There are three different forms of rating helps:

- checklists and questions which the user has to answer positively to achieve the full score,
- flow charts which bring the user to a fulfilment score, and
- graphs from which the rating can be taken.

By filling the rating help a fulfilment score between 1 (very bad) and 10 (very good) is automatically determined. For some rating help documents, the question of which measure is foreseen is asked. Depending on the answer, some parts of the rating system are taken out. If necessary, the complete criterion is valued with 0 and the weighting is likewise put on 0.

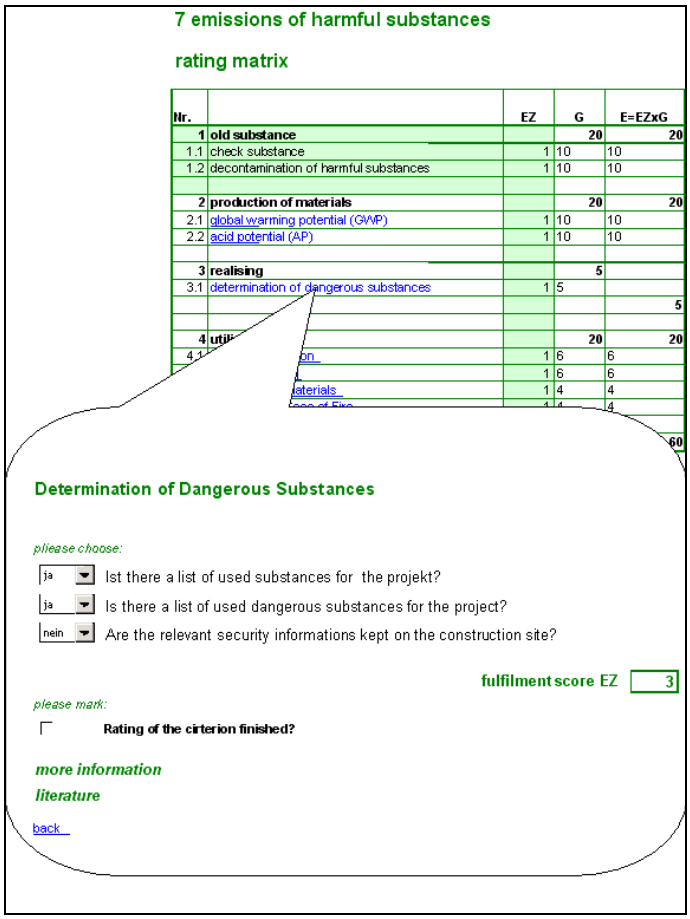

figure 4: rating matrix and rating help

2.4 Level 4: explanations

In the fourth level there are additional explanations and hints of literature for every criterion. Thus the user can find out more information on special subjects if required. In addition, with the additional explanations the rating questions become more comprehensible.

2.5 Presentation of the result

The achieved fulfilment points are multiplied by the respective weight. The product is the "weighted benefit score" or "utility value". The addition of those points delivers the benefit of a project. To value the result, it is compared with the highest score possible or to the result of an alternative project.

The best result is achieved if a maximum of 10 fulfilment points is multiplied by the sum of the weighting points (10 x 1,000 = 10,000). Minimally 1,000 points are possible (1 x 1,000 = 1,000).

In addition to the result the averaged fulfilment scores are also determined for the single main criteria as well as for the whole project. The criteria can be easily compared by the illustration of the fulfilment scores per main criterion. Thus in the example in figure 5 it is evident that the strengths of the building project are the project conditions and the location as well as the building costs, whereas the criteria "inhabitants", "water, soil and air" and "construction management" score low. The user will check these criteria to ascertain which partial criteria are responsible for the bad result. Thus the improvement potential can be uncovered.

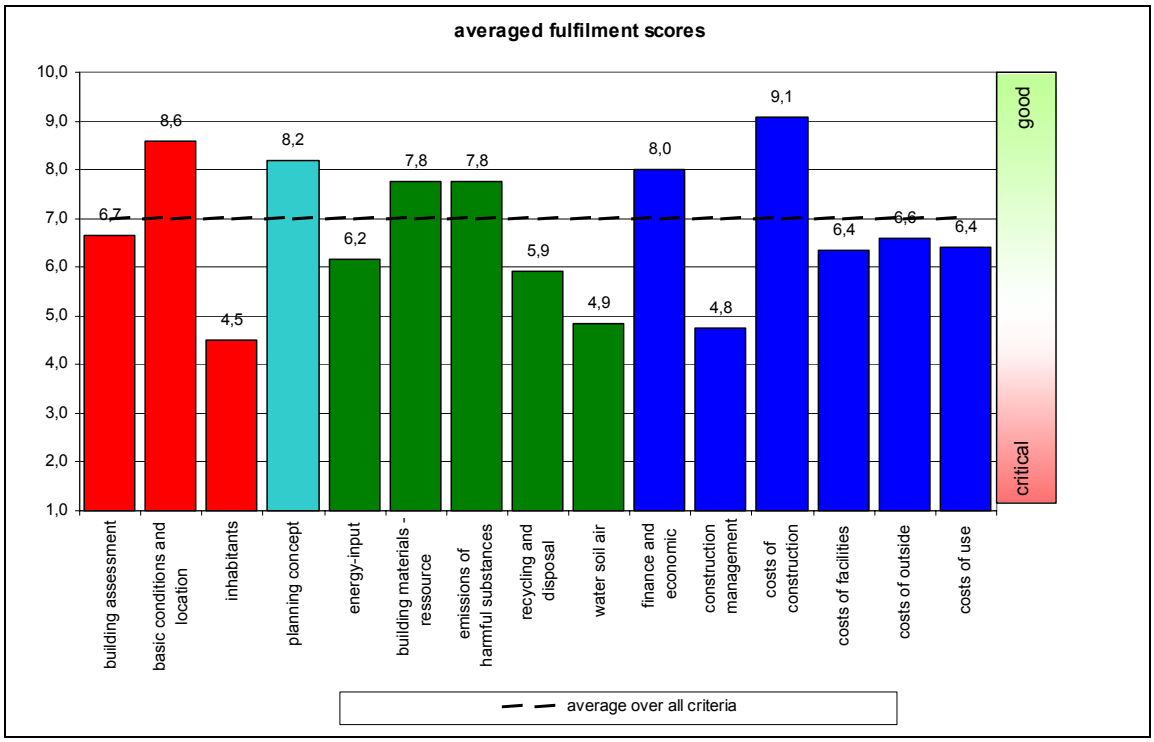

figure 5: example for the presentation of the results

Figure 6 shows another form of presenting the results. The achieved and the maximum weighted scores per criterion are illustrated side by side in column form. For an optimum project (with an average fulfilment score of 10) the resulting column and the weighted column are identical. By comparing the result column to the weighted column, it becomes clear which criteria were rated badly and thus could be optimized. At the same time the importance of the criterion can also be read.

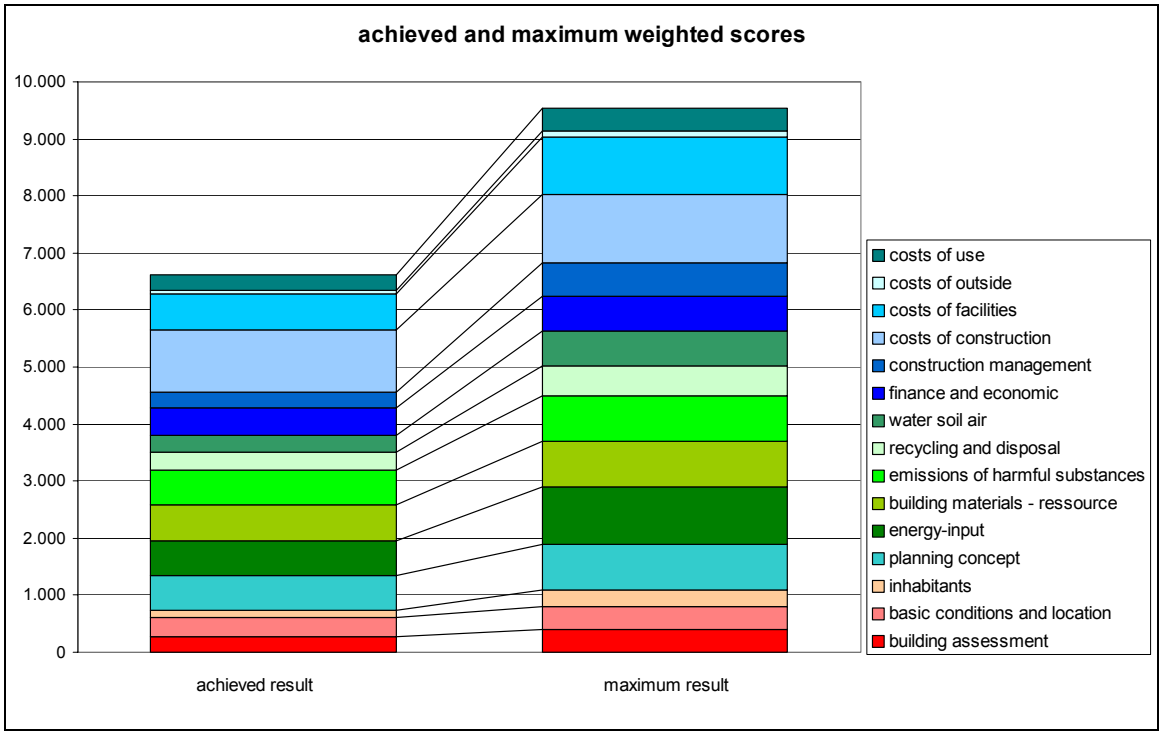

figure 6: example for the presentation of achieved and maximum weighted scores per criterion

The results are put together in a rating pass (figure 7, figure 8). This contains

- general information on the project like the address and the owner or developer
- data of building law and land property
- building characteristics like the number of the floors or the volume, but also the relation of surface area to volume and the annual requirement of premier energy before and after the renewal
- ecological values like the material input and the greenhouse effect
- the renewal costs for construction and facilities.

The rating result is displayed as achieved score, maximum and minimum score as well as the averaged fulfilment score. In addition, both introduced illustrations are taken over. The rating pass summarizes the results of the rating clear and briefly. Nevertheless, it is no substitute for a building pass.

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general information

Name and Address	Project XY Example street 1 12345 Example city
Owner/developer	Building Company ABC

building law

permitted floor space index	1.2	available floor space index	1.16
permitted site occupancy index	0.4	available site occupancy index	0.4

land property

total area	3466 [m²]	existing waste deposits	no
level of sealing	65 [%]	infiltration system for rainwater	no

building

number of floors	3		
volume	11900 [m³]	building area	3620 [m²]
surface area/volume	0.47	effective area	2800 [m²]

annual requirement of premier energy

old	280 [kWh/(m²Wfl.a)]
new	95 [kWh/(m²Wfl.a)]

ecological values (new construction elements)

TMR		material input water	1366 [kg/m²a]	GWP	41988 [g/m²a]
total material requirement	226 [kg/m²a]	material input air	33 [kg/m²a]	AP	286 [g/m²a]

renewal costs

construction	355 [€ /m²]	facilities	110 [€ /m²]

rating

maximum score	10,000	achieved score	6,700
minimum score	1,000	averaged fulfilment score	6.7

figure 7: rating pass – page 1

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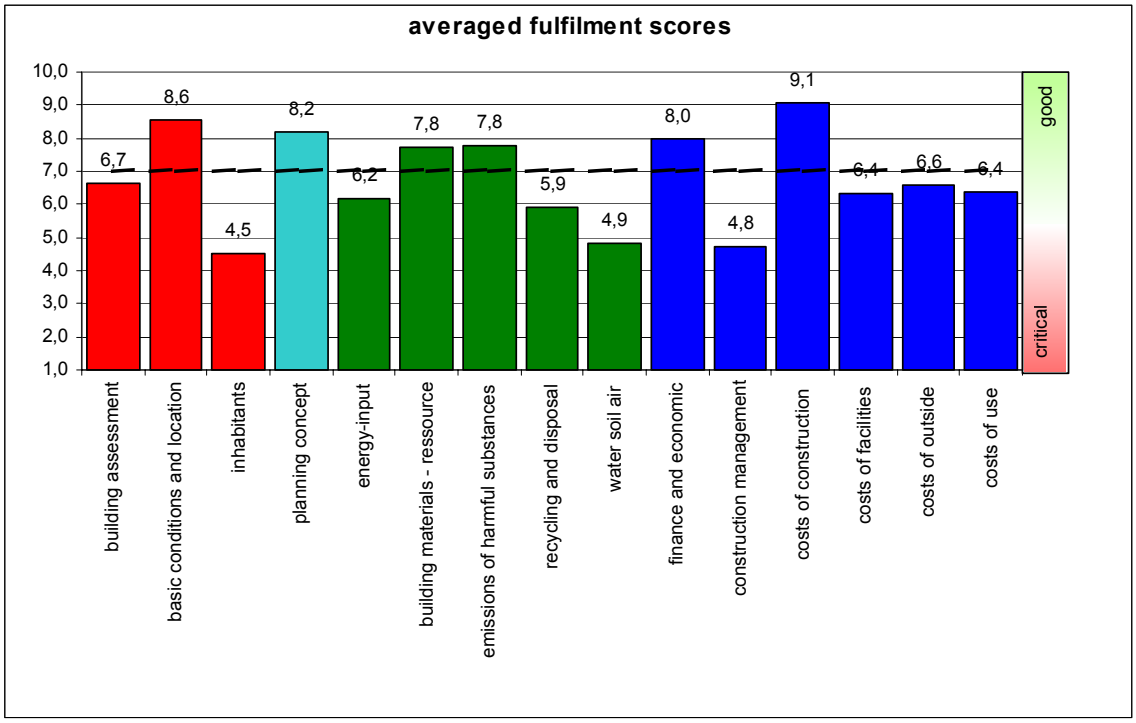
general information

Name and Address	Project XY Example street 1 12345 Example city
Owner/developer	Building Company ABC



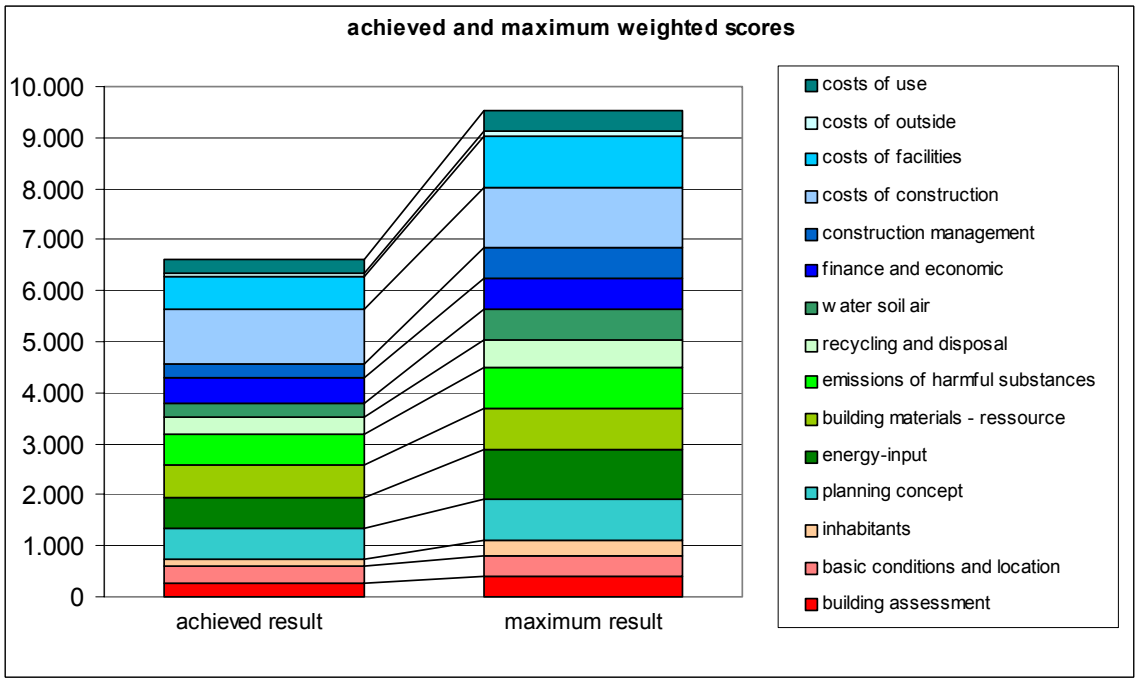


figure 8: rating pass – page 2

3 Summary and outlook

The rating system allows the rating of the design of renovation and modernisation measures at adequate costs. The system is easy to comprehend, clearly structured and usable without intensive training.

The rating system is designed for extensive measures which comprise renovation as well as modernisation in the house building. Partial renovation measures are not covered. In each individual case it has to be checked whether or not an individual rating system based on EES can be developed. The rating system was primarily developed for the rating of apartment houses. Single-family houses can be also valued. In this case some criteria are to be led out because they are not relevant. Up to now the rating with EES concentrates on the residential building. An extension for the rating of administration buildings is desirable in the future.

Using the rating system EES is helpful in many ways. Building owners can use the rating system to receive a neutral basis for design variations. All design options are valued with the same criteria and the differences are shown. Thus the judgement becomes clear and purposeful. Architects and planners can prove unambiguously and comprehensibly that the requirements of the building owner and user are fulfilled. In addition, design alternatives can be explained more easily. A positive rating result is a competitive advantage for new and follow-up orders. The rating system EES can also be used by providers of financial aid and investors as a measuring method to approve the compliance with defined requirements. The provider of financial aid determines the weighting of the partial criteria according to his purposes. In this case, a change by the user is not possible. The project will be promoted on the condition that a pre-defined minimum score is reached.

The knowledge of ecological and economic circumstances is still incomplete. The next years will bring new awareness. Therefore, the developed rating system EES merely shows a snapshot. It contents the most important subjects of renovation and modernisation. However, an adaptation of the single criteria and reference values to new developments and awareness, if necessary also the advancement of the whole system, is not only possible, but expressly favoured.