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<i>Technology</i> Transmission characteristics, ventilation, heating, hot water, cooling	<i>Aspect</i> Quality of the works	<i>Country</i> Germany
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QUALITY CONTROL OF STUTTGART'S RETROFIT STANDARD REALISED BY THE CITY'S ENERGY CONSULTANCY OFFICE

The City of STUTTGART's RETROFIT STANDARD comprises various steps to achieve the energy-efficient retrofit of both residential and non-residential buildings. This includes the construction supervision, for which the City's Energy Consultancy Office (EBZ) provides qualified experts. In this process, mainly the interfaces between the different trades/works are checked and documented. Moreover, EBZ-trained craftsmen are introduced who are able to install state-of-the-art energy saving measures according to the respective manufacturers' instructions. This ensures high quality of implementation and durable buildings.

Residential buildings <input checked="" type="checkbox"/>	Non-residential buildings <input checked="" type="checkbox"/>	Specific buildings: -
New buildings <input checked="" type="checkbox"/>	Existing buildings <input checked="" type="checkbox"/>	

Context

The City of Stuttgart's retrofit standard was established by the local Stuttgart energy consultancy office (EBZ) and the crafts and trades organisations. EBZ is an EU-wide protected label and describes a process in the rehabilitation of existing buildings which focuses particularly on trade-spanning interfaces. In the preparatory stages, the focus is on training craftsmen in order to ensure that building components will be installed according to the respective manufacturers' instructions. Further on, EBZ provides the construction supervision and documentation of the energy saving measures by independent specialists who check the implementation process on-site and make proposals for change, if necessary. EBZ names both architects and engineers as well as craftsmen belonging to the EBZ network. EBZ itself was founded in 1999 by initiative of the City of Stuttgart and provides five internal energy experts.

Objectives and problems addressed

By applying Stuttgart's Retrofit Standard the quality in the building sector is to be improved and the execution of works on the building site shall be rendered more transparent. In doing so, current or ensuing problems can be avoided and costs can be saved.

Further, EBZ focuses on the interfaces of the craftsmen's services among the different trades, an example of which is the connection between the roof and the external wall. If there was no clear solution found for the execution it may well be that this 'interface' had already been plastered by the stucco worker and cost-intensive problems, like mould growth due to thermal bridging, will become manifest only after a few years.

In addition to the construction supervision there are further services offered by EBZ: These include e.g. a free initial consultation for builders or preparing a building energy certificate. (For a more detailed description of the services offered, see section 'Process in practice'). According to EBZ, the procedure described below is recommended, but not mandatory:

Step 1: Energy performance diagnosis: On-site inspection, assessment of the building envelope and the technical building systems

- Step 2: Review of craftsmen's tenders
- Step 3: Fixing the supervision assignments between builder, craftsmen and EBZ
- Step 4: First on-site inspection after scaffolding and before start of the craftsmen's services: Defining the interfaces to be documented with the craftsmen involved and the architect, if need be
- Step 5: Construction supervision: Several checks by experts, including documentation of the services results
- Step 6: Certificate and protocol/short report

EBZ offers steps 2-6 also for new buildings. On its official website, Stuttgart's retrofit standard presents three examples of retrofitted residential buildings, specifying building data, the applied energy saving measures and the comparison of delivered energy before and after retrofitting. The single-family home shown in Figures 1 and 2 (data sheet, see [link](#)) is one of these examples. Figures 3 and 4 show a multi-family residential building before and after renovation.



Figure 1: Before retrofitting, Stuttgart Feuerbach



Figure 2: After retrofitting (plinth not yet refurbished), Stuttgart Feuerbach



Figure 3: Before retrofitting, Pforzheim



Figure 4: After retrofitting (KfW Efficiency House Standard 55), Pforzheim

The target groups include private investors, municipalities, small and medium-sized enterprises, associations and cities.

In most cases it is difficult to convince owners of implementing energy saving measures, as these seem to be rather expensive at first sight. In Stuttgart prices for buildings and land are high, often leaving little or no money at all for further renovation after purchasing a residential building. Besides, it is difficult for non-experts to assess the potential and the amortisation period associated with these measures.

Another problem regarding the construction supervision could be posed by the prices of EBZ services, which differ depending on the complexity of the respective building and the initial situation, and cannot be given as standard prices. EBZ is a non-profit association, hence its services are offered at a very

affordable price. Notwithstanding, building owners need to invest at least time for the initial consultation with the presentation of the plans in order to be eligible to receive an individual offer by EBZ.

Approach to overcome identified problems

Regulatory background

Taking advantage of the procedure of Stuttgart's Retrofit Standard and the services offered by EBZ is on a voluntary basis. There is neither the duty to make use of the offers made by EBZ, nor to comply with the requirements of the Standard.

Combination with promotion schemes by KfW

The KfW Bank¹ offers low-interest loans and/or repayment subsidies for renovation projects. Funded projects include e.g. energy efficient buildings, barrier-free rehabilitation measures, but also credits granted to builders/owners without specific requirements to buildings.

To be eligible for receiving KfW 'Efficiency House' funding, the bank requires and funds professional construction supervision. Funding includes the following services: Services concerning detail planning, support regarding tender documents and evaluation of offers, supervision of the execution of work, and approval and assessment of the renovation measures implemented. For these services, the bank will fund 50 percent of the costs. Find more information on this subject in section "Financial Aspects".

Energy concept of the state capital of Stuttgart

In Stuttgart, the energy turnaround in urban areas is to take place in three steps as follows:

1. Reducing the energy consumption in the sectors of heat, electricity and fuels
2. Increasing the energy efficiency
3. Building plants based on renewable sources of energy.

In this context the cooperation of various actors plays an important role. Here, EBZ is a useful tool to support the City of Stuttgart's energy concept by providing energy consulting in the building sector. The cost-free and independent initial consultation is frequently used. In 2014 alone, 650 appointments for consultation were fixed.

Process in practice

The following services are offered by the Energy Consultancy Office (EBZ) Stuttgart:

➤ Initial consultation

In this consultation, first questions that arise at the beginning of the project will be addressed and clarified. If any offers from various craftsmen have already been supplied, these may be reviewed by EBZ staff. For this consultation, the builder should provide existing plans and building information, for example floor plans and sections. The consultation is independent and free of cost.

In the scope of the 'renovation roadmap', the general procedure of retrofitting will be discussed and EBZ will give recommendations concerning the respective steps of the project. In this context, it will also be discussed whether several measures should be implemented in parallel already at an early stage. For instance, if it is necessary to install several new heating pipes it may be recommendable (for reasons of time and cost) to mount these pipes at the facade and subsequently lead them into the building interior at two spots, instead of creating many new apertures from the inside. In this case, it would make sense to immediately apply the new facade insulation housing the new pipes in order to reduce the heat losses and to optimise the building's appearance. Thus all measures or packages of measures need to be pondered and require long-term view.

➤ Energy diagnosis

The energy diagnosis serves to identify the actual condition of the building on-site. Besides, the building envelope, the heating system and the hot water generation are checked and evaluated. The situation is documented in a detailed report.

If several energy saving measures are necessary and the builder is not able to finance all of these at once, EBZ proposes a long-term renovation roadmap. This roadmap includes a detailed plan specifying when which measure should be implemented.

¹ KfW is Germany's Reconstruction Loan Corporation (KfW Promotional Bank)

➤ Expert network

After the energy diagnosis has been completed, an architect can do the cost planning according to German standard DIN 276. The architect compiles a list of service specifications, invites several comparable offers to optimise costs and checks these offers for prices, quality, and completeness. EBZ supports builders in finding qualified experts belonging to its network, e.g. architects and engineers who specialize in renovation work and apply the City of Stuttgart's Retrofit Standard. The network also provides specially trained craftsmen for these trades: facades, roofs, windows, heating systems and electricity. At this point it is referred to the following links given at the EBZ's website:

Architects

<http://www.ingbw.de/vernetzen/ingenieursuche.html>

<http://www.akbw.de/service/architektenliste.html>

<http://www.akai-stuttgart.de/netzwerk.html>

Craftsmen

<http://www.stuttgarter-hausrenovierer.de/index.html>

➤ Funding programmes

The builder is assisted in identifying the appropriate type of funding (KfW, BAFA etc.) that best suits the respective project and in submitting the required verification documents. Any funding of energy retrofitting (e.g. KfW) demands that the building in question will excel the minimum requirements specified in Germany's Energy Saving Ordinance (EnEV).

The associated required verification documents (certificates of compliance) may only be provided by specially trained experts who are included in the 'Experts-List' (BAFA), coordinated by dena (Deutsche Energie-Agentur, i.e. the German Energy Agency), see [link](#). This is also true for the experts named by EBZ.

➤ Construction supervision

The above-mentioned experts will examine the execution of the energy saving measures by paying several visits to the building site, to ensure that the building components are installed completely and correctly. These experts do not replace the actual specialist planners according to HOAI (Fee Structure for Architects and Engineers). When conducting the construction supervision, the experts check whether the technical guidelines prescribed in the Stuttgart retrofit standard are complied with to make sure that the energy consumption has been optimised and the funding for the desired energy standard is being achieved. Construction supervision is also available without contracting prior or further EBZ services.

EBZ exclusively collaborates with EBZ-trained craftsmen who are freely eligible for the builders in the EBZ network. Personal contacts, for instance on the occasion of continued training seminars, play an important role regarding communication during the construction process.

In the scope of the supervision required for KfW funding it is possible to furnish proof of the building envelope's airtightness (Blower-Door Test), and thermal bridges can be identified by means of infrared imaging.

➤ EP certificate

Irrespective of other services, it is possible to have an Energy Performance Certificate (EPC) issued by the experts. This EP certificate includes an on-site inspection, the certificate and a short report. Minimum price is 400 €, plus 25 € for each further residential unit. However, if the EP certificate is issued on the basis of an EBZ delivered energy diagnosis according to EnEV, only 150 € will be charged, plus 25 € for each additional residential unit.

In addition, a certificate (Figure 5) will be issued subsequent to the services, which confirms that the energy saving measures were executed in accordance with the City of Stuttgart's Retrofit Standard.



Figure 5: Certificate issued by the City of Stuttgart's Retrofit Standard

Having the choice of the various abovementioned services, most clients opt for the initial consultation. In 2014, EBZ performed about 650 consultations. Quite often, builders received further free-of-charge counselling. Besides, 2500 telephone consultations were given, followed (in descending order) by the services: funding programmes, energy diagnoses, expert network, and construction supervision.

➤ Events/Training courses

EBZ's educational offers comprise information events, trade fairs and consumer shows as well as courses to train craftsmen in applying the City of Stuttgart's Retrofit Standard. There are also informative events for homeowners and house owners, who receive information on recent developments in energy-efficient building renovation, changes in legislation, or potential funding. Craftsmen are also briefed about the latest developments. In addition, they are regularly trained in the field of technology (incl. processing technology) so as to enable them to install the building components according to the manufacturers' instructions. Usually, the master details of the various companies regarding manufacturers' instructions are rather comprehensive. Thus EBZ's free training courses for craftsmen provide good support in taking up the respective rules.

Further, EBZ hosts meetings of small groups in which interfaces between the trades are being discussed and possible solutions are developed, thus providing regular exchange between different trades.

Establishing contact

To contact EBZ, it is possible to fill in a contact form provided on their official website, or to phone or e-mail. For a personal consultation, an appointment should be fixed. On the website, several contact persons are introduced, including their photos, expertise and e-mail address.

Market acceptance of the approach

On average, 10 properties per year are being retrofitted according to the City of Stuttgart's Retrofit Standard and reviewed by EBZ. At present there is a decrease in demand, which is due to an increasing number of requests for single retrofit measures. The implementation of single measures does not require the application of the Stuttgart Retrofit Standard. As described in section 'Objectives and problems addressed', six steps are considered in this context, most of which deal with determining several measures and agreeing on appropriate remedial action.

Concerning the decrease in demand for construction supervision according to the Stuttgart Retrofit Standard, the high building costs in Stuttgart are playing a key role. The funding programmes that have been offered so far are no longer sufficient to provide overall refurbishment for private investors and landlords at affordable cost. The wish to retrofit one's house over a longer period of time or to implement only measures that are strictly necessary (like a new heating system) has grown. Currently, EBZ-services according to the City of Stuttgart's Retrofit Standard are rather contracted by housing companies/building associations than by private builders.

Pros and cons of possible options

This section will deal with a possible construction supervision by EBZ experts. In most cases, an architect or a specialised planner is available, who will assume this task. Sometimes, however, it may be better to contract a second independent expert just to make sure that all the work is performed correctly. Besides, the energy specialist can be a good choice if it is of great importance to accomplish a particular energy standard. If however - based on previous experience - the trusted planner enjoys a high level of confidence, it may also be an option to do without a second auditing professional on-site. In the table below (1) some advantages and disadvantages of the various options have been listed.

Option	Pros	Cons
<ul style="list-style-type: none"> ✓ Option 1: With construction supervision by an energy expert (builder's view) 	<ul style="list-style-type: none"> ✓ Improved quality of implementation, hence reduced maintenance costs in the long run ✓ Longer lifetime of the building ✓ Energy standard will definitely be achieved and documented ('Performance warranty') ✓ Saving time and money by avoiding problems on the building site 	<ul style="list-style-type: none"> ✓ Expenditure for the energy expert
<ul style="list-style-type: none"> ✓ Option 2: Without construction supervision by an energy expert (builder's view) 	<ul style="list-style-type: none"> ✓ Cost savings 	<ul style="list-style-type: none"> ➤ Poorer quality of implementation, hence higher maintenance costs in the long run ➤ Shorter lifetime of the building ➤ Possible failure to achieve the energy standard, consequently no documentation ➤ More problems arise on the building site, which cost time and money

Table 1: Compiled (dis-)advantages of the various options associated with construction supervision

Compliance concerns related to EP certificates and to the QM approach

No reporting <input type="checkbox"/>	Wrong reporting <input type="checkbox"/>	Not meeting the performance requirements <input checked="" type="checkbox"/>
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Compliance concerns related to EP certificates (see QUALICHeCK terms and definitions)

The approach of complying with the Stuttgart Retrofit Standard for buildings and opting for an on-site supervision by specialists is conducive to achieve high quality in the building sector, as the requirements exceed the minimum requirements specified in Germany's Energy Saving Ordinance (EnEV). The process of using on-site construction supervision during the construction phase is voluntary. Consequently, there will be no penalties or fines imposed if the building does not comply with the Stuttgart Retrofit Standard; however, there will be no seal of quality either. If the requirements are not met or if the services provided by the craftsmen are not sufficient, the respective company will be deleted from the network. So-called 'Statements of Commitment' specify which requirements the craftsmen have to fulfil.

In cases where construction supervision is requested for projects receiving KfW-Bank funding, the low-interest loans and repayment subsidies will only be granted if an independent expert examines and confirms the quality of implementation. Without providing this confirmation, the loan/repayment subsidy will not be paid.

Financial aspects

EBZ acts as a non-profit association. According to EBZ, this is the reason why their services can be offered at affordable prices. EBZ is being financed by membership fees (for members, see [link](#)), public subsidies, project funding and energy diagnoses. This guarantees neutral advice, just like a good price/performance ratio.

- For each on-site appointment: **300 € plus VAT** (usual number: three visits per building trade). Costs depend upon the size of the building/residential unit, as the inspection takes more time the larger the building is. For every further residential unit 100 € have to be paid in addition. In the case of possible KfW funding (KfW programme 431) 50% of the construction supervision costs (up to 4.000 € per project) will be paid. *Only possible in combination with loans for energy-efficient refurbishment (KfW programme 151/152) or repayment subsidy for energy-efficient refurbishment (KfW programme 430).* For further information, see [link](#).

The calculation given in Table 2 presents the costs for the construction supervision of the trades 'Roof and facade'.

Trades	Number of on-site inspections	Costs per inspection	KfW Funding
Roof	3	300 €	50%
Facade	3	300 €	
Total	6	1800 €	
Actual cost:		900 €	

Table 2: Sample calculation 'Roof and facade', plus VAT.

According to EBZ, 10 on-site inspections would be sufficient for the overall refurbishment of a single-family home, corresponding to a total amount of 3.000 € for the entire construction supervision. Reduced by the sum of KfW-funding, 1.500 € remain to be paid by the builder.

Besides, roughly estimated prices (plus VAT) can be given for further services:

- ✓ Energy diagnoses acc. to the directives issued by the City of Stuttgart and the German Federal Office of Economics and Export Control (BAFA): 1 residential unit at least 1.300 €
- ✓ Energy Performance Certificate including on-site inspection, certificate and short report: 1 residential unit at least 400 €
- ✓ Blower-Door Test (external offer): at least 575 €

Overall evaluation

The following evaluation of the overall approach of the Stuttgart Retrofit Standard and the City's Energy Consultancy Office (EBZ), including all services, is based on a comparison of the actors involved.

Actors	Pros	Cons
Builder	<ul style="list-style-type: none"> ✓ Cost savings due to reduced energy consumption ✓ Energy standard will definitely be achieved and documented ('Performance warranty') ✓ Longer lifetime of the building ✓ Improved quality of execution and thus less expensive maintenance in the long run ✓ Becoming eligible for KfW-funding by providing appropriate certification ✓ Additional, enhanced architectural value of the building ✓ The resale value of the property increases 	<ul style="list-style-type: none"> ✓ Planning the costs for an energy expert ✓ Additional time needed for fixing appointments/arrangements with the experts
Craftsmen	<ul style="list-style-type: none"> ✓ Cost-free training by EBZ ✓ Trade-spanning exchange/discussion via interfaces ✓ Possible follow-up work/complications or disputes (and thus costs) can be prevented ✓ Satisfied builders ✓ Possible recommendations by clients, hence ✓ Ensuring the institution's continued existence 	<ul style="list-style-type: none"> ✓ Possibly more time required for installation due to higher requirements
City of Stuttgart	<ul style="list-style-type: none"> ✓ Quality in the building sector is enhanced ✓ Reduced energy consumption ✓ Increasing requirements regarding politics and energy can be achieved ✓ The city scape is improved ✓ The economy is boosted 	<ul style="list-style-type: none"> ✓ Possibly more organisational efforts needed

Table 3: Overall pros and cons of the approach

Level of complexity (dark orange = simplest)	
Potential for replication (dark orange = best)	

Prerequisites

To make sure the EBZ approach will work, contacts need to be established with the crafts and the craftsmen need to be trained. Further, a pool of experts needs to be created who are able to examine the implementation on-site. Regarding the experts, this requires particular professional qualifications, e.g. in verifying the required compliance for the respective funding programmes (see also [link](#)). If these prerequisites are given, the approach can be adapted and applied to other cities.

Hints	Pitfalls
<ul style="list-style-type: none"> ✓ Establish rules for network actors, e.g. the listed craftsmen must attend at least 50% of the training courses offered by EBZ. ✓ The project is required to be self-financing. A business model must emerge from this, for instance by outsourcing to establish a GmbH/LLC. 	<ul style="list-style-type: none"> ✓ Danger of confusion: 'construction supervision' is not the same as 'building site management'. Construction supervision does not replace an architect or planner, because EBZ does not provide construction time planning.

Table 4: Overall hints and pitfalls to avoid when developing such an approach

References

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