



ifeu-Institut für Energie- und
Umweltforschung Heidelberg GmbH
Wilckensstrasse 3
69 120 Heidelberg
Telefon: (0049) 06221 / 4767 - 0
Telefax: - 19
eMail: hans.hertle@ifeu.de
Internet: <http://www.ifeu.de>



INSTITUT WOHNEN
UND UMWELT GmbH
Annastraße 15
64285 Darmstadt
Telefon: (0049) 06151/2904-0
Telefax: -97
eMail: info@iwu.de
Internet: <http://www.iwu.de>

**Environmental Research Plan
of the Ministry of Environment, Nature Protection
and Reactor Safety**

Funding identification (UFOPLAN) 203 41 191

**Contribution of the Energy Saving Regulation (EnEV) and the Energy
Saving Incentive Programme “KfW-CO₂-Gebäudesanierungsprogramm”
to the National Climate Protection Programme**

- Abstract -

authors:

Institut Wohnen und Umwelt, Darmstadt

Nikolaus Diefenbach

Andreas Enseling

Tobias Loga

ifeu-Institut für Energie- und Umweltforschung, Heidelberg

Hans Hertle

Dorit Jahn

Markus Duscha

**commissioned by
UMWELTBUNDESAMT**

July 2005

Project: „Beiträge der EnEV und des KfW-CO₂-Gebäudesanierungsprogramms zum Nationalen Klimaschutzprogramm“ (Contribution of the Energy Saving Regulation (EnEV) and the Energy Saving Incentive Programme “KfW-CO₂-Gebäudesanierungsprogramm” to the National Climate Protection Programme)

Abstract, July 2005

This project was carried out by order of the German Umweltbundesamt in the framework of the Umweltforschungsplan – Förderkennzeichen 203 41 191 and was financed by Federal funds

published: 10th May 2006

revised English version: 1st September 2006

Institut Wohnen und Umwelt GmbH

Annastr. 15

D 64285 Darmstadt

Internet: www.iwu.de

This research project deals with two important climate protection instruments in the German building sector: the energy saving regulation (EnEV) and the building rehabilitation programme “KfW CO₂-Gebäudesanierungsprogramm”. It examines reductions in CO₂ emissions and – against the background of the strategic framework for climate protection – makes proposals for the further development of these instruments.

According to the CO₂ balance system of the national climate protection programme the CO₂ emission reductions in the housing sector are reported, i. e. the on-site emissions of the buildings without considering the preceding emissions of production, transport and conversion of the energy sources.

The research project was carried out jointly by the Institut Wohnen und Umwelt, Institute for housing and environment (IWU) and the ifeu-Institut für Energie- und Umweltforschung, Institute for Energy and Environmental Research (ifeu). The focus of IWU's research was the evaluation of the Reconstruction Loan Corporation – KfW support programme, whereas the ifeu Institut concentrated on the EnEV.

Strategic framework for climate protection in the building sector

Climate protection is a considerable challenge for Germany. The main short-term goal is to fulfil the targets of the Kyoto Protocol. In the EU burden-sharing approach, the Federal Republic of Germany is supposed to reduce greenhouse gas emissions between 2008 - 2012 by 21 % as compared to 1990. In the long-term, a reduction of CO₂ emissions of at least 80 % is foreseen by the year 2050 according to the German Parliament's Enquete Climate Protection Commission.

When climate protection strategies for the building sector are discussed, long-term goals as well as short-term goals are to be considered. This is mainly due to the long life of span buildings and the long period to be taken into consideration before new technologies are widely introduced.

Current energy-saving activities in the building sector meet neither the qualitative nor quantitative requirements.

- Even new buildings and retrofitted buildings after an energy-saving modernisation don't meet the energetic quality standard which is necessary for reaching the long-term

climate protection targets. Usually the primary energy demand of these buildings is twice as high as technically necessary.

- With a rough estimate of 1 %/a (i.e., heat protection measures implemented an average of once in 100 years), the energy renewal rate in building enclosures is too low to reach long-term climate protection goals.

Currently, in Germany, these challenges are met with a “moderate” climate protection strategy that is based on step-by-step adaptations, avoiding profound changes of the framework conditions of the building sector, especially avoiding economic burdens for the owner or tax payer. Despite remarkable progress that has been made over the years with regard to regulations and support programs, we are still far from a “breakthrough”.

Therefore the further development of the current strategy is necessary. Against this background, the research project examines the instruments of the energy saving regulation and the promotion of energy savings. It is based on the a. m. “moderate” approach. However, at the end of the day, the strategies must be discussed on a much wider basis if the challenges of climate protection are to be met successfully.

- A “moderate” strategy that avoids profound changes of the framework conditions stresses the individual responsibility of the decision makers. The result of the saving efforts depends mainly on those directly involved in the construction, i. e. the owner of the house, the specialists (craftsmen, engineers, architects). Against this background, the current strategy appears still to be “incomplete”. The instruments for information, qualification and motivation should be emphasised more than before and be included in an effective and encompassing strategy.
- The question remains whether the current “moderate” approach will be successful in the face of the challenges of climate protection. Therefore an “offensive” climate protection strategy should constantly be checked. This would result in an increase in energy costs or higher burdens for the building owner or tax payer due to stricter regulations or from an energy saving promotional programme for all existing buildings. On the other hand, potentials have to be considered: the creation or maintenance of jobs in the building sector, the development of innovative technology, the advantage of switching early to new technologies (which will be necessary at some point anyway) or the reduction of dependency on energy imports.

The role of the energy saving regulation (ifeu-Institut)

This study examines the influence of the energy saving regulation (EnEV) on carbon dioxide emissions in housing stock and how short and mid-term improvements could be implemented by 2008/2012. Legislation of the federal level and the Laender as well as the enforcement of the EnEV¹ has been looked into.

Effects of the EnEV in reducing CO₂ emissions in new buildings

The German Parliament Enquete Commission on “sustainable energy supplies” predicted an increase of floor space of 13 % between 2000 and 2010, even though the population will remain stable (82 million inhabitants). This is an increase from 40 square meters to 45 square meters per person. Without considering the effects of the EnEV, the increase from 2002 to 2010 would result in about 11.3 million tons of additional carbon dioxide emissions².

The CO₂-reducing effects of the EnEV as compared to the thermal protection regulation (WSVO'95) is about 1.69 to 2.25 million tons³.

This results in a real growth of CO₂ emissions from 6.97 to 8.53 million tons caused by new dwellings by 2012.

Effects of the EnEV in reducing CO₂ emissions in housing stock

For new dwellings, the primary energy source of the entire building is evaluated according to EnEV. However, in housing stock only the structural component requirements of the EnEV apply since normally only individual structural components need to be modernised. Therefore, at first the theoretical potential for reduction was estimated on the basis of the structural component requirements of the EnEV⁴ for the existing buildings. When the energy cycles⁵ are considered, the application of the EnEV – structural component requirements results in a

¹ Enforcement means the implementation of the EnEV in the corresponding Laender.

² This report only considers CO₂ emissions on site. Here you have to add 2.4 million tons CO₂ in the energy (conversion) sector by increase of living areas of dwellings with electric or district heating.

³ Plus CO₂-reduction effect of 0.46 to 0.62 million tons by savings in dwellings with electric or district heating.

⁴ E. g. the EnEV demands an additional insulation of the outer walls for U-values > 0.9 W/(m²K).

⁵ The implementation of the potential is normally linked to the renewal cycle of the structural components.

theoretical potential for reduction in collectible energy of about 5,300 GWh_{ne} yearly between 2002 and 2012 equal a CO₂ reduction potential of about 1,050,000 tons⁶.

In practise however, this potential is not realised since the EnEV (and the requirements for implementation) allows many exceptions that restrict the reduction potential on the basis of the component values in the EnEV. For example, some measures may only be performed when the property is changed, or the outer wall can only be insulated under certain conditions (hammering off the plaster). Based on these assumptions, there is a maximal realistic potential for reduction in structural losses of about 2,300 GWh_{ne} of collectible energy per year between 2002 and 2012 with a CO₂ reduction potential of about 450,000 tons per year⁷. Assuming an enforcement deficiency of 25 %⁸, the actual implementation rate for the EnEV in existing buildings is only 32 % of the economic potential.

Consequently, due to insulating measures in housing stock based on the EnEV, only 3.7 to 5.0 million tons of CO₂ will be saved instead of the 11.5 million tons of CO₂ that are theoretically possible. Concerning heating systems the EnEV CO₂ reduction effects (including the decommissioning of old boilers and the requirements for retro-fitted line insulation) reach about 0.75 to 1.0 million tons⁹.

However the impact of the EnEV on the CO₂ reductions in existing stock is not sufficient to compensate for the increase in emissions caused by new dwellings from 6.97 to 8.53 million tons of CO₂ by the year 2012¹⁰.

Further development of the EnEV

For the short-term implementation of the reduction potential shown above, and to reach long-term target standards, the EnEV must be revised. Just to focus the EnEV is not enough. Additional framework requirements and the safeguard of the enforcement are required.

The following steps are helpful for the implementation of a sustainable climate protection policy in the field of EnEV.

⁶ Plus CO₂-reduction effect of 257,000 tons yearly by savings in dwellings with electric or district heating

⁷ Plus CO₂-reduction effect of 111,000 tons by savings in dwellings with electric or district heating per year

⁸ Maximum enforcement deficiency from the political scenarios III (according to Kleemann/FZ Jülich).

⁹ Partially there are some measures implemented only some years earlier (e.g. refitting old boilers)

¹⁰ However, modernisation measures independent of the EnEV – mainly the renewal of heating systems – can also lead to a reduction of CO₂ emission of private households' heating systems.

Optimisation of the EnEV

In the scope of this study, numerous detailed steps are suggested for optimising the EnEV of which only a few points are mentioned here. Due to the high increases in energy prices, most of these steps are economical to implement.

- Introduction of the energy-efficient house standard (NEH standard "Low energy consumption standard see footnote 16) by reducing H'_T ¹¹ and the structural component requirements.
- Elimination of the exceptions of modernisation requirements for one and two family homes (change of owner).
- Successive increase of modernisation requirements in respect to scope and quality.
- Check of the options for modernisation requirements for outer wall insulation in existing stock¹².
- Mid-term: Check of the option of introducing the passive house standard in new dwellings.

Adapting the EnEV – Implementation regulations of the Laender

Whereas the EnEV sets the federal framework, the Lander regulations set the details for enforcement. However, existing regulations are based on outdated assumptions of energy price developments¹³. Therefore, those Laender regulations should be quickly adapted to the current situation. Most importantly, outer wall insulation should be obligatory in all cases of outer wall modernisation (even if the plaster is repaired and painted) where the outer components have U-values over $0.9 \text{ W}/(\text{m}^2 * \text{K})$.

Improving the enforcement of the EnEV

The enforcement of EnEV was given much attention within this study. The specific Laender regulations were compared in detail.

¹¹ Specific transmission heat loss based on the heat transmitting surface area

¹² When external costs and increasing energy prices (to 6.5 cents/kWh) are considered, insulation of the outer walls with U values over $1.1 \text{ W}/(\text{m}^2 * \text{K})$ can be economical, even when the complete costs are calculated. So it may be possible to enforce wall insulation without considering the renewal cycle of the structural component.

¹³ In the study by Wolfgang Feist/Passivhausinstitut Darmstadt: "Wirtschaftlichkeitsuntersuchung ausgewählter Energiesparmaßnahmen im Gebäudebestand" 1998, that was also used as a basis for the *determination* of the *component U values* in the EnEV, an average future energy price of 2.6 cents/kWh was assumed. Today (2004), the current energy price is 4.2 cents/kWh.

In most Laender, deregulation was the main goal in implementing the EnEV. For EnEV enforcement, deregulation means that the building inspection authorities withdraw from state control over construction procedures as much as possible. Therefore, the responsibility for implementing the EnEV is shifted from state authorities to the private sector. However, with few exceptions, this responsibility has not been recognised to the extent required.

Efficient enforcement requires binding quality control within the private sector. For example it is the case in Brandenburg, a licensed expert could check certifications as a “private third party”. Additionally, as in North Rhine-Westphalia and Lower Saxony, random checks of construction sites should be made for every property. This should be supplemented by a random state authority check, foreseen in many Laender regulations.

The district chimney sweeper and/or the energy pass supplier could check retro-fitting requirements for existing buildings. This requires close co-ordination with the design for the new energy pass on the basis of the EU energy performance building directive.

To help the parties concerned understand to the integrated view of the EnEV, a federal IMPULS programme (similar to the programmes in North Rhine-Westphalia or Hessen) should be introduced on Laender level.

Implementing external costs in the Energy Conservation Code (EnEG)

The legal basis for the EnEV is the Energy Conservation Code of July 22, 1976. The code establishes requirements for heat insulation (§ 1) and plant engineering (§ 2 and 3). This especially concerns modernisation (conditional requirements and retro-fitting regulations in the EnEV) based on requirements for the economic feasibility of these measures as defined in § 3 of the Energy Conservation Code.

Since future questions about the energy supply today are mainly determined by the demands for climate and resource protection, this aspect should also be considered in the Energy Conservation Code. Not only the economic feasibility but also aspects of environmental and climate protection and resource saving, as well as criteria of commensurability should be elements of the efficiency principle.

For example, by including external costs in the calculation, EnEV can be adapted more quickly to the necessary long-term target standards.

Future strategies for the optimisation of the EnEV

To reach the long-term climate protection goals of the federal government, in the field of energy saving a transition from the current, moderate climate protection strategy to a sustainable climate protection strategy is necessary. The extension of the economic requirements in the Energy Saving Law specifically referring to climate protection goals is essential for this transition (see above). Doing this the retrospective conservative assessment of the pure economic feasibility of energy saving measures can be replaced by a sustainable evaluation of the national-economic requirements based on sustainability criteria.

At the same time, only a long-term, politically supported sustainability strategy offers the corresponding planning security in the construction sector. Regulations, such as the EnEV, are not effective due to the detailed calculation requirements; they are normally much too complex and not bold enough. The effectiveness comes from the adaptation of planning and construction standards to long-term, recognisable political goals. Therefore, it is necessary to formulate goals today for the future, even if an important correcting variable (the development of future energy prices) cannot be calculated exactly.

Therefore, as a political signal beyond the potential for optimising the EnEV as described here, we recommend announcing that the declared goal of the federal government is to make the passive house standard for new buildings a requirement within a reasonable time (such as within 10 years).

The role of the energy saving incentive programme

Emission reductions in the “KfW- CO₂- Gebäudesanierungsprogramm” (KfW CO₂ building modernisation programme)

The project results for emission reductions under the KfW programme can be summarised as follows (on-site CO₂ emissions in the residential buildings without preceding emissions):

- Assuming a credit volume of €5 billion in the years 2001 - 2005, the CO₂ reduction induced by the measures supported in the programme is about 0,5 million tons of CO₂.
- Assuming that a credit volume of about €1.8 billion is available per year based on a federal advance to the incentive programme of €360 million per year, the emission reductions resulting from the promoted measures could be calculated at approximately 0.18 million tons of CO₂ per year.

Such assumptions are always risky. It must also be noted that these figures cannot be added to the CO₂ reductions induced by EnEV as described above. Some of the promoted modernisation measures are already included in the assumptions on the level of general energy modernisation rates of the housing stock.

It must be stressed that the indicated CO₂-reductions resulting from the incentive measures are not the same as the CO₂ reductions resulting from the introduction of the incentive programme. Remember that incentive programmes cannot always exclude funding of measures that would have been executed even without support. On the other hand, the incentive programme can also have a “ripple effect” beyond the cases that are actually supported. Although these effects cannot be quantified in this project, they are of considerable importance for the design of the incentive programme and will be discussed in detail in the following section.

Proposals for the further development of energy savings programme

When the further development of the promotion of energy savings is considered, the question arises as to how limited finances can be used for maximum impact¹⁴. First, it must be clarified that this effect can be observed at two completely different levels:

- The programme triggers energy-saving measures in the buildings concerned and the corresponding CO₂-reductions are reached. This direct effect is described as the “trigger effect” of the incentives.
- The effect of an incentive programme can far exceed the objects directly targeted with the establishment of new standards, technologies, or procedures that can be further promoted by others. This indirect effect is described as the “ripple effect” of the promotion.

The trigger effect concerns the direct effects of the incentive programme. This deserves much attention. The suggestions for further development are specifically geared for improvements to this effect. However, the ripple effect is probably the decisive factor for the success of the programme. As long as only a relatively small group of measures actually necessary in the building sector can be promoted due to limited financial capacities, then we must strive for the largest possible effect outside of the targeted circle.

¹⁴ There are, therefore, other requirements than when a more highly financed energy savings promotional programme is handled for all existing buildings in the scope of an offensive strategy. Correspondingly, the following statements cannot be directly applied to this type of larger programme.

In the scope of the moderate climate protection strategy, the programme can be seen as a “motor”: In those areas where improved informational measures have not yet resulted in the desired advances, the programme can start by providing better standards and improved procedures for wide application and by introducing new technologies and building concepts to the market. This can close an important gap between the new solutions that have been developed in the laboratory and tested in demonstration projects and the successful transfer to general use. It will most likely be necessary to provide and maintain sufficient long-term financial support for energy saving programmes in Germany.

For the programme to perform this role and to actually be able to achieve a ripple effect, it must be based on innovative and exemplary energy saving measures. If only those measures are promoted that are already widely performed, nothing new can be created that would “ripple” to others.

Considering these points, we suggest that the following three goals be considered for the further development of energy saving promotion in existing buildings:

1. Dissemination of higher energy saving standards

The distribution of financial incentives for energy savings should always be linked to qualitative minimum standards¹⁵. These should be considerably higher than normal standards – especially the legal minimum. However, they must still be achievable with reasonable extra costs or have the potential for profitability. When these standards become general practice, as is the desired effect, the financial incentive per measure can be reduced or the standards can be raised again. An increased quality of energy saving measures contributes not only to the ripple effect but also to the trigger effect since there is an immediate increase in energy saving in the buildings in the programme.

2. Introduction of a mandatory long-term, very high energy saving standard

Along with the wide effects of the programme for increased energy saving standards, and in the spirit of a staggered promotion of various quality levels, opportunities for promoting innovative measures and technologies should be created that are required for achieving long-term climate protection goals. In new dwellings, this task is already

¹⁵ “Standard” are the target sizes for the individual components (e.g. minimum insulation thickness) or for the complete building (e.g. adherence to a specific primary energy value).

in action with the promotion of '40/60' type energy saving homes and passive homes¹⁶. The current gaps should be closed in existing buildings.

3. Integration of energy consultation in the concept of financial incentives

Especially in more comprehensive modernisation measures, the increased integration of technical energy expertise should be the rule. This should be considered in the requirements for financial incentives. The consultation can be performed by the planner/construction leader, who is included in the planning in most cases anyway, or by an external specialist. This results in a direct trigger effect: Since a comprehensive overall plan for the building is designed the owner may be incited to add additional measures that were not previously planned, the CO₂-reduction can be increased. The inclusion of the energy consultation can contribute to the ripple effect in several ways: Those involved are informed on site about the advantages of increased energy quality standards, the economics of these standards, and the necessary details for implementing them. They can use this expertise in additional projects or, as satisfied owners, convince others of the relevance of the consultation and the measures implemented. Specific requirements for the qualifications of the consultants in the promotional programme can ensure the quality of the consultation and support the introduction of corresponding training standards.

In the scope of that research project, a suggestion was developed for the further development of the existing energy saving promotion in the KfW CO₂ building modernisation programme. The details have not yet been clarified, however, this is meant to be a coherent example of how abstractly formulated promotional goals are integrated into a concrete promotional plan.

A 4-level promotion programme is recommended for the further development of the programme. The first level is targeted at partial modernisation and is based on a point system (see the table at the end). It connects the elements of the previous measure packets 0-3 (special requirements for constructional measures or heat supply measures) with packet 4 (incentive for high CO₂ reductions¹⁷), is more flexible, avoids certain existing disadvantages

¹⁶ 'type 40' energy saving homes and passive homes are promoted in the KfW CO₂ building modernisation programme, 'type 60' energy saving homes are promoted in the KfW CO₂ reduction programme. Passive homes must be given special recognition since they have a high energy standard and are also characterised by a conclusive overall design including quality assurance measures. The passive home has already contributed considerably to technological innovations in the middle-class construction sector, for example, by introducing new window and ventilation designs.

¹⁷ If in the framework of a promotion programme or another climate protection instrument target values for CO₂-emissions or emission reduction are used, the preceding emissions (production, transport, conversion of energy sources) should be included so that the total effect of the respective energy saving measures is considered. This is done in the KfW-programme, it has also to be respected in a further development.

(random combination of measures in the packet 0-3, lack of minimum standards in the measure packet 4), and integrates the energy consultation to a higher degree. Levels 2-4 promote complete energy modernisation at various quality levels up to the ‘type 60’ energy saving house. The primary energy demand and transmission heat loss ensure that exemplary energy standards are adhered to. Along with the special point requirement in level 1, the minimum requirements for heat protection underline the special relevance of long-term constructional measures.

- Level 1 “Partial modernisation”
Requirements: total of 6 points, 3 of these for heat protection)
- Level 2 “New building standard in housing stock”
Requirements: Primary energy demand q_P and specific transmission heat loss H_T' according to the EnEV new building level (corresponds to the current requirements for partial debt reduction).
- Level 3: “New building standard in housing stock minus 20 %”
Requirements: q_P and H_T' at 20 % under the EnEV new building level, performance of an in-depth energy consultation.
- Level 4: “‘type 60’ energy house in existing buildings”
Requirements: $q_P=60 \text{ kWh/m}^2_{\text{ANa}}$, H_T' at 30 % under the new building level (as for the ‘type 60’ energy saving home in new buildings), performance of an in-depth energy consultation.

	points
Thermal Protection	
wall	
1 point: min. 14 cm* outside insulation or min. 8 cm inside insulation or combination of both	
2 points: 18 cm outside insulation	
3 points: 24 cm outside insulation	
roof/upper floor ceiling	
1 point: 20 cm / 2 points: 26 cm / 3 points: 32 cm	
cellar ceiling/ground floor	
1 point: 9 cm / 2 points: 12 cm	
windows	
1 Punkt: coated glazing windows	
2 Punkte: passive house windows	

Points for thermal protection

required:
at least
3 points

Heat Supply Technique	
installation of a new heat generation unit	
1 point: gas condensing boiler, heat pump, connection to district heating (cogeneration plant)	
2 points: biomass system, cogeneration unit in the building	
insulation of heat distribution pipes	
1 point: insulation layer thickness 1,5 times the requirements of EnEV	
installation of energy saving pumps	
1 point	
installation of a solar thermal system	
1 point: solar system for hot water	
2 points: solar system for heating and hot water	
heat recovery ventilation system	
2 points (blower door test necessary)	

energy consulting	
energy consulting and energy passport	
1 point: short energy consulting	
2 points: in-depth energy consulting	

CO₂-reduction	
change of energy carrier or reduction certificate	
1 point: change of energy carrier form coal/electricity to gas/oil/district heating/renewable energy or from gas/oil to distircit heating from cogeneration/renewables or certificate of at minimum 30 kg/m ² _{ANa} CO ₂ -reduction	
2 points: certificate of at minimum 40 kg/m ² _{ANa} CO ₂ -reduction	

total points

required: at least 6 points

Scheme of a point system as a basis for the support of measure packages.