



**EVALUATION OF KFW SOFT LOANS
FOR BUILDING MODERNISATION**
WITHIN THE FRAMEWORK OF THE AID-EE PROJECT

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1 Characterization of the instrument

The residential sector in Germany is the largest consumer of energy (even bigger than industry and transport, Jülich, 2003). In 1996 the German government launched an incentive programme for building modernisation. Since then the program has been changed and restructured several times. The program provides favourable loans for implementing energy saving measures for households, building associations and public entities who modernize their buildings and apartments.

This incentive program was incorporated in the National Climate Protection Plan 2000 as an additional measure within the national strategy to meet the German Kyoto Protocol target.

1.1 Targets, including relation to end use sector and relation to national Kyoto target

Germany committed itself to reduce the emissions of six greenhouse gases (GHG) cited in the Kyoto Protocol by 21% by 2008-2012 compared to the 1990 level, within the concept of the EU burden-sharing agreement (NCP 2000). Additionally, Germany set its own national target- to reduce the CO₂ emissions by 25% by 2005 and by 30% by 2010 compared to 1990 level (NCP 2000). The forecast for achieving this target by currently implemented measures showed that in 2005 there will be a shortfall of 50-70 Mt, equivalent to 5-7% CO₂ reduction by 2005 (in the sector “private households and buildings” the shortfall is 18-25 Mt). Thus, the NCP 2000 designed a set of additional measures for individual sectors (industry, private households, transport, energy). The additional measures for the household sector included the KfW incentive program for building modernization. This program aims at providing the soft loans for building new houses and renovating existing buildings according to the highest energy standards.

1.2 Period the policy instrument was active

The KfW has been providing loans with reduced interest rates for the modernization investment in the new Länder¹ already from 1990. From 1996, when the CO₂ Reduction Program was introduced, the KfW has also been financing the CO₂ reduction measures in Western Germany. The KfW incentive programs has developed over time and extended significantly (see Table 1).

¹ So-called KfW-Wohnraum Modernisierungsprogramm

Table 1: Evolution of the KfW incentive programs for energy savings in the built environment 1990-2005

Period/ Date Established	Program	Focus of the measure	Individual/Packag e
1990-2000	KfW Living-space Modernization Program I (KfW Wohnraum Modernisierungsprogramm I)	Eastern Germany and Eastern Berlin	Individual measures
1996	KfW CO₂ Reduction Program (KfW-CO ₂ -Minderungsprogramm)	Both Eastern and Western Germany	Individual measures
2000-2002	Living- space Modernization Program II (KfW Wohnraum Modernisierungsprogramm II)	Eastern Germany and Eastern Berlin	Individual measures
2001	KfW CO₂ Building Rehabilitation Program (KfW-CO ₂ -Gebäudesanierungsprogramm)	Whole Germany	Packages of measures
2003	KfW CO₂ Building Rehabilitation Program (2003) - Change: The debt relief was introduced	Whole Germany	Packages of measures
2003	KfW Ownership program		
2005	New Building Modernization Program - Combines the KfW CO ₂ Building Rehabilitation Program 2003 and the KfW CO ₂ Reduction Program	Whole Germany New & existing buildings	Standard OKO-Plus measures introduced
2005	Ecological Building	Whole Germany New buildings	
2005	Solar Power Generation	Whole Germany	

The highlighted programs are the focus of this study.

A brief overview of the programs can be found in Annex Table A1.

In 2005 the KfW CO₂ Reduction Program and the KfW CO₂ Building Rehabilitation Program (as changed in 2003) were combined into a New Building Modernization Program. This program serves to finance CO₂ reduction (so-called “ÖKO-Plus”) measures and modernization (“Standard”) measures. The applied interest rate for the loan depends on the share of the “ÖKO-Plus measures” (the higher the share, the lower the interest rate).

1.3 Actions, Specific technologies and/or energy efficiency measures

In this paper we focus on the energy savings through the **KfW-CO₂ Reduction Program** and the **KfW CO₂ Building Rehabilitation Program** in the period 1996-2004.

**KfW CO₂ Reduction Program
(KfW-CO₂-Minderungsprogramm)**

The program was established in January 1996 and it was first available only for Eastern Germany and Eastern Berlin. However, in 1999 it was extended to whole Germany (Kleemann et al., 2003). The program originally supported individual renovation measures in existing buildings, such as improvement of the heating features. From 1998 the program was used to support also measures in new buildings, such as construction and initial purchase of KfW energy-saving houses 60, 40 and passive houses²³. The program was used also for financing the introduction of renewable energy sources (RES) in new and existing buildings.

**KfW CO₂ Building Rehabilitation Program
(KfW-CO₂-Gebäudesanierungsprogramm)**

This program, established in January 2001, provides favourable loans for the retrofification of buildings built before 1979 in the whole of Germany, as well as demolition of empty residential rental buildings in Eastern Germany and East Berlin. In 2003 a partial debt relief was first introduced. A precondition for receiving a debt relief is that the applied measures lead to an annual reduction of 40kg CO₂ pro m² of living space. The program offers 6 packages of measures (Table 2). The measures included in the Packages 0-3 are assumed to fullfil the requirement of 40 kg CO₂ (and the savings do not have to be calculated in order to receive the debt relief). The Packages 4 and 5 include individual measures of the Packages 0-3 and some additional measures, which are designed for buildings, which renovated in the past. The measures in these packages do not account for the full 40 kg CO₂/m² reduction per annum. If the house-owner achieves a reduction worth less than 40 kg CO₂/m² a support is provided, but lowered accordingly. In this case, the legal minimum level for building insulation (given by the Energy Saving Ordinance) has to be met. Achieving such reductions has to be certified by an authorized energy consultant. The height of the debt relief was originally set at 20% (2003), and later decreased to 15% (Heidrich, January 26, 2006).

² The construction of the low-energy houses was only supported until the end of 1999. The rest of the support for new buildings was used for construction of the passive houses and KfW-low energy houses 40 and 60 (Kleemann, 2005:11).

³ The KfW CO₂ Reduction Program supported construction of two types of low-energy houses: low energy house 40 and 60. The condition for receiving the support is that the annual primary energy demand of the KfW low-energy house does not exceed more than 60kWh/m², and 40 kWh/m², respectively (Kleemann et al, 2005: 25).

Table 2: Packages of measures in the CO₂-Building Rehabilitation Program

	Combination of individual measures
Package 0	<ul style="list-style-type: none"> • Thermal insulation of the external walls • Insulation of the roof • Insulation of the cellar ceiling or the exterior surfaces of heated rooms that have a ground contact • Replacement of the windows
Package 1	<ul style="list-style-type: none"> • Replacement of the heating system • Insulation of the roof • Insulation of external walls
Package 2	<ul style="list-style-type: none"> • Replacement of the heating system • Insulation of the roof • Insulation of the cellar ceiling or the exterior surfaces of heated rooms that have a ground contact • Replacement of the windows
Package 3	<ul style="list-style-type: none"> • Replacement of the heating system • Conversion of heating system to a different energy source • Replacement of the windows
Package 4	<ul style="list-style-type: none"> • Combination of the measures from Package 0-3
Package 5	<ul style="list-style-type: none"> • Replacement of coal, oil and gas furnaces by installation of modern heating systems • Replacement of the old boilers (installed before 1 June 1982) by standard oil and gas boilers in combination with solar collectors and installation of renewable energy sources technologies

Source: www.kfw.de

Energy audits

Most of the programs do not require execution of energy audits. However, in some variants an energy consultant has to certify the amount of CO₂ reduction resulting from the applied measures. In these and other cases the energy consultant also checks the house before the modernization and suggests energy-saving measures. The house-owners can only contract energy consultants eligible within the framework of the program, i.e. the consultants that are authorized by the state or federal law (Duve and Daub, 2006).

1.4 Target groups

The target groups are private individuals, housing enterprises, housing cooperatives, real estate agents, municipalities, local associations (communities), districts, civil groups and other establishments of public law (Kleemann et al., 2004).

The KfW incentive program for modernization of building stock was originally focused only on the “new Länder” (Eastern Germany and Eastern Berlin). However, later all programs were extended to the whole Germany.

In the period 1996 - 2000 the vast majority of the applicants for the support from the KfW incentive program were private households, both in terms of provided

loans and renovated dwellings. These were followed by construction enterprises and cooperatives (Table 3).

Table 3: Share of the beneficiaries of the KfW CO₂ programs

	Volume of the planned loans (%)	Number of dwellings (%)
Private households	85	70
Enterprises	10	20
Cooperatives/associations	5	10

Source: KfW, 1998.

1.5 National context

The building stock in Eastern Germany and Eastern Berlin was in a very poor condition in the beginning of 1990s. Therefore the federal government and the KfW developed an incentive program for building modernization, called Living-space Modernization. This program provided loans for general reconstruction of the buildings without specific requirements on energy standard of the building.

The energy measures were first introduced on 1.1.1996, when the KfW CO₂ Reduction Program started. This program financed individual retrofication measures (insulation of the walls etc.) in Eastern Germany and Eastern Berlin and in 1998 extended to Western Germany as well.

In 2001 a new program for the whole Germany, so-called KfW CO₂ Building Rehabilitation Program was put in place, through which additional modernizing measures were financed. The measures in this program are combined into several packages (Table 2). In 2000 this program was incorporated by the National Climate Protection Program (NCP) into the strategy to meet the Kyoto Protocol target of Germany (reduction of 21% CO₂ emissions by 2008-2010) and German own national target (25% by 2005). In NCP 2000 the German federal government committed to finance the program for the next three years. At the same time the government requested KfW to prolong the existing CO₂ Reduction Program for at least five more years. In 2003 the KfW CO₂ Building Rehabilitation Program was extended till 2004.

The national target of reducing 25% of CO₂ emissions by 2005 (compared to 1990 levels) proved to be too ambitious and it became clear that it would not be reached. One of the reasons was a failure to meet the target in the built environment, which was caused by a delay in introducing stricter legislation (especially the revised Building Code), as well as over-estimating the future reductions by this sector (Wagner et al., 2005).

1.6 Market failures to overcome

Energy rehabilitation, building modernisation above the current energy standards and replacement of the heating systems towards those based on renewable energy sources require high initial investments with long payback periods (10-30 years). The market does not provide the right incentives for the house-owners to modernize their houses and apartments in the most energy-efficient way. As a result the households choose the least expensive standard modernizing measures. At the same time, the households are not aware of how their choice of renovation measures can influence the energy consumption in their buildings due to the lack of information. Many people probably also do not know about the currently available modern insulation material that can save energy, lower their monthly expenditures on energy and increase their comfort.

The federal government initiated the KfW incentive program to overcome these market failures in form of providing information and monetary incentives for energy efficient modernization.

1.7 Organisations, which are responsible for implementation and execution

The implementation body for the incentive program is the Bank of Reconstruction, KfW (Kreditanstalt für Wiederaufbau) in Frankfurt. KfW is a bank group established in 1996 and owned by the federal government (80%) and the Länder (20%). The examined incentive programmes were launched in cooperation with the German federal Government (Duve and Daub, 2006).

1.8 Available budget

In the period 1990-1999 the KfW provided 40 billion Euro of loans. Initially, the KfW mainly focused on usual reconstruction measures (new facades, new bathrooms, new staircase etc) and only 25% of the investment went into energy saving measures. In order to achieve 5-7 Mt of CO₂ reductions in the “Climate Protection Programme for Existing Buildings” the federal government envisaged to make available to the KfW 200 million Euro for the initial 3 years (NCPP 2000). It was expected that afterwards the KfW would finance the programs from its own resources (Wagner at al., 2005). The subsidy of 200 million Euro allocated to lower the interest rates was exhausted in the first year of functioning of this program (Wagner at al., 2005). At the same time (2000) the federal government requested the KfW to extend the existing CO₂ Reduction Program by at least 5 years and to increase the current loan volume.

1.9 Available information on initial expected effectiveness and cost-efficiency of the instrument

The NCPP 2000 estimated that the **soft loan program for energy savings in existing buildings including energy audits** (in NCPP 2000 called “ Climate Protection Programme for Existing Buildings”) would result in a reduction of **5-7 Mt** of CO₂ emissions in the period 2000-2005 (NCPP 2000). This estimate, however, proved to be over-optimistic (Wagner et al., 2005). Evaluation in 2004 (by Prognos IER) calculated that the energy improvements of existing buildings will not provide for more than **2-2.5 Mt CO₂ reductions by 2005**, i.e less than half of what was expected (Wagner et al., 2005).

Introduction of the soft loan program was based on the previous experience, that the loans were more cost-efficient than the subsidies. Additionally, the costs are spread over the whole period, which does not put such a large pressure on the federal budget (Heidrich, January 2006, 2006). In parallel, other instruments were implemented along the KfW incentive program, which helped to raise awareness and motivation to save energy demand in the household sector (measures focused on lowering the electricity consumption in the households etc).

1.10 Side effects

The two KfW programs secured 96.000 jobs in 2003. These jobs were mostly created in the small and medium construction firms. If we consider also the jobs that were created by construction of the KfW low-energy houses, the total jobs created in 2003 were 142.000 (Table 4). However, since we do not know how many jobs would be created in construction anyway, we cannot calculate the net effect of the programs on employment.

Table 4: Effect of the programs on employment in 2003

Program	2003
KfW Building modernization program	60.000
KfW CO ₂ Building rehabilitation program	36.000
KfW CO ₂ reduction program	
Subtotal	96.000
Construction of the KfW low-energy houses	46.000
Total (including construction of low-energy houses)	142.000

Source: KfW (2004).

2 Policy theory

2.1 Cause-impact relations, indicators and success and failure factors

The assumptions of how the KfW loans for building renovation and rehabilitation works are described by means of cause-impact relationship. For each cause-impact relation suggestions are made for indicators and success and failure factors (Figure 1). These will be used to monitor the effect and to find out the learning experiences. The indicators are used in the evaluation (chapter 3) to monitor the effect of the various steps in the process (cause-impact chain). Also per indicator of success and failure factors are defined. These are used in the evaluation (chapter 3) to monitor the learning experiences.

1. The national government allocates funds for soft loans to stimulate energy savings in the built environment.
2. National government assigns the KfW to implement the program.
3. The KfW starts reduction program and begins a communication campaign to make the program public. This includes press releases in the newspaper and magazines, information available on internet (www.kfw.de) and fairs.
4. The house-owners consider modernization of their house. Based on the campaign they consider financing of the modernization by a KfW loan. Depending on their modernization needs they choose an appropriate set of energy-saving measures. (Due to the incentives of the KfW program they choose such measures, which lead to a higher energy savings than if they modernized the house without the measures.)
5. The house-owners apply for the KfW loan. The private entities and households submit their applications through their regular banks (so-called “Hausbank”, applicants’ principal bank), the public entities submit the applications directly to the KfW.
6. The applicants’ principal banks, which receives the application from the applicant also checks the application on financial data. They do not check the technological aspects of the application. Then the bank sends all the eligible applications to the KfW, which allocates funds to the individual applicants.
7. House owners receive the KfW low interest loan. If the measures chosen lead to the reduction of 40 kg CO₂/m², the bank provides the house owners with a debt relief.

8. House owners commission a construction firm to implement the modernization and energy saving measures. The renovation must fulfil at least the standards set by the Energy Saving Ordinance (EnEV).
9. Residents save energy due to the implemented measures.
10. House owners pay back the loan and interest rates according to the conditions stated in the contract.

2.2 Interaction with other policies

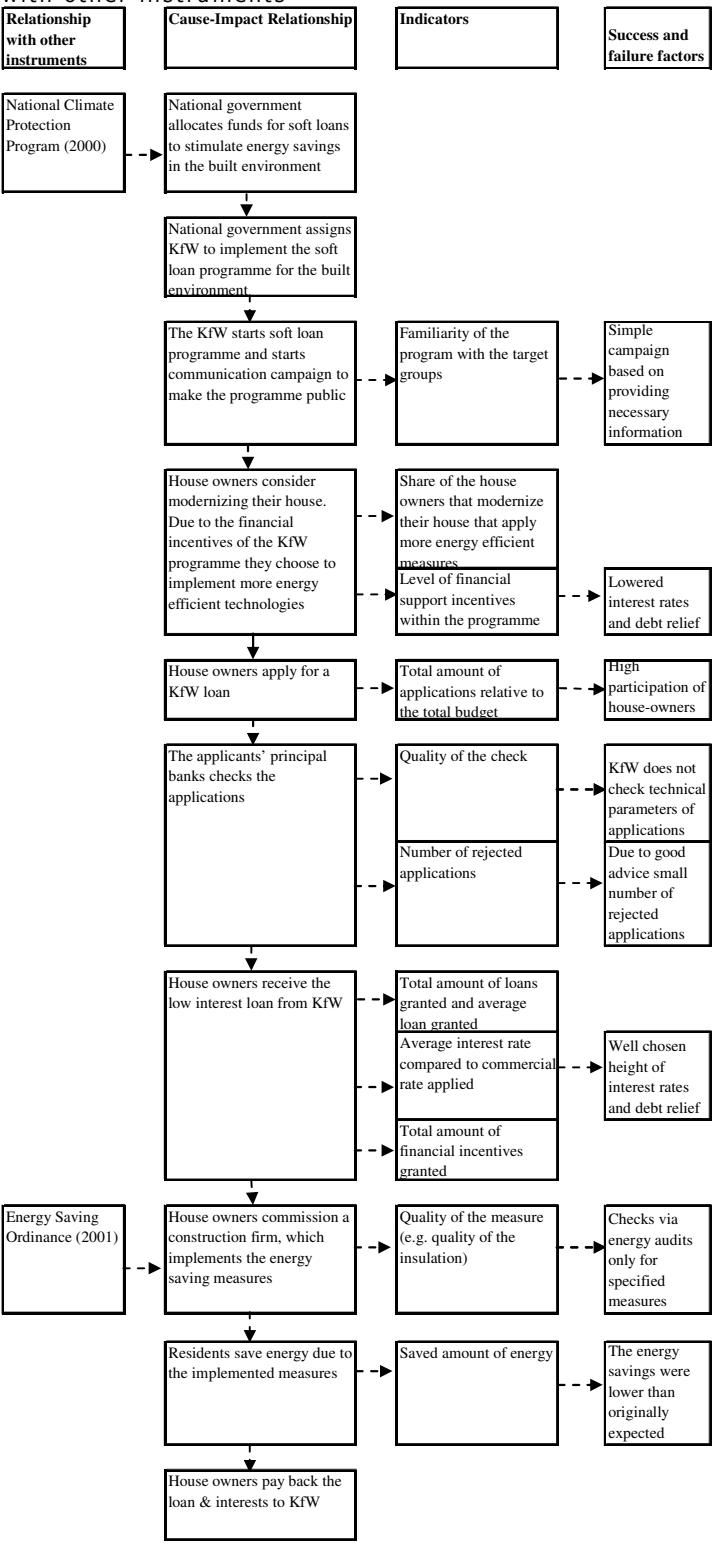
The National Climate Protection Program set the framework for the KfW soft loan program in 2000. The strategy for energy savings in the building stock developed by federal government is based on three pillars: regulation (Energy Saving Ordinance etc.), information (information about the program, potential to reduce energy consumption, etc.) and loans (KfW program) (Heidrich, January 26, 2006).

Energy Saving Ordinance (Energieeinsparverordnung, EnEV) entered into force on February 1, 2002. It has substituted the Thermal Insulation Ordinance (Wärmeschutzverordnung, last amended in 1994) and the Heating Installations Ordinance (Heizungsanlagen-Verordnung, last amended in 1998). The EnEV was amended in December 2004 on technical matters (www.bmvbs.de). The EnEV concerns construction of new and existing buildings, which are undergoing substantial retrofit. The target of the EnEV for the new buildings was to reduce the energy requirements by an average of 25-30% compared to the former standard. The energy demand of the building has to be stated on a certificate. The EnEV posed requirements on modernization of existing buildings, which includes requirements on insulation, replacement of windows and replacement of the boilers, which were installed before October 1, 1978 (FISI, 2004).⁴

The measures chosen in the KfW programs have to fulfil the standards set by the EnEV, and thus the KfW program helps achieving the EnEV regulations. However, the EnEV requirements do not have an influence on achievement of the KfW program, as the aim of the KfW program is higher than that of EnEV.

⁴ The National Climate Protection Program expected the EnEV to be passed by fall 2000 and to save about 4 Mt CO₂ emissions by 2005. However, due to a delay in passing the EnEV and weakening the energy standards of EnEV the target could have not been reached (Wagner et al., 2005).

Figure 1 Overall picture of assumed functioning of the instrument: cause-impact relations, indicators, success and failure factors and interactions with other instruments



3 Evaluation

3.1 Familiarity of the program with the target group

The information on the program was disseminated through internet, banks, fairs, newspaper and magazines. Interested were able to gain information through the network of the partners, such as banks and energy agencies. This information was focused on all those who invest in owner-occupied or rental housing (Duve and Daub, 2006). No surveys were held to investigate the familiarity of the program with the target group. However, an indication of how well the public was informed is that e.g. in 1996 the funds were quickly exhausted (Heidrich, January 26, 2006).

3.2 Share of the house-owners that modernize their houses, which apply more energy-efficient measures

No information is available on the share of households that modernize their houses, which applied for a loan within the framework of the KfW program.

3.3 Level of financial support incentives within the programme

CO₂ Reduction Program

This program finances the individual measures. The maximum loan provided is 5 million Euro (and maximum loans for low-energy house is 30.000 and for passive house 50.000 Euro, Kleemann et al., 2003).

CO₂ Building Rehabilitation Program

With this program up to 100 % of the investment costs including ancillary costs (architect, advice on how to save energy, etc.) can be financed. The maximum loan for Packages 0-3 is EUR 250 per m² of floor space (www.kfw.de). For Package 4 the financing is as follows: for CO₂ savings of at least 35 kg per m² of building floor area per year up to a maximum of EUR 200 per m² of living space and, for CO₂ savings of 30 kg or more per m² of building floor area, up to a maximum of EUR 150 per m² of living space. Maximum loan for the measures in the Package 5 is EUR 80 per m² of floor space.

If the modernization brings the building's energy consumption down to the level of a new building as defined by energy regulations (i.e. to the level of so-called low-energy house standard), then 15% (formerly 20%) of the loans from the CO₂ Building Modernization Program can be waived. The waiver is approved upon the results of the energy audit (OPET, 2004).

3.4 Total amount of applications relative to the total budget

The government provided 200 million Euro in order to reduce the interest rates (Wagner et al., 2005). Considering the actual number of applications, the budget could provide 28.4 thousand Euro for reduction of the interest rates per application on average in both programs (Table 5).

Table 5: Approved loans in the period 1996-2004

	Approved Loans (number of applications)	
	CO ₂ Reduction Program	CO ₂ Building Rehabilitation Program
1996	33,525	
1997	18,372	
1998	23,394	
1999	55,617	
2000	18,206	
2001	29,691	9,861
2002	25,537	14,151
2003	31,119	22,069
2004	36,904	24,762
Total	272,365	70,843
Sum of both programs		343,208
Available budget (million €)		9743
Available budget per application (€)		28.39

Source: Based on information provided by Duve and Daub (2006).

3.5 Quality of the applications and number of rejected applications

The principal banks that receive the applications also check them (only in terms of quality of financial data, not the technical aspects). Then the applications are sent to the KfW (Duve and Daub, 2006). The quality of the applications seems to be quite good; only one per cent of the total amount of received applications is rejected (Duve and Daub, 2006). Although the number of the applications from the housing enterprises is much lower than those of the individual households, such low participation of the housing enterprises was expected already in the beginning of the pro-

gram. The quality of the applications from the housing enterprises is not lower than expected either (Duve and Daub, 2006).

3.6 Total amount of loans granted and average loan granted

In the period 1996-2004 the KfW provided via the two programs 9.7 billion of loans. By this 73.1 million m² of dwellings were renovated. In this aspect the program exceeded the expectations (Table 6).

Table 6: Loans provided in the two KfW programs (in million Euro)

	Loans (million Euro)		
	CO ₂ Reduction Program	KfW CO ₂ Building Rehabilitation Program	Total
1996	716		716
1997	436		436
1998	386		386
1999	685		685
2000	564		564
2001	824	508	1332
2002	575	736	1311
2003	675	1332	2007
2004	836	1470	2306
Total	5697	4046	9743

Source: Kleemann and Heckler, 2004.

Average loan per dwelling (household)/ living space

In the period 1996-2004 the CO₂ Reduction Program 1996 provided on average a loan of 100 Euros per m², while the KfW CO₂ Building Rehabilitation Program 2001 provided on average 248 Euro/m² (Table 7). This could be partly explained by the fact, that while the Program 1996 supports only individual measures, the latter Program supports combinations (packages) of measures (insulation and replacement of windows). Thus we can assume that the Program 2001 supported measures, which require larger modernization per household. This is true also for the average loans per dwelling – the latter program provided almost 3 times higher loan per dwelling (20,643 Euro/dwelling) in comparison to the CO₂ Reduction Program 1996 (8,317 Euro/dwelling). *The question is whether the measures of Program 2001 led also to larger CO₂ reductions (per m²) than the renovation measures through the CO₂ Reduction Program.*

Table 7: Average loans provided by the two KfW programs

	CO₂ Reduction Program	CO₂ Building Renovation Program	Both programs
Loans (million €)	5697	4046	9743
Living space renovated (million m ²)	57	16	73
Average loan (€ per m ²)	100	248	133
	weighted average	174	
Number of dwellings renovated (thousands)	685	196	881
Average loan per dwelling (€/application)	8317	20643	11059

Compiled from the data of Kleemann and Heckler (2004) and Kleemann (2005).

On average the two KfW programs provided a loan of 133 Euro/m² and 11,059 Euro/dwelling (calculating through weighted average).

In the period 1996-2004 881.000 houses and apartments were renovated through the two KfW CO₂ programs: 685,000 in the CO₂ Reduction Program and 196,000 in the CO₂ Building Rehabilitation Program.

From the above we see that while the first program supported more dwellings in terms of living space (m²), the latter included more financially demanding renovations.

3.7 Average interest rate compared to market interest rate

On average the interest rates in these programs ranged between about 2 and 4% p.a. depending on the type of program, type of measures and the payback period (see Table 8). In comparison to the market interest rates the KfW provided interest rates about 1,04 -1,98% lower. Recently, the market rates have decreased substantially and currently they are at the historical minimum. This explains why also the interest rates for the KfW loans decreased over time.

Table 8: Interest rates in the KfW programs

	Interest rates (%) p. a.		
	(as of February 2002)	(as of December 2005)	
		Min	Max
CO ₂ Reduction Program (1996)	4.96		
CO ₂ Building Rehabilitation Program (2001)	2.93	1.96*	2.17*
Market Interest Rates		4	6

Sources:

KfW interest rates - Kleemann et al., 2003 and www.kfw.de.

The market rates are the estimates of Carsten Petersdorff, Ecofys Germany.

* The figures reflect rate at payback of 20, and of 30 years respectively.

** Depends on the period for which the loan was provided (the longer, the higher interest rate)

3.8 Quality of the measures (e.g. quality of the insulation)

Most of the KfW modernization programs do not require the quality check of the implemented measures (Duve and Daub, 2006). It is only in case that the homeowners choose packages of such measures, which do not automatically bring a reduction of 40 kg CO₂/m² per year (Packages 4 and 5). (This reduction is a prerequisite for obtaining a 15% waiver on the loan.) Here, an energy audit has to be conducted in order to prove that the measures lead to the reduction of 40 kg CO₂/m² per year.

3.9 Saved amount of energy

As most of the data available on the effects of the two examined KfW programs are expressed in terms of reduction of CO₂ emissions (Table 9), we used assumed conversion factors (Table 10) for the calculation of the gross energy savings. The two examined KfW incentive programs brought in the period 1996-2004 reduction of 2.9 million tons of CO₂ emissions (Table 9).

Table 9: The annual and the total gross CO₂ reductions in the period 1996-2001.

GROSS CO ₂ REDUCTIONS (kt)										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
CO ₂ Reduction Program	102	77	121	168	384	205	355	255	180	1847
CO ₂ Rehabilitation Program						20	75	428	555	1078
										2925

Source: Kleemann and Heckler, 2004.

Table 10: Conversion factors for the various energy sources and the share of the energy sources used for heating of residential buildings in Germany (year 2002).

Energy source	Share (%)	Conversion Factor (Mt CO ₂ /PJ)
Natural gas	47.7	0.056
Residential Fuel Oil	31.8	0.0774
Coal	1.6	0.094
District heating	13.7	0.094 (as coal)
Electricity	4.1	0.075 (average)
Wood	1.0	
Other	0.1	

In the period 1996-2004 the house-owners who applied for the KfW loan for modernization through its two programs saved 45 PJ (Table 10)⁵. This is the gross amount of energy savings claimed by the program, and it includes also the energy savings of those house-owners, who would implement the energy saving modernization measures in absence of the KfW incentive programs (so-called “free riders”).

Table 11: The annual gross energy savings through the two KfW programs and the overall reduction in the period 1996-2004.

Gross energy savings										
PJ	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
CO₂ Reduction Program	1.6	1.2	1.9	2.6	5.9	3.2	5.5	3.9	2.8	28.4
CO₂ Building Rehabilitation Program						0.3	1.2	6.6	8.5	16.6
										45.0

Source: Calculated according to Kleemann et al. (2003).

Note, that the energy savings are calculated here by using a weighted average of the main energy sources used for heating in Germany. The weighted average is calculated by multiplying the total CO₂ emissions reductions (resulting from the two KfW programs) by ratio of the different types of energy sources. This is then divided by the conversion factor for each energy source.

⁵ This includes the CO₂ effects on the production side: the investment effect increases the CO₂ emissions, whereas the crowding-out effect cause reduction of the CO₂ emissions. These effects were calculated by the use of the input-output analysis (Juelich, 2003).

Table 12: Total energy savings and average energy savings per household and m²

	Gross energy savings
Total energy savings (PJ)	45
Average per household (GJ/dwelling)	51.1
Average per m ² of living space (MJ per m ²)	615.6

Building modernization through the two KfW programs in the period 1996-2004 led to total gross energy savings of 45 PJ. On average the individual household saved 51 GJ per dwelling. The savings per unit of living space was on average 616 MJ/m² (Table 12).

3.10 Net impact (net energy savings)

For the purpose of estimating the net impact (i.e. the net energy savings resulting from implementing the incentive program) we have to take into account the energy savings realized by the free-riders. As no information is available on what the usual share of the free-riders on energy savings in the built environment is in Germany, we assume that the share of the free-riders on the energy savings ranges from 30% to 50%. This is an estimate based on the results of the previous studies on energy savings in the built environment that was performed in the Netherlands (Joossen et al, 2004; IER, 1998). The lower range of free-riders indicates that it is not cost-effective to finance the energy saving measures by themselves and thus more people use the incentive programs to gain financing. The higher range implies that the market conditions for implementing the energy efficiency measures are good and thus many house-owners can realize them without the support of the incentive program.

Assuming the range 30-50% of free-riders, the net energy savings ranges from 32 to 23 PJ (Table 13). An average household saved through the two KfW programs 26-36 GJ of energy (Table 14). The programs led to an average energy saving of 308-431 MJ per m².

Table 13: Annual energy reductions through the two KfW programs excluding the energy savings of the free-riders

Net energy savings (PJ)										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Free riders 30%										
CO ₂ Reduction Program	1,1	0,8	1,3	1,8	4,1	2,2	3,8	2,7	1,9	19,9
CO ₂ Rehabilitation Program						0,2	0,8	4,6	6,0	11,6
										31,5
Free-riders 50%										
CO ₂ Reduction Program	0,8	0,6	0,9	1,3	3,0	1,6	2,7	2,0	1,4	14,2
CO ₂ Rehabilitation Program						0,2	0,6	3,3	4,3	8,3
										22,5

Table 14: Total energy savings and average energy savings per household and per square meter.

	Gross energy savings	Net energy savings	
		Free-riders 30%	Free-riders 50%
Total energy savings (PJ)	45	31.5	22.5
Average per household (GJ/dwelling)	51	35.8	25.5
Average per m ² of living space (MJ/m ²)	615.6	430.9	307.8

Note, that the share of the free-riders on implementing of the energy efficiency measures depends on the cost-effectiveness of the program, i.e. the lower the cost of implementing of the measures the higher the share of free-riders.

In terms of CO₂ emissions, the average house-owner reduced 1.7 – 2.3 t CO₂ emissions via the two KfW incentive programs in the same period (Table 15).

Table 15: Total CO₂ reduction and average CO₂ reductions per household (1996-2004).

	Gross CO ₂ reduction	Net CO ₂ reduction	
		Free-riders 30%	Free-riders 50%
Total CO ₂ reduction (Mt)	2.9	2.1	1.5
Average CO ₂ reduction per household/house-owner (t/dwelling)	3.3	2.3	1.7
Average CO ₂ reduction per living space (t/m ²)	40	28	20

Note: we assume that the number of dwellings supported via the KfW programs is equal to the number of households participating in the program.

3.11 Effectiveness

The government expected that the “subsidy program for energy savings in existing buildings including energy audits” (as cited from the National Climate Protection Program 2000) would result in reductions of CO₂ emissions by 5-7 Mt by 2005 compared to 1990 level. In 2004 it was clear that this goal cannot be achieved and it was estimated that the programs would reduce the CO₂ emissions by 2-2.5 Mt by 2005 (Prognos IER, cited in Wagner et al. 2005). As the periods covered by the target (1990-2005) and the current assessment (1996-2004) do not correlate, it is difficult to compare the effectiveness of the program in terms of achieving this target. However, we can state, that the actual gross reductions brought by the two examined KfW programs in the period 1996-2004 were 2.9 Mt, which is approximately half of the NCPP 2000 estimations. (However, the KfW program reached the emission reductions as it was estimated in 2004 Prognos IER.)

The same applies to the achievement of the program in terms of energy savings: 23-32 PJ achieved through the program vs. 74-103 PJ estimated in the NCPP 2000 and 30-37 PJ in the Prognos IER estimate (Table 16).

Table 16: Comparison of the actual CO₂ reductions and energy savings achieved through the KfW programs in the period 1996-2004 with the expected achievements

	CO ₂ (Mt)		Energy savings (PJ)	
	Low	High	Low	High
NCPP 2000 target (1990-2005)	5	7	73.5	102.8
Estimate 2004 Prognos IER (1990-2005)	2	2.5	30	37.4
Actual reductions (1994-2004)	1.5	2.1	22.5	31.5

3.12 Cost efficiency

The cost-efficiency of the KfW incentive program is calculated as a ratio between the annual costs of the program and the amount of total energy saved during the examined period. The cost-efficiency is shown from three perspectives: society, government, end-users.

Energy prices

For calculation of the savings on energy costs we use the weighted average price for all major energy sources used for heating in Germany. For society we apply the energy price, which excludes taxes (Table 17).

Table 17: Shadow energy price for society and for end-user

	Share on heating		Price for end-user (Euro/GJ)	Price for society
Natural gas	0.477		6,22	2,72
Residential Fuel Oil	0.318		2,54	2,04
Coal	0.016		0,02	0,02
District heating	0.137	As coal	0,17	0,21
Other total	0.052	Average	0,39	0,24
Electricity	0.041			
Wood	0.01			
Other	0.001			
Weighted average energy price			9,33	5,23

Note: We assume that the district heating in Germany is mainly powered by coal. For the price for “Other total” is used the average of the prices of natural gas, oil and coal.

Capital costs

The capital costs of the program are the investments in modernizing all the buildings and apartments. These are split into the costs for insulation (insulation of external walls, roof and cellar), which are depreciated over a period of 25 years and installations (replacement of windows, boilers, installation of PV, heat pumps etc), which are depreciated over period of 10 years. From this amount we subtract the costs of the energy saved.

For calculation of the cost-effectiveness we have to distinguish the reference costs and the additional costs, which together make up the total capital costs. The reference costs mean those expenditures on the energy saving measures, which would occur also in the absence of the incentive program. The additional costs are then the expenditures on e.g. a more expensive energy saving material (the households can afford them only due to the loans provided by the KfW).

For calculation of the cost-efficiency we take only the depreciated (annual) additional costs, from which we subtract the financial savings due to energy saved. This is the total annual cost of the measures. Finally, this sum is then divided by the total gross energy savings (PJ) brought by the two CO₂ programs during the whole examined period.

Table 18: Investments into insulation and installation and the resulting gross energy savings (used for both society and end-users)

	Investment (mil. Euro)		
	Insulation	Installation	Total
CO ₂ Reduction Program	2467	3230	5697
CO ₂ Building Rehabilitation	2162	1884	4046
Total investment	4628	5115	9743

Reference	0	4092	
Additional costs which is paid for the EE measures	4628	1023	5651
Total investments	4628	5115	9743

Gross Energy Savings (PJ)			
CO ₂ Reduction Program	12.3	9.4	28.4
CO ₂ Building Rehabilitation	15.2	7.7	16.6
Total energy savings	27.5	17.1	45

Note: The shares on the investments are based on data in the period 1996-2001, Kleemann et al. (2003).

3.13 Society

The cost efficiency for the society is 4 Euro per every GJ saved. The Table 20 shows the cost-efficiency for the different measures.

Table 19: Calculation of the cost-efficiency for the society

	Insulation	Installations	Total
Annual cost (million euro)	€ 296.3	€ 126	€ 422.4
Annual financial savings on energy bill			
CO2 Reduction Program	64.4	49.2	
CO2 Building Rehabilitation	79.4	40.4	
Total financial savings (million Euro)	143.8	89.6	
Cost efficiency for society (Euro/GJ)	€ 6	€ 2	€ 4

3.14 Government

In the period 1996-2004 the government provided through KfW 9.7 billion Euro. The cost for providing loans with reduced interest rates was 101-193 million Euro per year. This investment brought a net reduction of 1.5-2 Mt CO₂ emissions. The costs for the government are the subsidies provided to the KfW bank to reduce the interest rate below the level of the market interest rate. In other words, the difference between the reduced interest rate and the market interest rate is the lost opportunity for the government (the government could invest in other programs with higher interest rates etc.), and thus the cost.

Table 20: Cost-efficiency for the government

Loans total 1996-2004 (mil.€)	9743
-------------------------------	------

	Interest rates	
	Low	High
Average interest rates in the program	2.02	4.96
Market interest rate (%)	4	6
Difference between KfW and market interest rate	1.98	1.04
Annual investment (mil.€)	192.9	101.3

Cost-efficiency of energy savings for government (€/GJ)	Low	High
	Free-riders 30%	6
Free-riders 50%	9	5

3.15 End-user

The capital cost of the program for the end-user are the additional investments into modernizing of all the buildings and apartments (alike capital costs for society). These costs are depreciated according to the type of the measure (insulation or installation) against the interest rate of 8%. As a result we get the annual investment costs. We assume that around 70% of all the applicants to the CO₂ Building Program obtained a debt relief of 15% of the payable loan. To take this into account we calculate the average annual investment cost per household. From this sum we subtract the financial savings from the energy saved. For this calculation we use the weighted average energy price with taxes (Table 17). Finally, the result is divided by total net energy savings.

The cost efficiency for the end-user is between 1,4 and 4 Euros per GJ of energy saved depending on consideration of the debt relief.

Table 21: Calculating cost-efficiency for the end-user

	Insulation	Installations	Total
Depreciated cost/annual (mil. Euro)	€ 433.58	€ 152.45	€ 586.03

Annual financial savings on energy bill			
Program 96	114.8	87.8	
Program 01	141.7	72.1	
Total financial savings (mil. Euro)	257	160	416

Total annual capital cost	177	-7	170
Cost efficiency for end-user without debt relief (€/GJ)	6	0	4

Debt relief of CO2 Building Rehabilitation Program			-106.4
			63.3
Cost efficiency with debt relief (€/GJ)			1.4

4 Conclusions

4.1 Net impact, effectiveness and cost efficiency

Net impact

The total energy savings (gross impact) in the period 1996-2004 account for 39.5 PJ. The net impact is 21.7 PJ energy saved. This corresponds to 2,9 Mt CO₂ and the net impact to 1,5-2,1 Mt CO₂ reductions. These numbers are much lower than the reductions expected by the National Climate Protection Plan from 2000 – 5-7 Mt CO₂ for the period 1990-2005. However, they are close to the estimate of Prognosis IRE, 2-2.5 Mt CO₂. Note, that the periods of the target and this study are not comparable.

The program is seen very positively by the policy makers. The amount of applications was higher than expected and the provided governmental funds to lower the interest rates were fully exhausted. The KfW program was also successful in driving the public attention towards modernizing with using more energy efficient measures. The instrument contributed to the change of the market, as the energy measures were used more often along with the standard reconstruction measures by buildings renovation (Heidrich, January 26, 2006).

Cost efficiency

The cost efficiency is lowest for the end-user (1 Euro/GJ) through 4 Euro/GJ for the society and 3-9 Euro/GJ government (for low interest rates and high share of free riders, and 9 Euro/GJ for high interest rates and low share of free riders).

Table 22: Comparison of the cost efficiency for society, government and end-user

	Society	End-user	Government	
			Low interest rates and 50% free riders	High interest rates and 30% free riders
Cost-efficiency for energy savings	4	1	3	9

4.2 Success factors

One of the main success factors is a well targeted information dissemination together with the reduced interest rates, which attracted more people than expected. Large variety of modules of the KfW programs and possibility to combine the loans from several modules (e.g. CO₂ Reduction program with House ownership program or Ecological Building Program) allowed for covering most of the costs by cheap loans. Moreover, implementation at the level of the federal KfW bank enabled transparent administration.

4.3 Fail factors

The people interviewed did not mention any particular problems. Only 1% of the applications was rejected, which is not significant considering the total amount of applications (They might have been rejected on financial or technical grounds).

Because of the scale of the program at the beginning, it has focused only on residential buildings. The potential for energy savings is still in such buildings as churches, nursing homes, dormitories, residential homes for elderly and other residential buildings. Therefore these can be considered as missed opportunities, which should be covered by similar program in the future.

4.4 Monitoring and evaluation

KfW is providing statistics on amount of loans provided every year both in terms of accepted applications and the volume of the provided loans. Research centre Jülich is monitoring and analysing the realized energy savings and related CO₂ emissions reduced in the households who applied the programs' measures (for this activities is responsible Mr Kleemann). The data is sufficient for assessment of the instrument in the period 1996-2004 (but not for the comparison with the target set in the National Climate Protection Program 2000).

The program was evaluated by Kleemann (et al.) in 2003 for the years 1996-2001. There was some evaluation also in 2004 (Kleemann and Heckler) and 2005 (Kleemann and Hansen), but not in the extent as the previous one (not including analysis of CO₂ emission reductions and cost-efficiency for modernization measures). The study of 2005 is an ex-ante analysis of the CO₂ reduction measures in the built environment (including KfW soft loans program) planned for implementation in the upcoming years.

4.5 Learning experiences

The main lesson is that such programs should start with a small focus, with few demonstration projects, from which the packages of economic measures should be identified. If this is successful then the program can be expanded further.

Further, based on the experience during the implementation of the KfW program, it is recommended to create a goal based on such indicator as CO₂ reduction per m². The Building Rehabilitation Program (2001-2006) conditioned receiving of the financial support by achieving 40 kg CO₂/m². However, the policy makers responsible for KfW program learned, that this target can be achieved by more or less effective measures depending on the state and age of the building. In other words, while the requirement can be currently achieved in one house by the best available techniques, in another house this can be done by simple measures, but without a long-lasting effect. (The indicator of reduced CO₂/m² is an indicator of improvement and not of a standard, which would bring the savings every year.) Thus, this requirement can lead to sub-optimal measures, which will necessitate further retrofication in near future (Heidrich, April 19, 2006). Instead, the incentives should cover either specific separate measures, or should be based on the requirement of energy demand of new building.

Mr Heidrich from the Federal Ministry for Transport, Construction and Housing Affairs (BMVBW) recommends that the support for energy savings (and CO₂ reduction) should be developed and implemented in two parallel paths: a. support in form of single measures (replacement of windows, retrofication of roof, cellar, replacement of boilers); and b. complex retrofication regulations with a goal of bringing the energy demand of the existing building to the level of new buildings (just like the EnEV in Germany, as well as the overall EU Energy Performance of Buildings Directive) (Heidrich, April 19, 2006). Such arrangement would motivate both owners of the apartments as well as the owners of the residential buildings to retrofit.

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Questionnaire from Peter Daub and Dr. Thomas Duve. KfW Bank. February 2006.

Annex

Table A1: KfW Supportive measures for energy saving in existing and new building

Program	Period	Measures	Description of measures	Type of support / Conditions	Focus/ exemptions
KfW- CO₂ Reduction Program	January 1996-2005	Individual measures	<ul style="list-style-type: none"> Improvement of the heating features in the existing buildings Introducing RES in new and existing buildings Construction and purchase of KfW Energy-saving houses 40 and 60 and Passive houses. 		Originally aimed only for the new Laender only, later extended to whole Germany
KfW-CO₂-Building Rehabilitation Program	January 2001	Packages of measures	For buildings built before 1979. <ul style="list-style-type: none"> Package 1 Package 2 Package 3 Measures 0-3 are assumed to reduce CO ₂ emissions by min. 40kg/m ² of living space per year. <ul style="list-style-type: none"> Package 4 – combination of measures except 1-3 Package 5 	Loans	Target area: whole Germany.
KfW Housing Modernization Program 2003	2003 (most probably follow-up of the KfW-CO ₂ -Building Rehabilitation Program)	Packages of measures	<ul style="list-style-type: none"> Modernization & rehabilitation (whole DE) Demolition of empty residential rental build. In Eastern DE + Eastern Berlin Introduction of the debt relief of 20% of the loan, later reduced to 15%. 	Loans Condition for obtaining the debt relief: minimum of 40 kg CO ₂ reduced per m ² per year of living space*	Whole Germany
“Solar Power Generation”	1.1.2005	Individual		Small loans < 50.000 Euro**	Communities excluded
“Ecologic Building”	1.1.2005	Individual	<ul style="list-style-type: none"> Construction of KfW low-energy houses 40 and 60 and passive houses Installation of heating systems based on RES*** 	Loans	
KfW Ownership Program	2003	Individual	Purchase or construction of fully owned house or apartment		
“Building Modernization”	1.1.2005	Individual or mix	<ul style="list-style-type: none"> Standard modernization measures - Standard measures Climate protection measures - ÖKO-Plus measures 	Loans Standard measures: Basic financing scheme ÖKO-Plus measures : particularly low interest rates	

Source: www.kfw.de as of 9 December 2005.

* If the reduction is just slightly smaller (35-30 kg CO₂), loan might be provided, but lower.

** Bigger loans co-financed from other sources from the ERP-Environment and Energy Saving Program and the KfW-Environment program

*** From 2001-? The construction of low-energy and passive houses was financed by KfW CO₂ Building saturation program.