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Financing Energy Efficiency in the Residential
Sector – Lessons Learnt from Germany and
Emerging Economies

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Preface

According to the International Energy Agency (IEA), the residential sector accounts for about a quarter of the global energy consumption – primarily for heating and cooling. With rapid urbanisation and rising incomes, an increasing share of energy for residential purposes is being consumed in emerging economies. Therefore reducing energy consumption in the residential sector – with an increasing focus on emerging economies – is a key to mitigate climate change effectively.

Over the past years, KfW Development Bank – together with its local partner banks – has piloted financing programmes that provide low interest loans for energy efficient construction of residential buildings in several emerging economies. The EcoCasa programme in Mexico implemented by SHF (Sociedad Hipotecaria Federal) and the pilot programme with NHB (National Housing Bank) in India are the most prominent examples.

When designing these approaches, KfW was able to draw from its comprehensive experience in its home market in Germany, where it acts as the German government's promotional bank with a strong focus on energy efficiency in buildings. These domestic programmes have developed into a comprehensive promotional system that forms a key element of the German government's energy and climate policy.

The paper published in this document is a first attempt to analyse which conclusions and success factors of the German programmes can be relevant for emerging economies and to relate the German experiences to first pilot experiences from Mexico, India and Chile. The resulting recommendations should also be valuable for developing new approaches in other developing economies.

Energy efficiency measures are technically available and in many cases also financially viable. However, the incremental costs of such measures compared to less energy efficient solutions are a barrier to their widespread application. The author analyses how financial incentives can be effectively used to reduce these barriers. Providing financial incentives linked to mortgage loans to individual homeowners (like in Germany) or to loans to real estate developers (like in Mexico) can influence investment decisions in favour of energy efficiency. Experiences from these countries show that a well-designed financing programme can even introduce new more efficient market standards.

The study also demonstrates that public financing programmes can have a substantial leverage effect, mobilising substantial private capital for energy efficiency. It also shows that loan-based programmes can be an effective way to establish improved building standards. Nevertheless, one key message is that a consistent system where regulatory requirements and financial incentives interact has proven to be the most effective approach.

The study also gives “hands on” recommendations on how to manage the complex technical dimensions of a promotional programme. Such a programme has to define technical promotional criteria for eligibility to be evidenced on a case-by-case basis for individual investments. These technical challenges can be managed by capacity development, a dedicated software tool and a quality assurance system.

The author of the study, Dr Rudolf Hennes, is a senior engineer and retired KfW staff member who has played an active role in designing the bank's promotional programmes both in Germany and for emerging economies. He is thus in a unique position to draw overarching “lessons learnt”.

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Introduction

Traditionally, Germany has been playing a leading role in Europe in developing and implementing energy efficiency standards for buildings. Many important innovative components of energy efficient buildings have emerged from Germany, like condensing burners, heat recovering ventilation systems, 3-pane windows or phase-changing materials for walls. Furthermore, innovative building concepts like the “Passivhaus” or the “Effizienzhaus40 Plus”¹ have been developed here and have been successfully introduced into the markets, not only in Germany and Europe. In fact, various developments have made it possible that a building standard is being applied widely in Germany already for a couple of years that can be considered to be in line with the future nearly zero emission requirement of the EU. The technical developments are a precondition for implementing the ambitious political agenda on energy efficiency, like the EU Energy Performance of Buildings Directive and the resulting national building standards.

There are, of course, many factors that have contributed to the successful introduction of new building standards. Research and development of new technical solutions, materials and concepts are key factors. However, to establish new technologies in the market requires more, namely a comprehensive concept for market introduction and market stimulation. One very important element of market introduction and stimulation is an appropriate set of financial instruments and promotional incentives. Already since the end of the 1990s KfW Group², a public bank owned by the Federal Government and the Federal States, is providing low-interest loans and grants for energy efficient buildings in Germany, with a strong focus on the housing sector. Other KfW financing programmes focus on municipal buildings, energy efficiency in small and medium enterprises or urban district energy concepts. Until today, KfW Group has developed a wide spectrum of promotional products to stimulate different decision makers, investors and stakeholders to apply higher energy efficiency standards in Germany going beyond the regulatory requirements.

A few years ago, KfW also started to support emerging economies to establish financing schemes for energy efficient residential housing – primarily in the context of climate finance. These activities are implemented by KfW Development Bank. In this process, KfW Development Bank has drawn on the Banks’ domestic expertise.

¹ “Passivhaus” or “Passive House” is a private sector label owned by the Passivhaus-Institut (further information under www.passiv.de). “Effizienzhaus” is a branded label by the German Federal Ministry for Economic Affairs and Energy, KfW and dena (the German Energy Agency) (see also <https://www.dena.de/en/topics-projects/energy-efficiency/buildings/>). “Effizienzhaus-Plus” is an energy efficient building, which generates more energy on annual basis than it consumes (https://www.kfw.de/KfW-Group/Newsroom/Aktuelles/Pressemitteilungen/Pressemitteilungen-Details_344640.htm). ; further information also under <https://www.forschungsinitiative.de/effizienzhaus-plus/>).

² For more information about KfW Group see: <https://www.kfw.de/KfW-Group/About-KfW/>

Objectives of the Paper

This paper aims at summarising the present state of experiences in designing and managing promotional programmes for financing energy efficient investments in the residential sector offered by KfW. It assesses the German scheme and analyses which of the experiences might be of general interest and could be relevant for other countries, in particular for emerging economies.

Because the respective programmes of KfW Development Bank are still ongoing, this paper is an early analysis. The paper does not replace a comprehensive assessment by scientists and evaluation experts. This assessment will be due, once the lending programmes have been completed. Against the background of growing interest in building energy efficiency all over the world such an early analysis, including lessons learnt, is worth the effort.

This study concentrates on newly constructed buildings, although KfW's domestic lending comprises both retrofit and new buildings. Although the retrofit programme will be analysed as well, the main focus lies on new buildings, since they are more relevant for most developing and emerging economies (see below). The paper confines also itself to residential buildings. Other buildings, in particular public and commercial buildings, are not dealt with. The overwhelming share of all buildings is residential. Since the living space for humans and the corresponding energy use are quite homogenous in comparison to non-residential buildings, they are more appropriate for standard financing schemes.

The paper starts with describing the German programme „Energieeffizient Bauen und Sanieren“ – „Energy Efficient Construction and Refurbishment“. Examples from three emerging countries (India, Mexico and Chile) follow, where KfW Development Bank has been involved in establishing loan schemes for new residential houses. Thereafter, all presented programmes and examples will be discussed and combined with conclusions. The latter may be useful in developing lending programmes for energy-efficient dwellings in other emerging economies.

The statements and the conclusions represent the opinion of the author and not of KfW.

The author is grateful to all persons who have provided information or reviewed an earlier draft of the paper, in particular Almut Ahlers, Bettina Dorendorf, Peter Hilliges, Corinna Peters, Dirk Markfort and Daniel Römer. My special thanks go to Christian Calov who had the idea for this paper and is responsible for the fact that the process to draft and edit this paper could be brought to a successful close.

KfW's German Programme for Energy Efficient Housing

KfW has been providing concessional low-interest loans for housing for decades. After German reunification KfW established a lending programme to upgrade the building stock in East Germany. It demonstrated that loan programmes can both improve living conditions and at the same time boost the economy by generating business opportunities and employment in the building sector.

Since 1990 KfW is offering loan programmes specifically for energy efficient homes. Over the years, the KfW programmes have become a central element of the German Government's climate strategy - from the first "National Climate Protection Programme" of the year 2000 to the "Climate Protection Plan 2050" launched in 2016.

When developing the programmes, the building sector, particularly the residential sector, was considered prime for CO₂ mitigation as it contributes to about one third of primary energy consumption in Germany. Another reason was that technical solutions to substantially reduce CO₂ emissions in buildings were available. Furthermore, several other benefits were expected from this approach, such as better living conditions, higher indoor comfort, employment generation and reduced fuel imports (see below and also [4]).

KfW is mandated for implementing promotional programmes by the respective federal ministries for energy, housing and environment, and the programmes are in general financially supported by the federal budget. KfW's activities in this field have become a substantial part of the German "policy mix" for promoting energy efficiency in the building sector³. Over time, the mandatory requirements of the Energy Saving Ordinance ("EnEV") (see Box 1) and KfW's promotional system developed into a coherent system in terms of performance standards and technical requirements.

Other forms of government support to home owners and subsidies also exist. They all complement the mandatory requirements for new buildings as defined in the Energy Saving Ordinance by informing the public and raising awareness for the issue:

- a) There is a comprehensive system of support for scientific research and applied technology development including piloting schemes. Various federal ministries established research funding schemes.
- b) The German Energy Agency "dena" and the German Customer Organisations⁴ are mandated by the Ministry of Economic Affairs and Energy to raise general awareness of energy efficiency and to offer advisory services for individuals and companies. Dena established model buildings and is managing a data base of qualified energy auditors (see below).

³ An overview of KfW programs in English can be found in [2]

⁴ <http://en.vzbv.de/>

- c) There is also a promotional grant system for innovative and climate friendly technologies by the Federal Office for Economic Affairs and Export Control, called “BAFA⁵” (according to its German abbreviation) under the Ministry of Economic Affairs and Energy.

Principle of Lending Programmes

KfW’s concessional lending is not direct, but rather based on the on-lending principle. This means that intermediary financial institutions (mostly commercial or public banks) on-lend KfW funds to their final customers. They do so according to KfW criteria which are established in consultation with the respective federal ministries. As an apex institution KfW is only refinancing loans issued by local retail banks. To avoid competition with the retail banks, KfW is not allowed to issue loans directly to final customers. The on-lending banks assess the creditworthiness of the customer and the viability of the investment. The credit risk remains with the on-lending bank. As a compensation for the risks and costs, the bank receives a fixed margin of the interest (Fig. 1).

The decision whether a loan application meets the promotional criteria rests with KfW. Generally, KfW requests the application to be fielded before starting the measures. KfW requests evidence that the envisaged measures correspond with the promotional criteria both at the time of application as well as after completion. The respective documents have to be issued by eligible energy auditors and they have to comply with KfW’s quality criteria.

Box 1: The German Energy Saving Ordinance (“EnEV”)

The Energieeinsparverordnung (or EnEV in its German abbreviation) defines energy efficiency standards for residential and non-residential buildings by calculating the energy demands for a whole building as baseline for building permits and for major renovations.

The performance standard is based on the reference building concept.

The reference building is a virtual “twin” of the real building having the same geometry, orientation and usage. However, the energetic relevant parts of the building such as thermal insulation of the building envelope, the heating and ventilation system are predefined and correspond to a technically good, but financial feasible standard.

The real building to be assessed should have the same or a better energetic performance (same or lesser energy demand) than its virtual twin. However, it is up to the designer to decide, by which building parts the objective will be achieved.

The energy demand is a theoretical value. It describes the characteristic of a building without considering the individual difference in the energy consumption of the occupants.

The EnEV also regulates the calculation method for the energy demand of buildings based on an asset rating, the energy performance certificate and who is eligible to issue such an energy performance certificate.

KfW's main source of refinance is the capital market. Being a public bank with a warranty by the German Government, its rating and corresponding refinancing conditions are excellent.

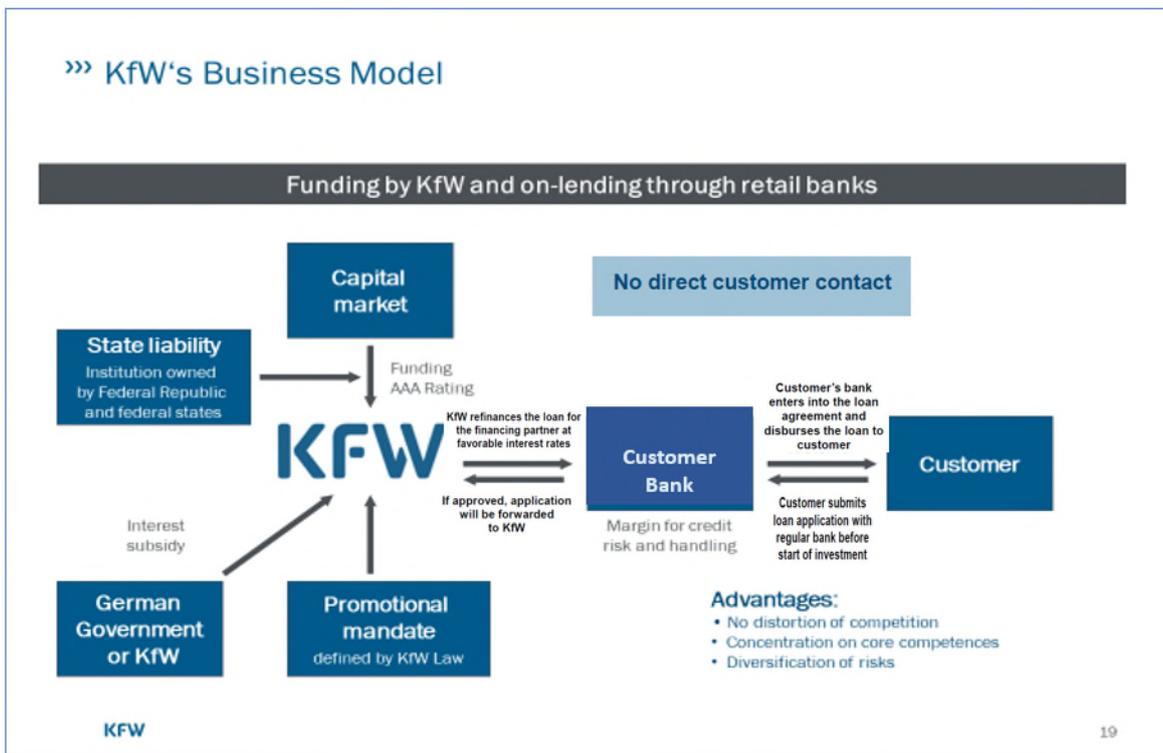


Fig. 1: KfW business model (source: author based on various presentation of KfW 2013-2018).

Under the law governing KfW [10], the German Government can mandate KfW to give out concessional loans with even better conditions than under capital market refinancing. Funds from the federal budget are being used e.g. to subsidise interest rates, for partial debt relief or are even given out as grants under conditions agreed upon with the Federal Government.

The promotional conditions (interest rates, scope of partial debt relief) are adjusted from time to time depending on a variety of factors (general interest rate development, availability of funds from the federal budget, market demand for promotional products).

Structure of the Programme

The KfW products for energy efficient construction and refurbishment cover a wide range of products including concessional loans, grants and partial debt relief.

The eligibility for financing is based on objective and transparent promotional criteria. They must be precise to avoid the misuse of funds. At the same time, they have to be concise and comprehensible, so that the final customer understands what documents he has to provide. As some criteria are technical, based on regulatory requirements or corresponding DIN standards, it is challenging to define the obligations in a practical way. KfW solved the issue by defining levels for building standards, described by the "Effizienzhaus" label.

For new buildings several promotional levels have been introduced (at present three: Effizienzhaus55, Effizienzhaus40 and Effizienzhaus40-Plus). The least challenging level (Effizienzhaus55) requires that the legally permissible primary energy demand of a building compliant with the Energy Saving Ordinance is being

undercut by at least 20 percent⁶. The top level, the Effizienzhaus40-Plus, is generating more primary energy by means of renewables (mostly photovoltaic) than it requires for the conditioning of the building and for hot water for sanitary purposes.

On request of the applicant and after approval of the on-lending bank, KfW is granting a loan up to a certain amount per newly constructed dwelling (at present up to EUR 100,000, previously EUR 50,000). The interest rate for all levels is almost identical; however, the programme is rewarding the achievement of the two higher levels by so-called step-up bonuses (see Fig. 2). These are partial debt reliefs of the loan amount once the building has been completed and once it has been certified that it is complying with the criteria for the respective level. Considering the low interest rates of the German housing finance market that have been prevailing for quite some time, the partial debt relief is the main promotional incentive. It is staggered according to the achieved promotional level (see Fig. 2).

»» Promotional programs for residential buildings – Set-up Energy-efficient Construction

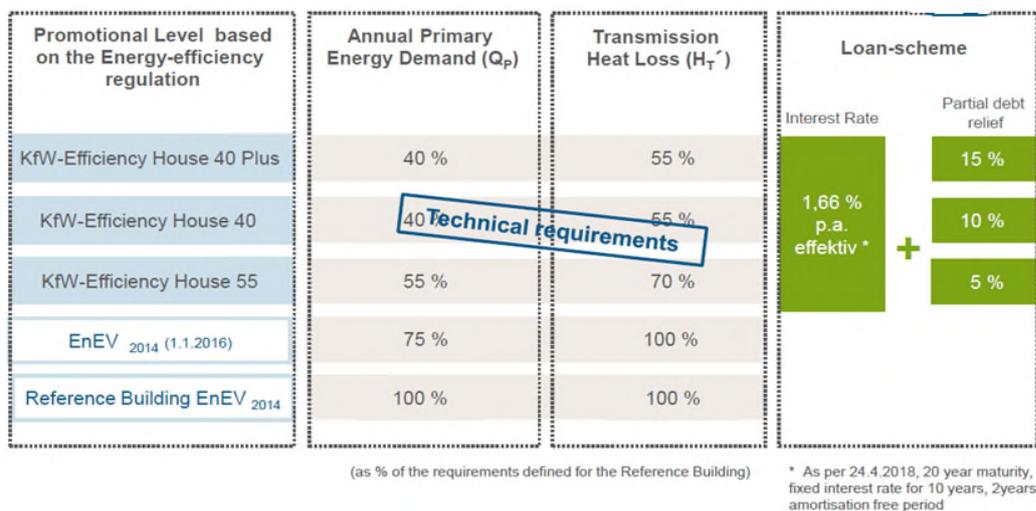


Fig. 2: Structural set-up of the KfW programmes for energy efficient new buildings as of April 2018 [11].

Whether or not a building is fulfilling the promotional criteria is checked by an energy calculation using “asset rating”⁷. This is in line with the modalities of the calculation for the building permit. However, the requirements of the KfW programme are stricter regarding primary energy consumption and heat losses through the building envelop (peripheral surface) of the building. For the asset rating calculation several commercial software tools are available, covering the requirements both for the building code and the promotional programmes. Involving a qualified energy auditor during the design and application process is mandatory. The auditor has to certify that the calculation is correct and in line with the building design. Once the works have been completed, the auditor also certifies that it has been done in a way that the promotional level is reached.

⁶ According to the Energy Saving Ordinance (see Box 1) the reference building as defined in 2006 had a primary energy demand of 100 percent. In 2016 the requirements of the Energy Saving Ordinance were tightened by leaving the reference building unchanged and defining the requirements by the ordinance as 75 percent of the reference building. As this requirement was very close to the then first promotional level for new houses of 70 percent, the entry level had been shifted to 55 percent in 2016.

⁷ The calculation of the energy demand of a building using asset rating is a mathematical approach by which the theoretical energy consumption of a building is calculated based on the actual physical layout of the building, but under standard weather and usage parameters.

A similar approach is in place for the comprehensive retrofit of buildings. It also focusses on an entire building but here single measures are being supported as well – like the insulation of walls, efficient windows or ventilation systems with heat recovery. This allows retrofitting a building step by step, as the economic effects of energy saving measures are higher if the works can be combined with due maintenance works.

For retrofit of buildings, the interest rate of the concessional loans and the step-up bonus are even more attractive than for new buildings. This reflects the fact that the specific costs of retrofit activities are higher than the incremental costs in new constructions. The maximum step-up bonus for retrofit to the highest energy efficiency category (“KfW-55”) currently amounts to 27.5% of the loan amount.

To meet the particular demand of certain groups of customers (owner of family homes, home owner associations) pure grants can also be issued for retrofit as an alternative to concessional loans. Additionally, grants are available for the cost of advisory services by energy auditors when preparing and implementing a refurbishment project. These funds are also available to pay for the costs associated with the mandatory involvement of an energy expert during the process of application for a promotional loan or grant.

Programme management

The implementation and operation of such a comprehensive programme family requires specific tasks:

- a) **Programme development**
Defining appropriate Effizienzhaus-levels and promotional criteria requires technical expertise. KfW uses a pool of building experts who provide the necessary in-house expertise. They give guidance for eligibility criteria and provide counselling on technical issues. The experts keep up with the latest developments in the field.
- b) **Liaison with the Government**
The KfW programmes play an important part in Germany’s energy and climate policy. The German Federal Government provides funds to finance the promotional elements (interest rate subsidy, partial debt relief and grants). The Government is also the regulator for the building sector. Correspondingly, there are many interactions between the ministries and KfW in terms of development, management and evaluation of the programme.
- c) **Liaison with on-lending banks**
The on-lending banks, taking the credit risk of the final customers, should well understand the programme conditions, including the technical aspects. In order to be able to adjust their systems and information materials they have to be informed timely on any changes. KfW has appointed special liaison officers for the partner banks. They are offering regular training on relevant issues for staff of the on-lending banks. This is supported by other communication channels like the KfW Academy and web-services.
- d) **Information provided to the final clients and their business partners**
The promotional products serve a broad spectrum of different customer groups. The final client can for example be an individual, who applies for a loan to upgrade his single-family home, a home owner association interested in replacement of a heating system or a housing company developing a housing estate with several hundred units. Irrespective of the

client, he or she is the one who is responsible for meeting the programme conditions by accepting the loan. This requires that the owner understands the relevant conditions. For complex retrofit tasks or for new construction, the owner might use the advisory services of an energy auditor (see below). For many technical conditions he or she can transfer the responsibility to the contractors/suppliers; e.g. he or she can specify in the contract that the building must comply with the requirements of an Effizienzhaus⁴⁰.

This implies that KfW provides all relevant information to the clients directly, via the web or via the on-lending banks. Respective means are:

- Programme leaflets including technical attachments describing the programme conditions.
- A call centre, responding to inquiries of any sort, supported by a second level support system of financial and technical experts.
- KfW Academy providing training for experts (architects, energy auditors, contractors, etc.), multipliers like consumer advisory offices or municipalities and stakeholders (e.g. professional or lobby organisation and real estate managers).
- Media outlets like press services, TV spots and an annual “KfW Award” for individual energy efficient buildings with outstanding features.
- All information is available on the web, including software tools to calculate the financial benefits of KfW loans. It is important to generally promote the programmes and to inform about programme modifications.

To ease the process – to allow for early indication of compliance with the promotional criteria and to reduce loan processing time – the application is fully IT-based. It can be submitted online (e.g. for grants there is a dedicated online-portal on KfW's webpage⁸). The whole due-diligence process is highly computerized. This way, the customer also receives information if his or her application is complete and in line with the promotional criteria. The loan department is using various software tools so that it only takes a few working days until the result of the appraisal is sent out.

e) Quality assurance

As standardisation of works in the building sector is possible only to a limited degree and as many parties are involved (architects, engineers, auditors, contractors, subcontractors, suppliers), deviations from the original concepts are the rule. To ensure that the works are really compliant with the selected energetic standard – meaning the intended energetic level has been reached and the conditions under which a concessional loan has been granted are met – KfW established a comprehensive quality assurance (QA) system.

The energy auditors play a key role in the QA process. Their core function is to advise the applicant on the most appropriate and economic option to achieve the energy efficiency targets. A registered qualified auditor has to certify that the energy efficiency measures as described in the application are sufficient to achieve the intended Effizienzhaus-level. That is mandatory not only at the design stage, but also later after completing the building. The judgement is based on site visits. KfW defined the necessary qualifications of the auditors together with the relevant federal ministries

⁸ www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/Zuschussportal/

and other stakeholders. Only when they fulfil the criteria they may be listed as Energy Efficiency Expert and are eligible as auditors. In addition, the experts have to undergo regular retraining and submit exemplary project calculations for review to the institution in charge of operating the energy efficiency expert list - currently this is the German Energy Agency ("dena"), the institution in charge of managing the data base.

KfW developed an online tool to conduct a plausibility check of the auditor's calculation before formally submitting an application.

KfW is also running an ex-post control system by reviewing the documentation of completed measures, including sample site visits. If the ex-post review concluded that a project was non-compliant the loan would have to be redeemed by the customer or the promotional conditions would be adapted (i.e. the scope of the step-up bonus would have to be changed).

The experiences of the QA measures are fed back into the training process. The training curricula for the listed experts are revised regularly to reflect identified shortcomings.

f) Monitoring and evaluation

KfW is regularly producing standardised reports, in parts available on the KfW website, to inform external stakeholders on its promotional activities.

A key activity is the measuring of programme results and impacts. There are two different sets of data:

Data emerging from the loan applications and KfW's management system, for example:

- Number of applications and financial volume of committed loans/grants by type of measures.
- Number of buildings and flats covered by the programme.
- Distribution by region or type of owner (individual, company, etc.).
- Intended and achieved energy efficiency level and theoretical CO₂ savings.
- Total investment in buildings and flats being supported under the programmes.

Data requiring special approaches to be collected, for example:

- Actual Energy savings
- Actual CO₂ savings
- Effects on the labour market
- Effects on federal budget (social security contributions, tax revenues, etc.)

The second data group contains relevant indicators of the programmes' impacts. To collect these data, KfW and the ministries are periodically contracting external research institutes. These apply macro-economic models which are sometimes calibrated by sampling data in dedicated surveys.

Results and Impacts

Between 2005 and 2017 energy efficiency measures in some 5 million dwellings representing 12 percent of approximately 40 million dwellings in Germany have been financed with the support of KfW's promotional programmes (based on data published on KfW homepage [12]). Between 2010 and 2017 KfW has committed between EUR 6.5 and 15.5 billion p.a. in the form of concessional loans and grants for the Energy Efficient Construction and Refurbishment Programme (Fig. 3) (Source: data from various KfW reports on its promotional activities ("Förderreports") [14]).

As KfW is financing the construction or retrofit only up to a maximum amount per dwelling, the total investments in construction/modernisation are about three times higher than the KfW commitments.

The Government is receiving substantial return flows from the construction/retrofit. The Value Added Tax (VAT) alone, based on the present rate of 19 percent, exceeds the budget contribution to the KfW programmes⁹. Including indirect taxes and effects on the public budgets by social contributions and reduced costs for unemployment, an external evaluation estimated that the Government is receiving around 4 Euro for every Euro it spent from the budget for the "Energy Efficient Construction and Retrofit" Programme [7].¹⁰

The additional annual savings of CO₂, which will be generated over the lifetime of the respective buildings by commitments of one year are in the range of 700,000 tons p.a. (Fig.3) [5]. This corresponds to 0.33 percent p.a. of the total CO₂ emission of the German building stock (incl. non-residential) of 208 million tons in 2015 [4].¹¹ Furthermore, investments in energy efficient buildings are long-lasting (30 years and more). Hence, the carbon savings of the programme since 2006 accumulate to more than 9 million tons p.a. [7]. Overall, improving the building standard through the KfW Programme is contributing significantly to the national CO₂ mitigation targets.

⁹ Calculations by the author based on [7]

¹⁰ These effects of the program have been evaluated again in 2018, but the results of the evaluation were not publicly available at the time of completion of this study.

¹¹ Energieeffizienz in Zahlen http://www.bmwi.de/Redaktion/DE/Publikationen/Energie/energieeffizienz-in-zahlen.pdf?__blob=publicationFile&v=10

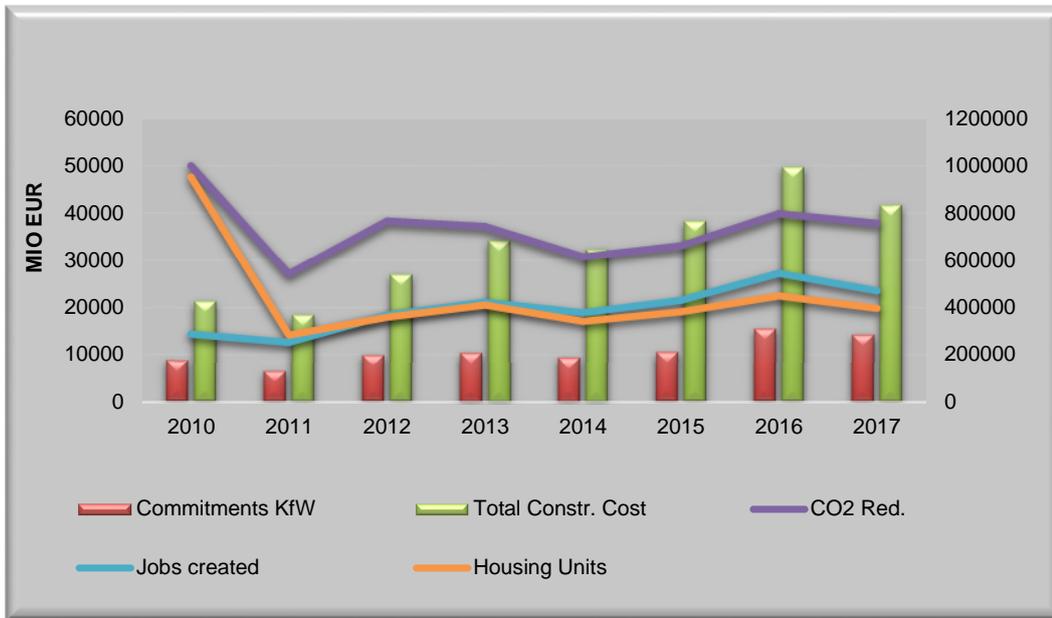


Fig 3: Financial volumes (left scale) and impacts of the EBS Programme (right scale). Source: compiled from evaluation reports on the KfW programme [12].

In 2016 the number of housing units being (partially) retrofitted or constructed with KfW support amounted to some 450,000 units out of which some 160,000 were new constructions. This corresponds to about 50 percent of housing units receiving a building permit in 2016 (own calculations).

This demonstrates the high market penetration of the programme, despite the fact that energetic requirements have been tightened in 2016. The KfW standard for new buildings is more relevant on the market than the Energy Saving Ordinance although it is at least 30 percent more demanding than the Ordinance. The KfW programme has a de facto regulatory function as the Effizienzhaus standard has become the most common energetic building standard.

Another important impact of the programme is employment generation. In particular retrofitting is labour intensive and is securing several hundred thousand jobs (see Fig.3).

Lessons from KfW's Domestic Programmes

Relationship between Promotional and Regulatory Systems

As the Effizienzhaus standard is embedded in the regulatory framework of the German Energy Saving Ordinance (see Box 1 above), the definition of the standard uses the calculation rules and the definition of the reference building laid out in the Energy Saving Ordinance. The formal and training requirements for the energy auditors are based on the criteria defined in the Ordinance. Consequently, the calculation tools and trained auditors required for the implementation of the promotional programmes were available in the market when KfW initiated its programmes. The availability of these resources in the market spared KfW to develop a calculation tool and to establish systems for the qualification of auditors. Over time, the large scale of the KfW promotional programs also helped to enable a market for energy efficiency services (e.g. for craftsmen, energy auditors), thereby also fostering a sound knowledge base in the market.

Furthermore, considering the large market share of the Effizienzhaus and considering that the programme triggered innovations, the regulator has adopted the definition of the Effizienzhaus to define the legally permissible building standard in the most recent version of the Energy Saving Ordinance from 2016. The regulator could base the periodic tightening of the standards on the established Effizienzhaus-levels, which consequently lost their promotional status. Thus, regulation and concessional lending are interacting in developing and introducing new, more energy efficient building standards.

From the perspective of the regulator, a potential new regulatory standard can be "tested" on a voluntary basis through a promotional programme, with the early adopters of energy efficient technologies benefitting from incentives under the KfW programme. During that promotional stage it can be demonstrated if the new standard is technically feasible and is being accepted by the market.

The mandatory introduction of a new standard usually raises concerns with regard to its technical and financial feasibility. Hence, the introduction of a mandatory scheme requires a lengthy consultation process, whereas a financing scheme can be changed much more easily as it does not require a lengthy consultation process but can be agreed upon between the federal ministries and KfW.

KfW's quality assurance of the "Effizienzhaus"-standard by applying elements of the regulatory systems is generating experiences that help to identify flaws in the technical documents supporting the regulatory system. By staying in close contact with the responsible departments in the federal ministries, KfW's experiences help to constantly improve the regulatory system. On the other hand, linking the promotional criteria to the regulatory system limits KfW's flexibility in adjusting e.g. technical requirements and calculation procedures.

A Dynamic Programme

At the beginning of the domestic KfW programmes, the list of technical eligibility criteria was quite simple and brief. The number of programme variants was very limited. Over the years, partly by learning from practical experience, a comprehensive system of programme variants has been developed. The daily contact with final customers and stakeholders, e.g. through call centre, has produced a wealth of information on how the programme criteria are being applied in practice.

Over the years, the programme has been refined to address particular building types like e.g. listed heritage buildings, which require a very sensitive approach and special know-how.

Also a grant of up to 50 percent of the cost of an energy auditor, previously only offered to special target groups like self-used family homes or home owner associations, has been made accessible to all customers. This is to ensure competence on energy efficiency during the whole implementation process.

The programme conditions must also take into account that the market is permanently improving appliances and building parts. The technical programme criteria have to be adjusted constantly to technical progress and innovative building components. New ambitious approaches to be incorporated into the programme are even more challenging - like e.g. the "Effizienzhaus-Plus" which generates more energy from renewable sources than it consumes; or battery storage of energy or approaches on district level trying to make use of heat sources from industry.

To cope with these challenges, KfW has established a dedicated "product development and management team". It also consists of engineers and architects to cover technical aspects.

Information System

References were made above to the comprehensive information system of KfW. The system is based on the principle that the various target groups find their contact point within KfW as easily as possible.

Target groups for information on the KfW programmes are:

- Final customers (individuals, corporates)
- Stakeholders (energy auditors, architects, suppliers, contractors, etc.)
- Political decision makers (Members of Parliament, leaders of ministries)
- Lobbying associations (building owners, housing associations, chambers of architects and engineers, industry, other NGOs)
- Multipliers (press, TV etc.)
- Financial Partners, such as commercial banks and insurance companies.

Since the information needs vary KfW developed different formats to brief target groups:

- Webpage
- Leaflets giving a first overview over the various programmes and key conditions
- Data sheets on programme conditions, with technical attachments, if required
- Periodic reports with statistical data on programme volume and results
- Press releases
- Own magazines
- TV interviews and TV spots

- TV and cinema spots
- Newsletters for banks, associations of industries and other stakeholders
- Briefing meetings
- “KfW Academy” for stakeholders offering 1-day seminars focusing on solutions to overcome barriers in energy efficient construction and refurbishment
- A prestigious annual “KfW Award” honouring outstanding concepts for energy efficient buildings with considerable media coverage; the focus of the award changes every year, covering e.g. new building in urban centres or retrofit by optimising the use of renewable construction material.

The format should provide information in an appropriate and serious way. It should motivate people to consider investing in energy saving measures. The presentation of concrete examples like recently completed homes has proven to be a very effective way to overcome possible reservations.

Apart from communication and information officers, staff members working in the KfW programme sections are involved in such activities as well. This way, partners receive first-hand information, on the other side staff is able to collect feed-back from the market.

Data Management

The promotional programme requires some more data than conventional bank lending programmes. However, in principle it can be managed like a standard banking product with some modification, due to e.g. the periodic revision of the eligibility criteria.

To manage the large number of applications within a reasonable timeframe, KfW has consequently sought ways to use IT solutions in loan processing. One key element is a web-based application and approval process including an online checking tool, which indicates to the energy auditor (who is entering the result of his asset-based calculation on behalf of the applicant) that the proposed investment is passing the technical eligibility criteria (subject to a detailed checking on a sample basis). In fact, by applying for a KfW loan online, the applicant will receive a statement within minutes whether the loan is likely to be approved or not.

Importance of Quality Assurance

As KfW is a public institution and implementing a programme with support from the federal budget, it has to address the fiduciary and reputational risks appropriately.

A key task in this regard is to ensure that the buildings financed by KfW are implemented in compliance with programme conditions, in particular that the energetic standard has been achieved in line with the standard outlined in the application. Only then, the expected energy and CO₂ savings will be accomplished.

A QA system which encompasses the full project cycle is a must. It starts with the “quality at entry” by defining entry criteria regarding quality of materials or skills of implementers e.g. the required qualifications for auditors depending on the intended energetic performance of the Effizienzhaus. The plausibility of the technical data of the applications is being checked at several stages:

1. Once the auditor submits the technical data of the application electronically to KfW, KfW runs a software-based plausibility check.
2. For a sample of applications, the full documentation is being checked by KfW’s in-house experts.

3. After completion, again a detailed random sample of buildings is being checked to ascertain the consistence between application and executed works. This check quite often includes a site visit.

If major deficiencies are detected, corrections are requested. If the owner is not willing or able to correct the flaws, the loan conditions will be adjusted to the Effizienzhaus level actually reached.

The quality assurance system is understood not only as a control, but also as a learning mechanism. Experiences from the checking process are e.g. fed into the learning process of energy auditors to keep their qualifications abreast with changing requirements. In order to renew their registration as eligible auditors they have to prove that they were involved in this ongoing qualification process.

Leveraging Private Funds

It can be said that due to the information system and attractive financing conditions the KfW programme has significantly contributed to a higher level of awareness in terms of energy efficiency in Germany. A viable indicator is the fact that more than fifty percent of new buildings are compliant with the "Effizienzhaus" standard. There is even evidence that this standard has been applied and certified by developers even without KfW loans. The reason being, that the marketing for energy efficient homes is apparently easier than for standard homes. There is no doubt that the KfW scheme has mobilised private capital for energy efficiency beyond the volume of concessional lending and grant financing. The leverage effect includes both the total cost of KfW-financed buildings, where the concessional lending is covering only a part of the total cost (see Fig. 3), and buildings complying with "Effizienzhaus" standards, that were fully financed through other sources than the KfW programmes.

The "Effizienzhaus" label has played a decisive role in initiating a market transformation in favour of energy efficient buildings. The label has been widely used by the real estate market.

Effects

As described above, a large programme like "Energy Efficient Construction and Refurbishment" has substantial environmental and economic effects. It contributes to a sustainable reduction of CO₂ emissions, directly by reducing the non-renewable energy consumption of buildings, indirectly by accelerating the development of new building standards. The energetic standards first introduced by the KfW programme have become the market standard. They reduce the cost of energy efficient construction by creating economies of scale and they have radiating effects on the construction practise in Germany.

In addition, the programme has substantial positive effects in other areas as well: generating employment, stimulating the economy, improving living conditions etc. And all of this is achieved at no net financial costs to KfW.

Experiences in Emerging Economies

In cooperation with local partner banks, KfW Development Bank has been financing the construction of new energy efficient residential buildings in emerging economies like Mexico, Chile and India. These three programmes are implemented by local public development banks and to some extent have an approach similar to the German programme “Energy Efficient Construction and Refurbishment”. However, the framework conditions and starting points have been quite different in each country.

These programmes have also created findings that might be valuable when replicating the approach in other emerging economies.

Besides, KfW Development Bank is financing credit lines in many developing countries under which energy efficiency measures are eligible: They are not subject in this paper, as they are not focussed on new residential buildings based on a whole building approach.

India: Promotion of Energy Efficient Housing through the National Housing Bank

This programme aimed to support the new construction of residential buildings with an improved energy efficiency standard. The target was to reduce energy consumption by 30 percent, including appliances respective 18 percent by passive measures only (insulation, shading, reflective paint etc.) compared to buildings without energy efficiency measures. A total of 1,912 flats in 12 housing schemes have been financed. The programme is completed.

Background and approach:

India had no nation-wide energetic standard for the residential sector. On the other hand, substantial construction activities are going on to satisfy the tremendous housing needs of the fast-growing urban population. Air-conditioning in summer and heating in winter are becoming affordable for an increasing share of the population. At the time of developing the programme, there was no national policy to reduce energy consumption in the building sector besides a labelling system for appliances and a building code for large commercial buildings, which was introduced on a mandatory basis only in several states.

There was de facto no regulatory system for energy efficiency in housing and no calculation method for the energy demand based on asset rating (see footnote 7 above). Thus, the first step was to develop and to calibrate an energy efficiency assessment tool for multi-story apartment blocks. This was undertaken by the German “Fraunhofer Institut für Bauphysik” in cooperation with the Indian research institute TERI (“The Energy and Resources Institute”). TERI was also in charge for the training of developers and it certified the development schemes.

NHB, the National Housing Bank under the control of the Government of India, was the executing agency. NHB used the KfW funds to refinance intermediary banks, which issued mortgage loans for purchasers of apartments in condominiums in certified schemes (Fig.4).

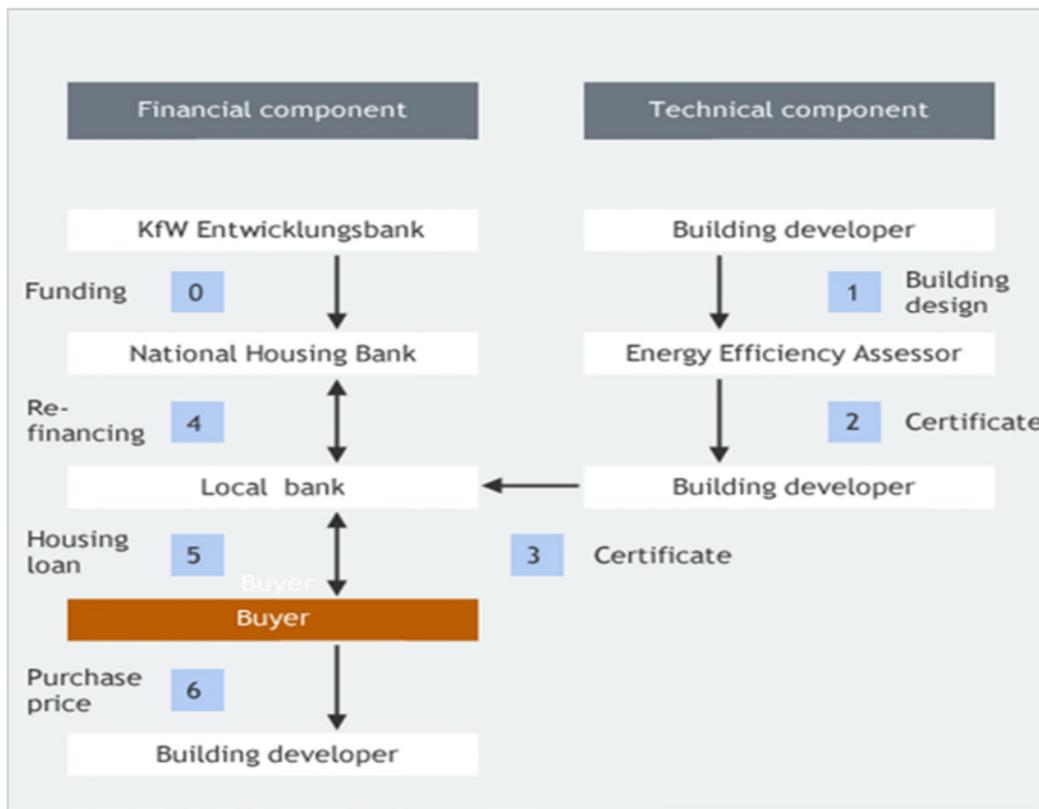


Fig. 4: Financing structure of the NHB Programme in India. (Source: Christian Calov / KfW).

Experiences:

A first approach focussing on economically weaker parts of the population was abandoned due to the low level of energy these sections consume. On the other hand, the housing demand of the dynamically growing middle-income segment provided ideal conditions for an energy efficiency programme based on loans.

The programme, however, was only moderately successful. One reason might have been the refinancing conditions that kept the interest rates of energy efficiency loans only slightly lower than conventional mortgage loans. Another reason could be the weak marketing of the programme loans towards the housing financing institutions of the Indian Federal States. NHB had difficulties to implement a programme concept outside its traditional business mandate of promoting low-income housing. The flow of funds was hence quite slow. Staff training proved to be marginally effective due to high fluctuations.

The energy saving targets defined for the scheme were quite often exceeded and more and more attention was paid to including passive measures for energy efficiency in the building design. However, it was also noted that the capacities to properly manage and maintain appliances, PV-panels and solar thermal collectors were quite poor.

Incremental costs of constructing the energy efficient buildings were only marginally (0.8 to 2.8 %) higher than those for conventional buildings in the Indian market [6]. According to this study, passive measures concerning the building envelope were more cost-effective than energy efficient appliances.

Despite the implementation problems, the programme had some more far-reaching effects.

The calculation tool was well-received by planners and developers of housing schemes, in particular those committed to sustainable construction. TERI had earlier developed a sustainability label under the name of GRIHA (“Green Rating for Integrated Habitat Assessment”), and is using the tool to calculate the energetic performance of buildings. So far, over 400 buildings have been certified by GRIHA. The programme has raised awareness for the fact that not only energy efficient appliances, but also the building design and passive measures (insulation, shading, low-energy windows, reflective paint, etc.) can reduce energy consumption.

On the other hand, it became clear that developing the software for the calculation tool, based on a German software kernel, is very expensive and time consuming. Substantial technical assistance is required to implement such an approach in a country with no corresponding capacities.

In India, the marketing of the apartments usually starts before ground-breaking; the risk that the design could be substantially changed between certification and completion (and the promotional criteria are not fulfilled) did not materialise. However, several certified buildings were not realised at all.

In the absence of an effective regulator, the promotional loan stimulated energy-efficient construction and capacity development; however, the program would have benefitted from a regulatory system with technical standards as well as trained engineers and architects. The topic has been innovative to India and finding partners for the program (architects, engineers, developers, financial intermediaries, etc.) was a challenge.

Mexico: EcoCasa Programme

The Mexican EcoCasa Programme comprises several schemes intending to provide some 43,000 flats with reduced energy demand (35,500 KfW/Interamerican Development Bank financed, 8,000 as NAMA- financing¹² under a German/British climate initiative) and 600-800 dwellings at passive house level (EU financing through a special facility for Latin America as partial grants). The target for the KfW financed measures was a 20 percent energy reduction and an improvement of comfort level¹³. The programme sponsor “Sociedad Hipotecaria Federal” (SHF) is supporting qualified developers of housing schemes by bridging loans and guarantees (Fig.5.).

Background and approach:

The programme is part of Mexico’s plan to reduce CO₂ emissions. SHF is a Bank under control of the Federal Government with the mandate to refinance the construction of homes and flats for lower income groups. Mexico has a mandatory home-saving scheme for workers leading to a high demand for privately owned houses and apartments for lower income levels.

¹² “NAMA” stands for “Nationally Appropriate Mitigation Action” and refers to a set of policies and actions that countries undertake as part of a commitment to reduce greenhouse gas emissions.

¹³ SHF has revised the requirements in 2018. The new requirements depend on the interest level and range between 20 and 40 percent for energy savings; they vary by climate zone. Besides, it is required to save at least 20 percent water and to comply with urban infrastructure standards.

Mexico is committed to reduce the energy consumption of buildings towards zero energy in the long term and the programme is an important element with regard to this target. The country has recently introduced some minimum energetic standards for buildings receiving subsidies under social programmes, yet these standards are not very demanding. However, previous experiences in Mexico on energy efficient buildings were very limited and the EcoCasa programme is therefore quite innovative both regarding technology and implementation procedures.

The programme approach has been prepared by GIZ and a NAMA financed consultant team. This team developed a tool for the energy performance assessment of buildings based on the calculation tool PHPP¹⁴ of the German Passivhaus Institut.

Different from other programmes, the incentive is a bridging loan, which SHF is providing to developers and not a mortgage loan to the purchaser. The bridging loans complement the mortgage financing by public institutions and private banks (see Fig. 5) and the housing subsidies for economically weaker sections offered by the National Housing Commission (CONAVI). The passive houses, financed by a special Fund for Latin America by the European Commission, are subsidised with grant funds of up to 70 percent of the incremental cost to reduce the sale price to the typical market level of conventional buildings. It was decided to focus on the developers due to the fact that there is little awareness on energy efficiency among purchasers of private homes or flats and that developers are the ones who decide on the energetic standard. An attractive interest rate for the bridging loan in combination with better marketing prospects appears to be an effective stimulus for the developers to invest into a higher standard.

Electricity, the main source for domestic energy, is still subsidised moderately.

SOCIEDAD HIPOTECARIA FEDERAL (SHF)

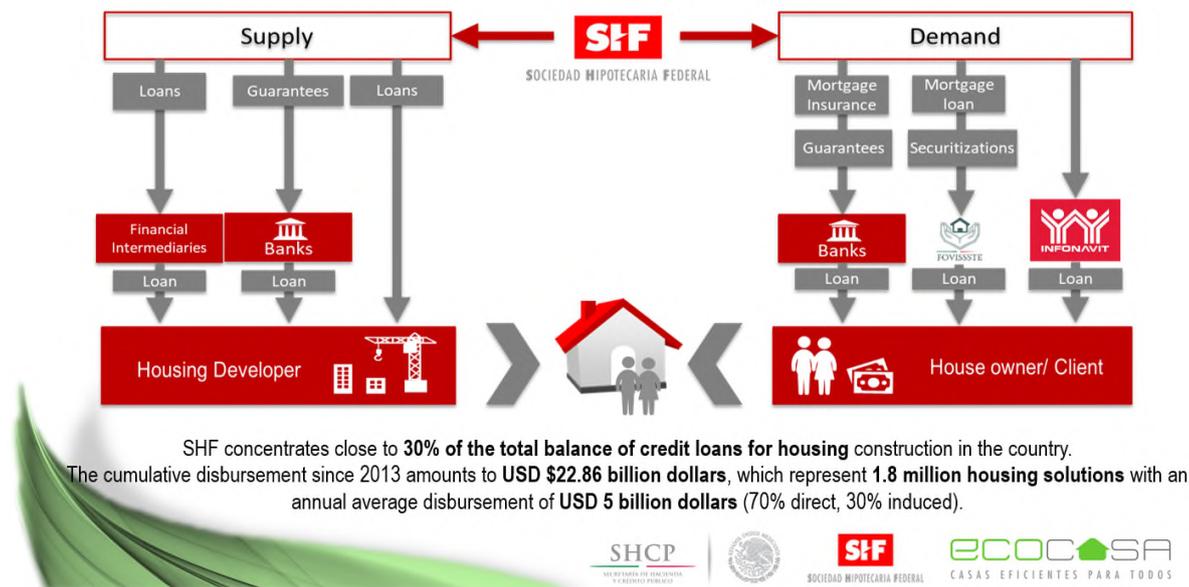


Fig 5: Financing structure SHF (Source: [13]).

¹⁴ PHPP: Passivhaus Projektierungspaket.

Experiences:

The programme is ongoing. It has developed a high momentum and the target number of flats in the standard component will be overachieved as the turn-over of the developer loans is higher than anticipated. The original comfort definition was not appropriate under the given social and climatic framework for the programme; a simple but more appropriate definition has been defined in 2018.

The Mexican Government and SHF are showing a strong ownership of the programme. The general and financial management by SHF is excellent. However, technical skills, including an understanding of the background of modelling and algorithm of the tool, had to be developed. The support by a small consultant team, in particular to develop economically feasible passive house approaches, is justified. However, the build-up of capacities, both within SHF and on the side of developers, designers, contractors and suppliers, is still progressing.

Seeing the short credit period of the bridging loans, the financial advantage is limited but tangible for the developers. The response by developers is very positive which led to a high demand for the bridging loans. There is also interest by developers in the partly grant financed passive house component, but with some precaution as this represents leapfrogging with regard to technical approaches and implementation standards. At least some of the developers appear highly motivated to learn about the implementation of ambitious energy efficient standards by applying them in practice.

Chile: Energy Efficiency in Residential Buildings

Chile is a country with extreme climatic differences: hot and dry desert climate in the North, cold, humid and stormy in the South, alpine climate in the Andes, and temperate climate in the central areas. Inappropriate housing standards are hampering comfort due to poor envelop quality and ineffective conditioning systems. In some areas where fire wood is the prime source for heating the air quality is poor and leads to corresponding health impacts. All these factors are potential drivers for higher energy efficiency.

Under the auspices of the housing ministry, a calculation tool on residential building energy demand based on asset rating was developed. Energy auditors were trained to use the tool and to establish assessments of the energetic performance of buildings. This tool is being used to classify buildings, taking into account the country's different climate zones. It could also be utilised to define a regulatory standard in the future. For now, the Ministry of Housing proposed a binding energetic standard for residential buildings but has not yet officially introduced it.

Given that some essential preconditions for a promotional programme are existing (tool, auditors, defined building standards) KfW has supported Banco del Estado Chile in designing a concept for an energy efficient loan programme for new residential homes. The programme is based on the building classification applied by the Chilean calculation tool.

Banco del Estado is a government controlled bank with substantial direct retail business. Hence, it can lend the programme funds directly to developers or owners of energy efficient dwellings.

The implementation of the programme has started; preliminary conclusions on its progress are not yet available.



Fig. 6: Financing scheme Banco de Estado (Source: author).

General Experiences from Various Environments

At present, only a few countries outside of Europe have launched financing programmes to promote energy efficient housing. As indicated above, KfW has been engaged in various housing programmes, aiming to reduce the energy consumption in several continents and under various conditions over the last decade. Seeing the timing, the scope and volume of engagement, KfW can be considered a pioneer in this area, facing all the challenges of implementing an innovative approach. KfW has regularly been approached by countries and organisations worldwide to share its respective experiences. One of the questions usually is whether KfW's financing model of its domestic energy efficiency programmes is suited to be transferred to other countries. Similar promotional systems have been installed in some other EU-member states. As these are governed by similar framework conditions, the transfer was quite straightforward in particular where promotional banks like CREDEX in Estonia exist.

The three examples in this paper give some insight as to what might be different in emerging economies. They indicate that the preconditions and institutional frameworks vary substantially between countries. The preparation of a financing programme requires careful analysis of the building sector and the financial sector before a programme can be established. Of course, it is much easier to develop a finance sector programme when studies on the energy saving potential of the residential sector have already been undertaken or where elements of an advanced regulatory system have been installed, like in Chile. The conditions are more favourable in countries that have been implementing social housing schemes (Mexico) or climate protection programmes through the financial sector.

The analysis should include an assessment of the respective government's commitment, of the local capacities and the need for capacity developing measures. Quite often, the local capacities are too weak to base a programme on. In the case of Mexico, technical assistance at policy and programme levels had prepared the implementation of the programme. In the case of India, technical assistance had previously not covered energy efficient housing, The necessary preparatory activities had to be undertaken within the programme implementation period and were clearly focused on enabling and supporting programme implementation.

A special need for technical assistance does exist where no tool to calculate the energy use of buildings is available. In India and Mexico substantial efforts were undertaken to establish the tools based on kernels from Germany. Nevertheless, ownership of the tool and local capacities to update the tools, e.g. the databases on properties of materials and appliances, remain issues to be considered in establishing a sustainable system to quantify energy performance of buildings (see below).

Living standard and energy consumption increase with household income. Poorer households in emerging economies are quite often trying to save energy for economic reasons, e.g. by accepting reduced levels of comfort. On the other side, public housing banks focus on the lower income segment of the population. Therefore, it is quite often expected both from the governments and the donors that the housing programmes target the economically lower section. This expectation ignores the fact that in developing countries this part of the population has the lowest per capita energy consumption and is therefore not suited to establish an energy efficiency programme.

In India, a feasibility study beforehand revealed that the energy consumption of people with smaller incomes is so low that activities for energy saving in buildings were not feasible. The programme therefore was geared towards supporting homes for the growing urban middle class.

In Mexico, some 20 percent energy savings are possible in the low-cost housing schemes for the weaker (but not the weakest) sections compared with the reference building. However, many homes for this income segment are not being equipped with air conditioners immediately after completion of the buildings, because they simply cannot afford it. But even if the homes for weaker segments are not (yet) air-conditioned, improved room comfort is possible anyway, meaning less hours/days where the indoor temperature is beyond the temperature limits of the comfort zone (between 19 und 26 degree Celsius). This can be achieved by combinations of passive measures like shading and better insulation alone. Such measures do not save energy directly, but they might contribute indirectly because they reduce the need for conditioning.

More ambitious energy saving measures are not attractive for the people with lower incomes. Therefore, the Mexican SHF is testing these levels of ambition – like the Passivhaus – in schemes for the middle-income class.

Recommendations for Promotional Programmes

Programme Design

Since the framework conditions are different in each country, promotional programmes should be designed to make optimal use of existing structures and capacities. The following recommendations should be considered when preparing a promotional programme:

1. A comprehensive analysis of activities of the public sector with regard to energy efficiency, climate protection and housing standards, housing finance and construction is necessary. Where are starting points for programme preparation activities? Which agency could best be involved as programme sponsor or coordinator?
2. A potential sponsor agency has to be assessed carefully with regard to its motivation, capabilities, capacities and resources. If the agency does not have the necessary capacities, a roadmap for capacity development measures might be established. How can the human and institutional resources needed for a programme be mobilised? How should a programme be designed to match the agency's capabilities?
3. The programme design should start with simple promotional criteria and technical requirements. These have to be in line with the (strengthened) capacities of the agency and with the private sector. A calculation tool might be needed, but a promotional programme can also be based on minimum requirements for building parts and technologies (see below).
4. The potential demand for the financing must be assessed (market study). Does the demand for energy efficient homes justify such a programme? For which income levels and building standards does sufficient demand exist? Do the demand and the capacities of the implementers have to be tested in a pilot phase?
5. It has to be assessed if the proposed promotional criteria and intended energetic standards are financially viable. Do the savings from lower energy consumption match the incremental costs of the energy efficiency measures within a reasonable period? What subsidy amount is required to bridge the financial gap?

Defining the Technical Concept

In designing an energy efficient building programme, it has to be decided whether it should involve building stock or new buildings.

In many emerging countries the urban population is growing and with it the demand for buildings. Therefore, new construction is in high demand and usually more relevant than modernising the existing stock. Many countries for instance in Latin America support new housing schemes for economically weaker sections through public financing.

New buildings have the additional advantage that standards can be influenced much more easily. Also, larger quantities can be reached through developers and the incremental costs for energy efficiency are much smaller than for retrofit measures. In addition, the financing of new buildings has lower transaction costs than retrofit because the ownership of new buildings stays in one hand at least until completion and turn-over to the final customers.

Retrofit of older buildings is technically more challenging. Furthermore, buildings might be inhabited, a fact that has to be taken into account. Thus, construction activities might be hampered if inhabitants cannot move temporarily out.

A comprehensive retrofit can be the right option in countries with a substantial building stock and a low level of construction activities as it is the case in many European countries. Energetic retrofit can also be combined with the rehabilitation of heritage buildings like those in historic town centres. However, these programmes are very demanding with respect to architectural, engineering and implementation capacities. In fact these aspects might be more decisive than financing itself because many heritage buildings are located in urban centres and increase their market value afterwards.

Regarding the building stock, an alternative to a whole building approach might be single measures like the insulation of roofs or walls, replacement of windows, solar water heaters or efficient conditioning appliances. These measures can be financed by standard credit lines or other delivery models like on-bill financing through utilities. In particular for appliances, labelling systems can be used as technical promotional criteria.

The Importance of the Building Tool

A software tool to calculate the energy consumption of a building under local climate conditions is a must for programmes focussing on new buildings or the comprehensive retrofit of existing buildings. The tool calculates the annual energy need for a building at design stage taking into account key features like lay-out, orientation and size of windows, the dimension and type of building materials, appliances, airtightness, ventilation, utilisation and hot water demand. For this purpose, it uses e.g. climate data, the geometry of the building, data on the physical properties of materials, performance parameters of appliances and data on usage patterns. Tools for energy efficient buildings require up to several hundred input data. Accordingly, they can only be used by trained and qualified experts.

To compare the energy efficiency of a building in the design stage with legal requirements or criteria of a promotional programme, a reference building concept is generally used to define the baseline (see Box 1). The reference building is a model, which is identical with the designed building in terms of geometry, climate condition and usage pattern. However, its parts (e.g. walls, roof, windows, etc.) and appliances have defined properties. These properties and thereby the whole reference building correspond with the regulatory standard, in the absence of legal requirements respectively with the market standard. The energy efficiency of the designed building can thus be compared with the regulatory or market standard. The promotional programmes in Germany, India, Mexico and Chile are all based on the reference building approach. Their main promotional criterion is that the energy consumption of the designed building should be better than the reference building by a defined percentage.

This approach is straightforward and clear. However, it has some drawbacks:

- There is no universal model for the whole world¹⁵ which covers all potential energetic standards. A model not only has to be adjusted to the local climate conditions, quite often (e.g. Mexico, India, Chile) also for several climate zones of a country. It has to integrate data on typical local construction materials, appliances and usage patterns. Finally, it has to be calibrated to reflect local consumption patterns.
- As the tools are complex software packages, their development is time consuming and expensive. To ease the introduction of a tool to a country, an established tool or at least its kernel can be used and adapted to local conditions. This approach is usually faster and less expensive (e.g. Mexico and India) than programming a new tool. However, the owner of the kernel will not transfer all rights to a customer. The customer will have to negotiate a contract with the owner on the usage of the software, including maintenance and updating of the data base.
- As mentioned above, the application of the tool requires trained staff. For e.g. architects and engineers who have basic knowledge of building physics the training takes but a few days. Experience from Germany shows that even for trained staff a quality assurance system including independent review of calculations and retraining is highly recommendable.

Besides the energy consumption, broken down by fuel or month, the tool delivers other relevant parameters for example with respect to the insulation quality of the building envelop, the CO₂ emissions or the percentage of time during which the indoor temperature and humidity is within the comfort zone. Some of these parameters can be used as additional targets in promotional programmes.

The issue of linking a building energy tool based on asset rating as described above to promotional programmes emerges in all countries where the regulator has not introduced a calculation method e.g. as part of the approval process of building permits. However, a rising interest in building energy efficiency by the private sector can also be noted world-wide. The driving factors for the private sector are operational cost, increased attention to sustainability and awareness regarding the carbon footprint.

In India and Mexico there was substantial private sector interest in receiving training on the tool. In both countries a local institution (TERI in India, SHF in Mexico) was the focal point for the tool application. TERI has used the tool beyond the programme for the sustainability certification of green housing schemes. In more and more countries, sustainability rating is driving the application of tools to calculate the energetic performance of buildings. However, most certified buildings are outside of the residential sector. Furthermore, these rating tools do not cover deep retrofit or nearly zero energy level concepts like the Passivhaus.

Capacity Development

Financing energy efficient buildings requires specific expertise from a bank, since it has to define technical promotional criteria for buildings and has to process loans based on these criteria. The building sector differs from other sectors by the lower degree of standardisation: every housing scheme is unique and different from others by e.g. the architectural design, technical features or implementation quality. Also, buildings vary in that they are often “custom made”, sold before produced, and produced in situ under non-standardised conditions. The quality issues and the longer delivery period make the financing of buildings different from the financ-

¹⁵ EDGE from IFC and some other tools have a global data base on climate data; however, there are several restrictions limiting their use as basis for a promotional programme. Recently, EDGE has been upgrading its data basis and might have reached a good level of detail for some countries. That makes it prone for further consideration as tool to define an initial promotional level.

ing of goods that are much more standardised, and the production is industrialised. The need to comply with the promotional criteria in an environment where national capacities are still weak even increases the challenges for energy efficiency in buildings. It is helpful if some of the activities to generate the evidence for compliance and quality are available in the market like in Germany, where the promotional criteria are based on the regulatory framework, or like in Chile, where a classification system has been established. On the other hand, the examples in Mexico and India demonstrate that technical expertise can be established in financial institutions, e.g. in the form of in-house architects (Mexico). In both cases, an external consultant team with national and international experts is supporting the programme sponsor on energy efficiency issues, training of staff and partners (developers, architects, auditors, contractors, etc.), monitoring, quality assurance or special studies to refine the standards. Particularly, the briefing, training and backstopping of the on-lending banks as part of the marketing is a task that might be underestimated for a successful implementation.

The German experience highlights the importance of quality assurance. This issue is equally relevant for any other programme, in particular when the requirements are becoming more ambitious and leaving the level of “low-hanging fruits”. With a growing number of parameters and higher standards of design, implementation and materials, the risk of underperformance increases. A first step towards a quality assurance is an objective-based monitoring system, where key parameters will be developed for the whole project cycle.

The Incentives: Interest Subsidies and Grants

Subsidies in the form of low interest loans, step-up bonuses and grants to the final owners are the core of KfW’s programme. These subsidies are an effective incentive to adopt the ambitious building standards of the programme. Whereas the bonus and grants are fully financed from the federal budget, the low interest rates result both from federal budget subsidies and from KfW’s excellent refinancing possibilities on the financial market.

However, this financial model cannot be transferred to developing or emerging economies, as so far none of them are willing to finance subsidies for energy efficient residential housing from their budgets. In the given examples, an attractive interest rate could be realised by good refinancing conditions by KfW loans or loans from other development banks or funds. Besides low interest loans, also other sources of finance like climate finance through NAMA, regional grant funds and technical assistance could be mobilised. Typically, the main objective of grant funds are programme preparation, capacity development, tool development, monitoring or demonstration projects. Due to their limited volume, they cannot substitute loans for construction.

Regardless of whether a developer loan (Mexico) or an owner loan (India, Chile) has been financed, the financial advantage compared to market interest rates is small, but tangible. It is expected that quite often the grant element covers the additional investment costs due to low interest rates. This is particularly true for developer loans, as these do not benefit from the energy savings. To provide a sufficient grant element in the same magnitude of the incremental costs, the loan must cover not only the incremental cost, but a substantial share of the investment costs.

However, whether the grant element covers the incremental costs should not be overestimated. Some developers stated that participating in the programme has other important benefits like better marketing and faster selling of energy efficient homes, higher reputation or faster adaptation to future building standards.

Energy savings are an important element in the financial cost benefit calculation. Calculations in India [6], Chile and Mexico have shown that the present level of energy efficiency underlying the programs is providing a return on investment which is higher than the incremental cost including the corresponding financing cost. Life-cycle costs of a sample of buildings under the programme in India were up to 1.6 percent lower than those of conventional buildings.

There is no simple answer to the question whether a bridge finance for developers or a loan for final customers is more effective. Bridging finance directly addresses the decision maker of the building, namely the developer. A bridging loan has a relatively short maturity of about three years and might be revolved several times if refinanced by a development loan that lasts substantially longer. Final customer loans are generally medium term (around 10 years). They only have an effect on the building standard, if the developer designs the housing scheme especially for the target group of the clients of this loan programme. The developer bears the risk that the programme could be closed once the marketing of the scheme has started. In the German KfW programme this risk is being covered as the developer can also apply for a loan which is forwarded to the customer as part of the sales contract.

Because the loans are generally much bigger than the incremental costs the CO₂ savings per invested amount of money are quite small. This issue has to be addressed when the use of climate funding in the financing of energy efficient housing schemes is intended e.g. by blending various finance sources.

Box 2: Ten Basic Recommendations on How to Establish a Loan Programme for Energy Efficient Housing

1. Start with **SMART promotional criteria**. They should be as **Simple** as possible, the impact on the energy consumption should be **Measurable**, they should be **Accepted** by all stakeholders (developers, users, contractors, etc.), **Reasonable** regarding the local capacities and **Timebound** (they should be fix over a certain period, but might be tightened in line with climate policy, progress in construction technology and energy availability).
2. Assess and discuss the **requirements for training** and external support. Develop a catalogue of requirements based on the experience e.g. in Germany and Mexico. Also review the capacities and training needs of other players required to implement the programme and decision makers (on-lending banks, architects, designers, energy auditors, etc.).
3. Assess the local availability of special **materials for energy efficient buildings** (insulation, windows, ventilation systems with heat recovery etc.). If those are not available, discuss with suppliers what has to be done for the market introduction of these supplies. Assess the potential to lower prices by economies of scale.
4. A custom-made **marketing** must be an element of the programme activities, providing the required information to the decision makers (developers, architects, purchasers). Besides informing about the modalities and conditions of the programme, marketing should inform about the multiple benefits of energy efficiency.
5. A **tool** for assessing building energy performance is a key element for any programme going beyond the level of single measures. There are several tools (or kernels of tools) commercially available, but transfer into a new country or climate zone requires significant adjustments and calibrating might be necessary. This should be completed before the marketing of the programme has started. As in an initial step the technical and financial feasibility of the proposed level of intervention has to be established.
6. Be sceptical about the need for a programme, if the target group gets subsidies for energy. Even if the programme can be justified on a macro-economic level by saving subsidies, it remains open whether households are prepared to invest into energy saving measures under such circumstances.
7. **Assess the energy consumption** of the target group. Energy can only be saved if the potential beneficiaries have access to energy and if they can afford energy for improving their living conditions, in particular heating and cooling.
8. The programme design should take into account different **climate zones** in a country, e.g. hot and humid at the coast, dry and hot in some valleys, cold and wet in the mountains. The promotional criteria and the reference building might differ for each zone. Even in sub-tropical zones quite often there are some areas with a temperate climate, where no energy is being spent for room conditioning so that there an energy efficiency programme will be difficult to justify.
9. Be aware that the money saved by energy efficiency can be spent for other purposes, some of which might again consume energy (consumer electronics, more ACs, etc.) and that **rebound effects** are not unusual.
10. Establish a **monitoring system** on progress of implementation including quality of construction. This should include on-site inspections by independent experts. The monitoring should be a base for permanent learning process.

Structural Effects of the Programmes

The promotional programmes had significant structural effects, too. As mentioned before, one local partner for the tool development started a marketing initiative to promote the tool. Regular training courses were held, in which architects and engineers were not only familiarised with the tool, but also with the concept of energy efficient building design. As building energy efficiency is an important parameter in sustainable construction, many experts enhanced their knowledge to be applied in buildings outside the programme, e.g. those who are undergoing a building certification for a sustainability label.

In Mexico, some developers stated that they apply the EcoCasa standard even without SHF funding. This indicates that they see some advantages of this standard compared to the legally required minimum (marketability, company reputation, collecting experiences with a future-oriented standard, etc.).

The example of Mexico also shows how quickly the industry (contractors, suppliers) responds to the new requirements of building components. A brick factory established a production line for burnt bricks filled with polystyrol foam, whose standard is compliant even with European requirements. Foam sheets to insulate the roof are now widely used, as they also ease the formwork for the roof slabs and are hence more cost-effective compared to the conventional building practice.

The assessment of the German example has shown that a mass programme based on loans is feasible. Even at the present low market interest rates, the KfW programme is co-financing around 50 percent of the new apartments constructed in Germany. The programme has substantial employment effects, in particular the retrofit component. The programme has eased the introduction of more ambitious mandatory standards as they were anticipated by the KfW promotional levels. For example, the promotional level of KfW Efficiency House70 was the “standard” KfW promotional level for new construction until the German Energy Saving Ordinance was revised in 2016, making the KfW Efficiency House70 basically the new mandatory standard for new construction. And finally, the programme has been generating substantial revenues for the government by direct and indirect taxes, labour market effects and by reduced social security spending.

Advantages of a Loan-Based Programme

Blending public funds with low-interest loans from the capital market through a reputable lender like KfW is leveraging the public funds. A similar programme based on grant financing could probably not have been established due to budget implications. Besides the limited volume of potential grant finance, a critical aspect is that grants are not available reliably because programmes may be put on hold once the budget for a specific fiscal year has been exceeded. Not knowing whether incentives are available is a substantial barrier and demotivation for any potential investor. In loan financing, KfW has developed mechanisms to balance demand and available resources, e.g. by adjusting the interest rate or by bridging funds.

It is a merit of the German loan-based programme that the government can run an effective programme to promote energy savings and CO₂ mitigation in an area where ambitious mandatory standards are difficult to be enforced. This is particularly true for the retrofit component which could hardly be made mandatory within the German legal system. Financial subsidies in the form of low-interest rate loans have proven to be an effective incentive with substantial impact on around 50 percent of new buildings and on about 10 percent of the building stock [9].

On the other hand, any programme based on financial incentives has the potential disadvantage that “free riders” benefit as well, while their decision was not influenced by the programme at all. However, in light of the ambitious requirements for the German programme, this risk can be considered minimal. It is higher in new programmes that commence with comparatively “easy” requirements.

Pros and Cons of a Loan Scheme versus Alternative Funding Mechanisms

The promotion of energy efficient buildings as applied by KfW is one of various possible approaches. Alternative concepts can be:

- Tighter regulation
- Tax credits
- Grants
- Utility loans (pay-as-you-save schemes).

A higher efficiency standard can also be introduced by the regulator via the building code. Experiences with tighter, more ambitious building standards all over the world have shown that this is a very controversial and cumbersome issue. In Germany, the law demands that a building standard prescribed by the respective ordinance must be financially viable. As the financial feasibility depends on many assumptions, a debate on the standard can easily become endless. Even if a binding standard has been approved, exceptions are possible, if the application of the legally required standard is not financially viable. In contrast, a standard being linked with financial incentives is voluntary and bypasses several problems in the process of fixing a legally binding standard.

Due to lacking control mechanisms, in many countries the enforcement of building standards – in particular when some important works like insulation are being covered by plaster – remains an unsolved challenge. The experiences of KfW's programme have shown that citizens accept controls of the building standard based on financial incentives apparently more willingly than controls of a standard that is based on regulatory requirements.

Tax credits are another financial incentive on a voluntary basis. It is bound to an effective tax system. However, there are two major drawbacks:

- a) The incentive in form of a tax refund is normally disbursed quite some time after completion of the investment, once all documentation has been provided and the tax declaration statement has been made. Thus, it does not help to overcome financing shortfalls of the incremental costs. On top, the applicant does not know during the implementation phase whether the authorities will approve the refund or not; this uncertainty undermines the incentivising effect.
- b) The tax authorities do not have the experience to assure the quality of a building. They might switch to using the services of private sector auditors; however, the German case shows that private sector auditors only work reliably once integrated into a quality assurance system.

One advantage of a tax credit system is that it reaches investors who have no interest to borrow funds. On the other hand, there are – at least in Germany – several types of investors, who do not have taxable profits as they are not profitable or as they are not allowed to make profit like cooperative societies or charity NGOs. The German example demonstrates that for target groups not interested in loans, grants are an effective incentive.

As discussed above, grants in mass programmes are expensive for the government and their management proved to be little flexible. It is hardly expected that governments of emerging economies would make grants available for mass programmes like EcoCasa. On the other hand, grants can be a very effective instrument e.g. for testing innovative technologies in the field.

Pay-as-you-save schemes linked to utility bills have proven to be effective for small investments like solar water heaters (South Africa) or condensing burners (several European countries). However, as they are linked to the utility bill, they are only suitable for small investments with a short payback period. Substantial retrofits with a financial payback period of more than 10 years are not suitable to

be financed by pay-as-you-save schemes without a financing partner providing long term loans.

Interaction of Loan Programmes and Regulation

In principle, a loan programme based on energy efficiency criteria can be run without any linkage to government standards (example: case study India). The loan programme can to some extent even substitute a regulatory standard. The best example is the German programme defining the de facto energetic standard of buildings as more than 50 percent of new homes are compliant with the "Effizienzhaus" standard. Also in Chile, the lending is based on a building classification system which is not set into force by the government.

The German and the Mexican example demonstrate that there are many interdependencies between the promotional lending programmes and the regulatory system. A few examples are:

- The minimal promotional standard is the legal maximum energy consumption minus 20 (Mexico) respective 30 percent (Germany).
- In Germany, the algorithms and software tools as describes in the building ordinance can be used for the documentation required by KfW. The same applies in theory for the majority of issuers of building certificates as defined by the ordinance. However, at a higher level of energetic ambition KfW is more restrictive in terms of initial qualification at entry than the ordinance and has linked the eligibility with its own quality assurance system.
- Vice versa, many findings from KfW's quality management are being fed back to the regulator, who is using them to revise the ordinance and supporting technical documents. The interdependence of regulatory and promotion system is so high, that the regulator has to take into account the requirements of the KfW programme in revising the ordinance to avoid inconsistencies.

The general advantage of a coherent system of regulatory requirements for the calculation of energy use and for auditors is that the implementation of the lending programme can take recourse to existing capacities (Chile). Otherwise, these capacities might have to be built up before launching the programme. Building up capacities particularly for a promotional programme bears the risk, that there could only be a niche market for developed capacities (e.g. India), or no market at all, once the promotional programme would come to an end.

That a promotional programme can be used to introduce tighter mandatory requirements has been discussed above for the German case.

Conclusions and Lessons Learnt

A few conclusions can be drawn after reviewing the promotional programmes in four countries:

1. Promotional lending is an efficient tool to promote energy efficiency in the residential sector, regardless whether the target group are developers (Mexico) or purchasers (Germany).
2. Subsidised loans allow mass programmes with a substantial effect on energy savings and CO₂ mitigation as they can reach a good portion of the construction market. They can contribute significantly to the national CO₂ mitigation objectives. However, the specific investment costs per ton of CO₂ saved per year are high, as the loans have to cover more than the incremental costs to be attractive.
3. Markets appreciate the advantages of energy efficient construction as long as the additional costs are moderate and are at least partly compensated by the grant element of the loan and by energy savings. Developers can sell energy efficient homes faster than conventional homes, which is a substantial financial incentive (Mexico).
4. Studies in India, Mexico and Chile indicate that the promotional level is financially feasible at household level in the long run. For Germany macro-economic analysis indicates that the loan programmes have substantial employment generating effects and that the public spending on interest subsidies is more than covered by government revenues in the form of taxes, duties, contributions to the social security system and saved unemployment expenditures.
5. Given that in all developing economies the economically weaker groups only consume energy moderately, it has to be assessed if they are really an appropriate target group. In India, the loans focused on the growing middle class, which is responsible for a large share of the construction activities. The programmes in Mexico and Chile might not reach the poorest section, as even in there the poor cannot afford appropriate air conditioning or heating. But the Mexico scheme does reach economically weaker sections by being linked with social home saving schemes and public support for labourers.
6. The loan programmes are an appropriate tool to influence the national building standard with regard to energy efficiency. They can shift the national average of building energy substantially below the legally permissible level (Germany) and trigger the introduction of innovative, more efficient technologies, which might become cost-effective by scaling effects (Mexico). A coherent system of regulatory requirements and promotional criteria preparing the further tightening of these regulatory requirements is helpful both for the regulator and the finance institution.
7. Preparation and management of the programmes are demanding for the finance institution as the promotional criteria are based on technical aspects. The banks can use external expertise (local auditors, consultants). However, it is advisable that the bank has at least some technical capacities to manage the external skills and to respond to queries by the regulator and donors.

8. A loan programme can better be prepared if the country has initiated a CO₂ mitigation policy (Mexico) or steps to create a framework for energy efficient building standards (Chile). A high commitment by the government to address the energy saving potential in the residential sector by effective measures and to develop a strong ownership for the promotional programme is extremely important.
9. Existing private sector capacities in designing and constructing energy efficient houses are easing programme implementation. However, in all countries a huge interest in training on energy efficiency measures has been noted, beyond the capacities needed for a programme. Private sector stakeholders in all countries are aware that under changing climate and energy market conditions, energy efficiency in the building sector is one of the main challenges.
10. Attractive interest rates and conditions of the loans are important. It cannot be expected that governments of developing or emerging economies will be able to provide substantial funds from their budgets for interest subsidies, in particular if the measures are not focusing on the weakest economic groups. Attractive financing conditions can usually only be created by reducing expectations on the rate of return on the capital of the financial institution or by attractive refinancing by donors or climate funds.

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