Using Equity Capital to Unlock Investment in Building Energy Efficiency?

By Claus Michelsen, Karsten Neuhoff and Anne Schopp

The energy transition will require considerable increases in energy efficiency, particularly in residential buildings. Financial support mechanisms, information and advice programs and dedicated training and certification of craftsmen are already in place to stimulate energy efficiency investment. Nevertheless, the required annual rate of thermal building refurbishment of around two percent is so far not achieved. For some real estate owners this may be explained by a investment horizon that is shorter than lifetime and repayment period of energy efficiency investment projects. The reluctance may also be due to an inadequate risk assessment by investors. Alternative financing approaches that rely mainly on the principle of coupling the revenues of the investment to actual energy cost savings and the increased involvement of equity capital might in such instances contribute to increasing investment activity. Particularly, in the current phase of low interest rates, there is more investment pressure on institutional investors whose willingness to participate in energy efficiency projects is likely to have increased substantially. Experience in other countries has however moderated expectations of being able to trigger greater short-term stimuli with innovative financial instruments. Nevertheless, given the challenges of the energy transition, further investigation of innovative financial concepts also based on equity funding seems warranted.

Energy efficiency investments in buildings can substantially reduce the consumption of fossil fuels such as oil or gas and, consequently, contribute to both climate protection and minimizing energy imports. At the same time, they can trigger growth for the entire economy.[1] These investments are usually viable from an individual investor's perspective. However, the diffusion of efficiency technologies—whether in the construction of new buildings or in renovating existing residential buildings—lag far behind policy objectives. This is surprising, given the often high potential returns. This situation is therefore frequently referred to as the energy efficiency paradox.[2]

In terms of the government's[3] agreed objectives on energy upgrades for buildings, there are considerable investment gaps in Germany, despite provision of preferential loans and direct subsidies (see Table 1). According to calculations by DIW Berlin, it would require an additional annual investment in energy upgrades in the order of ten to twelve billion euros to achieve an annual refurbishment rate of around two percent (see Figure 1).[4]

One reason that may explain this deviation from the desired path of refurbishment is likely to be the discrepancies in short investment horizon of some home owners and longer repayment periods for energy efficiency

1 J. Blazejczak, D. Edler, and W. P. Schill, "Improved Energy Efficiency: Vital for Energy Transition and Stimulus for Economic Growth," DIW Economic Bulletin, no. 4 (2014): 3–15; K. Neuhoff, H. Amecke, A. Novikova, and K. Stelmakh, "Energetische Sanierung: Handlungsbedarf auf vielen Ebenen," DIW Wochenbericht, no. 78(34) (2011): 2–12.

2 A. B. Jaffe and R. N. Stavins, "The energy-efficiency gap: What does it mean?," Energy policy 22(10) (1994): 804–810.

3 Federal Ministry for Economic Affairs and Energy (BMWi) and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) (2010), Energy Concept for an environmentally friendly, reliable and affordable energy supply, Berlin (2010), Federal Ministry for Economic Affairs and Energy (BMWi) (2014), BMUB (2014), National Action Plan for Energy Efficiency.

4 The additional investment required also includes a surcharge to compensate for the lack of investment to date which would have been required to achieve the objective of a two-percent refurbishment rate. See J. Blazejczak et al., "Energy Transition Calls for High Investment," DIW Economic Bulletin, no. 9 (2013): 3–14.

Table

Volume of newly commited loans and grants
Million Euros at current prices

	2009	2010	2011	2012	2013	2014
New construction of energy efficienct buildings	3,094	3,654	3,613	5,640	6,265	5,623
Energy efficiency refurbishment	5,769	5,092	2,896	4,247	4,103	3,697
Program: "KfW Effizienzhaus"	3,772	3,292	1,639	1,976	1,862	1,795
Small scale refurbishment	1,898	1,653	1,198	2,186	2,022	1,725
KfW grants	99	147	59	85	159	148
supplementary loans	–	–	–	–	60	29
total	14,632	13,838	9,405	14,134	14,471	13,017

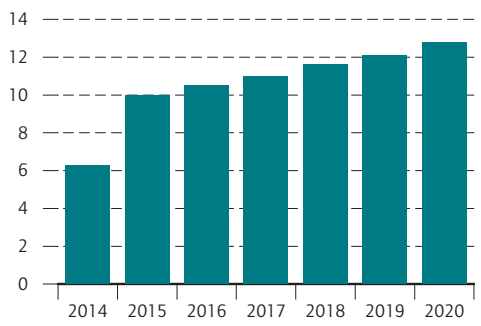
Source: KfW Förderreport.

Despite the excellent conditions for construction, the volume of new loans for "green" refurbishment declined substantially.

investments. In addition, real estate owners are reluctant to invest in deep refurbishments, especially for rental apartments, given their complexity and the risks involved. Information and advice campaigns aimed at real estate owners and qualifications and certification for construction companies should have a positive effect on individual risk assessments. This applies in particular to energy improvements due to be implemented as part of overall building refurbishments. The incremental costs of energy efficiency upgrades are then a much lower.

Figure 1

Additionally required investment in "green" refurbishments
In billion Euros[1]



1 at 2012 prices.

Quelle: Blazejczak, J. et al. (2013): Energiewende erfordert hohe Investitionen.

There is a urgent need for additional investment in "green" refurbishments.

For most of the previously skeptical investors the combination of comprehensive advice on energy upgrades with preferential loans or direct grants through Germany's public bank KfW *(KfW)* seems a suitable strategy. Nevertheless, this program might still not reach some investors. This gap could potentially be closed by with equity capital of third party investors with investment and risk profiles that match energy efficiency projects.

Quite similar approaches have been proposed in April 2015 by the expert commission on strengthening investment in Germany appointed by the Minister for Economic Affairs and Energy. The commission sees the establishment of an investment fund as one option to increase investment in energy efficiency. In this proposal, the fund should collect private capital and provide equity capital for investments. These should then be refinanced from the returns of the investments, such as energy cost savings. In the subsequent debate about the National Action Plan for Energy Efficiency, the Innovative Financing Concepts working group set up at the Federal Ministry for Economic Affairs and Energy is currently reviewing whether a private equity fund could stimulate more investment in building energy efficiency.[5] The present report discusses at what point an instrument of this type makes sense, what gaps it could close in the current financing structure, and what experiences other countries have had with similar Pay As You Save (PAYS) programs.

Energy Efficiency Investments Involve Risk

Compared to other asset classes, energy efficiency investments in buildings are small scale and complex, which partially explains investors' reluctance to invest. In fact, real estate owners need to consider four different risk types:

Technical risk can result from unprofessional implementation of refurbishment measures. They result uncertainty about expected energy savings and returns to refinance the investment. A lack of information for investors may also lead to an overestimation of technical risks. Public information and advice programs as well as proposals to introduce systems for certifying craftsmen and technical planners aim to reduce this risk.[6]

Energy price risk arises from uncertainties about the development of heating prices which can have a negative

5 See Fratzscher et al., Stärkung von Investitionen in Deutschland, Final Report by the Expert Commission (2015): 74.

6 F. Mohaupt, W. Konrad, M. Kress, K. Rebmann, and T. Schlömer, "Beschäftigungswirkungen sowie Ausbildungs- und Qualifizierungsbedarf im Bereich der energetischen Gebäudesanierung," research project commissioned by the Federal Environment Agency in Dessau.

impact on the earnings expectations of investors.[7] For example, the extensive use of fracking technology in the US has led to significantly higher delivery volumes of gas and oil than predicted in most forecasts. This contributes, *inter alia*, to the current decline in energy prices which, in turn, is reflected in the profitability of energy efficiency investments.

Real estate market risk is caused by changes in the willingness of tenants and investors to pay for the energy efficiency of a building. Landlords are uncertain about their ability to pass on costs of energy efficiency investments to tenants in the form of higher net rents and real estate sellers are uncertain on whether the sales price will increase to reflect the energy efficiency investment. This depends largely on the structure and development of the regional housing market.[8]

Financing risk is partly due to the fact that default probabilities are bundled into a single investment project. Investors do not have the ability to spread risk through diversification. Moreover, lenders do not usually take account of a project's energy savings because they are not a direct cash flow. Therefore, it is not the profitability of a project that is crucial for the financing decision but the borrower's creditworthiness. The possible increase in real estate value is often not considered as additional security for financing on energy efficiency investments. Financing solely from equity is not usually an option due to the high upfront costs of energy efficiency investments.

The sum of these risks can lead to investment projects not being implemented due to the high imputed interest and, associated with this, an excessively long payback period. Frequently, investment horizons are not in line with individual investment objectives. The borrower may also be refused the loan on the grounds of an inadequate credit rating or the interest rates offered on the additional credit volumes might be less than attractive, meaning that profitable investments may not receive any funding.[9] Dedicated policy instruments have therefore been implemented to increase investment in energy upgrades for existing buildings. There are three types of instruments: (i) regulatory instruments such as minimum standards of energy efficiency, (ii) information instruments such as the energy certification for buildings, and (iii) financial instruments such as low-interest loans, repayment bonuses, or investment subsidies.[10]

Credit Financing from Banks Alone Has Its Limits...

Traditionally, it is the responsibility of private banks to play the mediator, i.e., to award "small-scale" loans and take out major loans (i.e., issue bonds) themselves. In doing so, banks need to cover the default risk of individual loans with an equity ratio which has increased since the financial crisis according to Basel criteria. Since this equity capital is scarce, banks prefer to use it to back short-term loans and thus achieve higher transaction volumes. As a result, energy efficiency investments are quite unattractive to the traditional lending business of private banks due to their relatively long maturities. In addition the technical complexity associated with new project types creates risks and administrative costs for banks that may result in mark ups of interest rates offered.

...so the Government Steps In to Help Out

In many countries, public banks provide loans either directly to home owners or through private banks.[11] Public banks benefit from the government's creditworthiness and receive money at favorable rates which is allows for preferential loans at lower interest rates and with longer tenure and is frequently supplemented by direct government grants. Grants have the dual advantage of improving the economic viability of projects and increasing the equity base of the home owner, and thus enhancing its creditworthiness.

The programs of the *KfW* heavily promote measures that promise high energy savings. This should encourage investors to pursue deep refurbishments instead of implementing small-scale measures, despite the higher investment costs involved. Currently the maximum loan amounts for the energy upgrade *(Energieeffizient*

7 A. Alberini, S. Banfi, and C. Ramseier, "Energy efficiency investments in the home: Swiss homeowners and expectations about future energy prices," Energy Journal 34(1) (2013): 49–86; K. A. Hassett and G. E. Metcalf, "Energy conservation investment: Do consumers discount the future correctly?," Energy Policy 21(6) (1993): 710–716. Journal 34(1) (1993): 49–86.

8 K. A. Kholodilin and C. Michelsen, "The Market Value of Energy Efficiency in Buildings and the Mode of Tenure," DIW Diskussionspapier 1398 (2014); M. Hyland, R. C. Lyons, and S. Lyons, "The value of domestic building energy efficiency – evidence from Ireland," Energy Economics 40 (2013): 943–952.

9 H. Bruderer Enzler, A. Diekmann, and R. Meyer, "Subjective discount rates in the general population and their predictive power for energy saving behavior," Energy Policy 65 (2014): 524–540.

10 In addition, there has been much discussion about "white certificates." For an overview, see Paolo Bertoldi et al., "Energy supplier obligations and white certificate schemes: Comparative analysis of experiences in the European Union," Energy Policy 38.3 (2010): 1455–1469.

11 For an overview, see C. Hudson, A. Schopp, and K. Neuhoff, Financing of Energy Efficiency: Influences on European Public Banks' Actions and Ways Forward, (2013). DIW Berlin report in co-operation with IDDRI, EnergiaKlub, and the University of Vigo. Although the funding programs for the state banks are all aimed at encouraging investment in energy efficiency, there are certainly differences in their design. KfW loans in Germany are only awarded through private banks, and some of the default risk on the loans and therefore the incentives for credit checks remain with private banks. In France, the Caisse des Dépôts et Consignations (CDC) awards discounted energy efficiency loans directly as part of the Eco-prêt logement social.

Sanieren)[12] program is up to 75,000 euros per dwelling unit and discounted interest rates at 0.75 percent. Depending on the energy standard, up to 22.5 percent of the loan can be waived as a repayment bonus.[13]

However, government-backed loans are designed as traditional real estate loans. Here, too, available collateral and the creditworthiness of the investor are decisive in the granting of a loan—but this constellation increases the number of financing options considerably. In the German model, the principal banks use the borrower's credit rating as a guideline. Under the terms of the *KfW*, an expert must confirm compliance with minimum requirements. By standardizing the process and drawing on experience gained, this allows lenders to reduce the premiums for technical risks and, therefore, to accept a substantial part of the overall credit risk, which should greatly expand the total volume of loans for energy efficiency investments.

However, as mentioned before, for some investors the payback period may be longer than the real estate owner's investment horizon. Furthermore, if real estate owners consider the selling the premises they must be confident that they can recover the energy efficiency investment from higher proceeds in the event of a sale. The present studies show that real estate sellers can certainly expect a significant increase in value of their real estate.[14] However, remaining uncertainties may reduce investor's willingness to invest, particularly in markets where real estate market risks are high.

Green Bonds: Not Currently an Option for Buildings

Given the current phase of low interest rates and declining yields on government securities, major investors (such as insurance companies and pension funds) are increasingly looking for long-term and safe investment opportunities. Initial attempts to encourage this group of investors to get involved in the market for energy efficiency investments were sales of green bonds or climate bonds. These are bonds invested in "green" projects as debt capital. This type of instrument allows investors to diversify CO_2-intensive investments in their portfolios. Green bonds are therefore particularly attractive for institutional investors.[15]

The first bonds were issued in 2007 and 2008 by the European Investment Bank and the World Bank, followed by private providers such as GDF Suez, Unilever, and Bank of America. In 2014, the green bond market had a global volume of over 30 billion dollars and rising. However, this represents less than 0.1 percent of the total bond market of approximately 80 trillion dollars.[16] To date, green bonds have mainly been used to finance renewables since the technical risks are well known and many countries now ensure reliable regulatory conditions for consistent payment flows.

Private lending for energy efficiency investments and refinancing via green bonds has yet to gain any significant market share. This is mainly due to the fragmentation of energy efficiency investments. In order for a green bond to achieve the usual issue volume of hundreds of millions, many individual loans have to be aggregated. However, it is difficult for investors in green bonds to evaluate the quality of these small-scale projects. In this context, for example, the Climate Bonds Initiative has attempted extensive standardization to reduce transaction costs and administrative complexity while ensuring the quality of the underlying loans. However, it is currently hard to imagine a direct aggregation to green bonds with no government participation, in particular for loans to private building owners.

Pay As You Save: Refinancing Directly from Efficiency Yields

The Pay As You Save programs (PAYS) are an attempt to establish incentive compatibility and, particularly, to overcome differences in investment horizons. These have already been implemented on a small scale in the US.[17] The Green Deal caused quite a stir when it was introduced in the UK in 2013; it meant that loan repayments were linked to energy cost savings for the first time throughout the country. These are serviced through an add-on to the electricity bill of the building and may not exceed the expected savings. Since repayments are linked to the electricity bill, they are deferred in periods

12 For funding terms see KfW's "Bauen, Wohnen, Energie sparen," https://www.kfw.de/PDF/Download-Center/Förderprogramme-(Inlandsförderung)/PDF-Dokumente/6000003070_M_151_152_EES.pdf, last accessed on April 21, 2015 (in German only).

13 Instead of a loan, private owners can apply for a grant of up to 18,759 euros per dwelling from the energy upgrade (Energieeffizient Sanieren) program (program number 430).

14 For a comprehensive overview of the literature, see. Kholodilin and Michelsen, "Market Value of Energy Efficiency."

15 See World Bank, "Green Bonds Attract Private Sector Climate Finance," (Brief) (January 5, 2015).

16 "The market for green bonds is booming, but what makes a bond green?," The Economist, July 5, 2014.

17 See M. Fuller et al., "Toward a Low-Carbon Economy: Municipal Financing for Energy Efficiency and Solar Power," Environment: Science and Policy for Sustainable Development 51(1) (2009): 22–33; M. Jewell, "The growing popularity of on-bill financing," Engineered Systems 26(9) (2009): 18–20; K. Johnson et al., "Lessons learned from the field: key strategies for implementing successful on-the-bill financing programs," Energy Efficiency 5(1) (2012): 109–119.

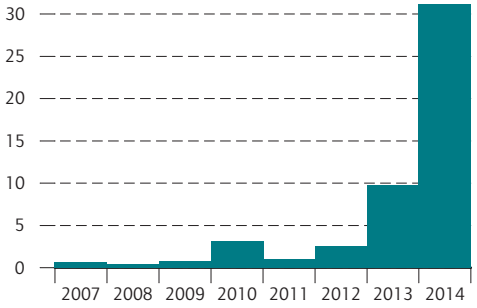
when the property is not in use—meaning that building owner or tenant pursuing the energy efficiency investment does not bear the risk that the energy efficiency investment will not be of use and remunerated. This is to encourage energy efficiency measures being implemented in buildings with a risk of periods of non-occupancy. In the event of a sale, the payment obligation is transferred to the subsequent owner or tenant. As a result, the risk of financing on unsecured loans is reduced and even tenants can get access to financing for energy efficiency measures.[18]

The Green Deal combines energy advice from certified experts with the provision of loans for energy efficiency measures. Capital is made available by Green Deal providers. In turn, these providers can obtain financing from the Green Deal Finance Company, a consortium including British Gas, E.ON, EDF Energy, Goldman Sachs, and HSPC. Green Deal providers currently receive an interest rate of around seven percent.[19] In return, the Green Deal provider bears the risk of households not fully paying off premiums on heating bills. However, the default rates are considered to be relatively low and are pooled across all households.[20]

The Golden Rule determines the maximum loan sum that can be made available for any premis: Expected savings on heating costs must be greater than the debt service costs, and the repayment period must be shorter than the expected technical lifetime of the energy efficiency measure.[21] Consequently, the loan is not tied to the value of the property or the creditworthiness of the owner as is usually the case, but explicitly to the return on the investment. With a maximum loan sum of less than 12,000 euros, the program is aimed at small-scale measures[22] and therefore cannot be used to finance comprehensive thermal retrofits of buildings that are required to meet the long-term energy and climate objectives.

Figure 2

Volume of newly issued Green Bonds
In billion Euro at constant prices



Sources: Climate Bond Initiative; Calculations of DIW Berlin.

Recently, the volume of newly issued Green Bonds has increased substantially.

There has been very little demand for the Green Deal since its introduction in 2013. The reasons for this have not yet been thoroughly researched, given the short period the program has been in place. Since large volumes of efficiency measures have been implemented in previous years, generic administrative barriers and the lack of capacity to implement measures do not appear to be principally responsible. Interest rates are generally described as unattractive even though no equity is needed and the Golden Rule actually ensures a net profit for real estate owners.[23] That the maximum loan sum is relatively small and includes no subsidy component is likely to play a role. Above all, the technical project risks and energy price risks remain largely with the real estate owner and the tenant. Awareness and understanding of the opportunities of the Green Deal were also quite low—an indication that the success of the program does not only depend on the financial provisions.

Energy Saving Performance Contracting: Largely in Germany's Public and Commercial Sectors

Instead of financing energy efficiency investments through debt capital, they can also be financed with venture and/or equity capital. This has already been practiced for many years in energy saving performance contracting (ESPC). The contractor invests in energy upgrades and concludes a service contract with the real estate owner (contractee). The contractor receives a fee

18 M. Schröder, P. Ekins, A. Power, M. Zulauf, and R. Lowe, The KfW experience in the reduction of energy use in and CO_2 emission from buildings: operation, impacts and lessons for the UK (2014).

19 There is a lack of precise information on the average returns for Green Deal providers. It is reported to be around seven percent. See, for example, "Eco living: why is the Green Deal failing?," The Telegraph, July 18, 2014; or DECC Final Stage Impact Assessment for the Green Deal and Energy Company Obligation, (London: 2012).

20 J. Rosenow, N. Eyre, V. Bürger, and C. Rohde, "Overcoming the Upfront Investment Barrier–Comparing the German CO_2 Building Rehabilitation Programme and the British Green Deal," Energy & Environment 24(1/2) (2013): 83–103.

21 M. Schröder, P. Ekins, A. Power, M. Zulauf, and R. Lowe, The KfW experience in the reduction of energy use in and CO_2 emission from buildings: operation, impacts and lessons for the UK (2011).

22 J. Rosenow, N. Eyre, V. Bürger, and C. Rohde, "Overcoming the Upfront Investment Barrier–Comparing the German CO_2 Building Rehabilitation Programme and the British Green Deal," Energy & Environment 24(1/2) (2013): 83–103.

23 J. Rosenow and N. Eyre, "The Green Deal and the Energy Company Obligation–will it work." Paper presented at 9th BIEE Academic Conference, Oxford, 2012.

equal to the energy cost savings for the term of the contract. After the contract period has ended, the real estate owner benefits in full from the investments made. The burden of financing and project risks are largely transferred to the contractor.[24] As a result, the barriers for contractees are only the administrative cost of contracts and losing the option of carrying out refurbishment themselves.

Energy saving performance contracting has been established largely for commercial and public real estate owners to date and is usually focused on heating technologies and not thermal insulation. This model is also used by private real estate owners to a very limited extent.[25] On the one hand, this is due to the inadequate legal framework, particularly for tenancy law and, on the other, to the considerably more heterogeneous risks in the private sector and the small scale of the projects compared to non-residential construction. In addition, the contracting model may be accompanied by disincentives arising from the payment of a lump sum for a usage-based service: Individual users no longer have an incentive to save energy by changing their behavior.[26] Given its risk structure, the residential real estate segment is rather unattractive for contractors. In addition, refinancing the projects is likely to be comparatively expensive. For private building owners, this constellation would presumably also result in relatively long-term contract commitments limiting flexibility for adjustments to building structure or use.[27]

Opportunities Afforded by Energy Efficiency Funds

A closed fund, as proposed by the expert commission on strengthening investment in Germany as an alternative for financing particular municipal or commercial energy efficiency investments, could complement existing instruments by providing equity capital, in particular. The fund would accumulate capital from investors with a similar temporal investment and risk profile as energy efficiency investments, such as life insurers or pension funds under pressure in the current environment of low interest rates. The development of recently issued Green Bonds shows the increasing willingness to invest in such projects.[28]

A fund that invests equity capital in energy efficiency projects initially likely to be particularly relevant for municipal as well as commercial projects. The experience of energy saving performance contracting has shown that these projects are sufficiently large and that creditworthiness and contract design are comparatively low hurdles. Nevertheless, if the projects were bundled appropriately, this model might also be used for the residential sector. The current development of integrated concepts for entire residential areas,[29] presents a possible starting point.

The model corresponds broadly to the system of contracting. The fund could either act directly as a contractor or invest equity capital in private contractors.[30] Yields would come directly from the energy efficiency improvements—in accordance with the PAYS principle. In addition to contractors, a correspondingly large fund would provide better opportunities to diversify the risks of individual projects, thus reducing the risk premiums when refinancing. Long-term investments could help to align investment pay back period and investor's horizon. This kind of fund could also gradually build up technical knowledge and the capacity to assess investment projects and allow investors to embark on a learning curve which would permit further cost reductions in the medium term. The complexity of the projects would presumably have to be reduced by standardizing implementation and contract design. The products could be standardized according to the Green Deal, especially taking into account the Golden Rule. This would, however, substantially limit the range of possible measures—ambitious upgrades would rarely withstand a comprehensive assessment. The government could contribute by bearing the higher administrative costs arising due to the small scale of the project which would be detrimental when refinancing. Government participation would also increase creditworthiness.

Alternatively, a fund could serve as a Green Deal provider and make debt capital available. Yields would be tied directly to savings representing an incentive-com-

24 A. Marino, P. Bertoldi, S. Rezessy, and B. Boza-Kiss, "A snapshot of the European energy service market in 2010 and policy recommendations to foster a further market development," Energy Policy 39 (2013): 6190–6198.

25 For an estimation of market volumes, see BMVBS/BBSR, Contracting im Mietwohnungsbau – 2. Sachstandsbericht (second status report) BBSR online publication 27/09 and BMVBS/BBSR, Contracting im Mietwohnungsbau – 3. Sachstandsbericht (third status report) BBSR online publication 28/09 (2009).

26 M. Pogoda-Urbanski, Gestaltungsformen von Energie-Contracting in Theorie und Praxis: Analyse in ausgewählten EU-Ländern (Cuvillier, 2013).

27 J. Ruhland and R. Herud, "Wärmecontracting in der deutschen Wohnungswirtschaft: Instrumente für eine angemessene Regulierung," Zeitschrift für Energiewirtschaft 33(3) (2009): 237–245.

28 For details of possible fund solutions, see the report by the expert commission on strengthening investment in Germany on behalf of the Federal Minister for Economic Affairs and Energy, Sigmar Gabriel, p. 44 ff. and p. 74 ff.

29 See also KfW leaflet, "Kommunale und soziale Infrastruktur, Energetische Stadtsanierung – Zuschüsse für integrierte Quartierskonzepte und Sanierungsmanager (Programm 432)" and "Energiekonzept der Bundesregierung" (2010) and "Nationaler Aktionsplan Energieeffizienz (NAPE)" (2014).

30 Similar models have been debated for quite some time, see, for example, P. Grösche, "Marktkonforme Möglichkeiten zur Forcierung privatwirtschaftlicher Investitionen in den Wohngebäudebestand zum Zwecke einer effizienteren Energieverwendung," Final Report, RWI Project Reports (April 2006).

patible alternative to existing models for both tenants and real estate owners. Here, too, the government could help by participating in the administrative costs to facilitate market entry for private investors. In principle, this type of financing can be applied to the existing and proven system of debt financing. Given the very low uptake of the Green Deal in the UK, more extensive studies should be implemented in advance to examine whether this is due to general barriers to uptake as described in the model or whether its practical implementation in the UK actually deterred potential investors.

Conclusion

The debate over innovative financing instruments for energy efficiency investments has recently gained momentum. Given the large investment demand with simultaneous high investment pressure on large institutional investors, the discussion about a greater involvement of private capital seems obvious. In order to achieve climate protection objectives, considerable investment is needed by 2020, particularly in the German residential sector. Many aspects of the German system of subsidies for energy efficiency investments, particularly through *KfW* programs, are considered a good example by other countries. Nevertheless, efforts so far have not been sufficiently effective at lifting the rate of refurbishment up to the desired two percent per year. In order to positively impact homeowners' risk assessment, there is clearly still a need for considerably more information and advice. Improving qualifications and certification of construction companies and/or certain construction services can help increase willingness to invest.

However, classic lending models have their limitations, in particular for investors whose investment horizons are much shorter than the duration of the project. Such investors could be encouraged through programs structured along the principle pay as you save. The risk of the investment is assumed in whole or in part by third parties—repayment or remuneration is serviced solely from energy cost savings. However, there is limited experience with such models to draw on at present. The available evidence, particularly in the UK, indicates there are greater initial difficulties and problems with loans serviced through energy cost savings. To date, there is very little direct participation of investors in energy saving performance contracts in Germany, at least in residential construction. Alongside legal barriers, this is likely due to the complexity and small size of the projects. At this point, a larger-scale fund model could provide a starting point to appeal to more capital investors and, at the same time, solve some of the problems associated with equity financing. On the one hand, this affects options for diversification and associated improvements in the risk structure as well as more favourable fund refinancing compared to smaller contractors. On the other hand, a larger fund allows experience to be gained and will reduce transaction costs with standardized projects and contracts.

Projects eligible for these funds remain limited to individually profitable investments. A fund could supplemental existing *KfW* instruments, in particular, where there is a lack of equity capital or willingness to implement projects of a longer duration.

Due to its complexity, setting up a fund of this nature would certainly be a challenge, probably highly costly, and therefore unlikely in the short term. Also, the potential market volume is currently difficult to predict. Given the major challenges of the energy transition, the innovative financial instruments described above should be examined in more depth in terms of their design and implementation options, and, at the same time, existing instruments should be developed further.

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