Chapter 9
Conclusions: A New Way Forward

Abstract Germany has engaged better-off homeowners in advanced thermal retrofits to high standards. However, at this level retrofits are inherently economically inefficient, and empirical research shows they often bring significantly smaller savings than calculated. This 'top-end' approach also fails to engage the bulk of homeowners, due to severe technical and economic difficulties of retrofitting to the required level. In order to increase the annual retrofit rate and energy savings, we propose a broadening out of policy into three distinct streams, simultaneously promoting: *cost-effective* thermal upgrade measures, which would not necessarily meet current, stringent EnEV standards; *user behavior* change, which appears to have a very large saving potential that is already beginning to be realized; and *top-end* thermal retrofits which may not be economically viable but could be promoted for their environmental and comfort benefits. To put this three-stream CUT model into place would require institutional change, and also a significant shift in attitude among policymakers. They would have to accept the value of modest thermal upgrade measures, and of the contribution of behavior change, rather than remain narrowly focused on the extreme end of technological capability. Notions of 'economic viability' would also need to be overhauled.

Keywords Retrofits · Thermal regulations · German policy · Economic viability · Energy use behavior

9.1 Introduction

This book has critically analyzed the German project of thermal retrofitting of existing homes. We have found much of value in this policy, but also seen that the results it is achieving fall far short of what policymakers have aimed for. The policy is leading to real, measurable reductions in domestic heating fuel consumption of about 0.25% per year, whereas this needs to be about 2.1% to reach the policy goal of 80% reductions by 2050.

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In this chapter we summarize the reasons for this shortfall, but also take the matter one step further. We believe our detailed analysis has not only uncovered weaknesses of this policy, but has also brought to light pointers as to how it can be improved. We think a set of well-designed policy initiatives along certain lines could lift the current 0.25% annual consumption reduction rate to well over 1%, without any significant increase in government spending. Much of this chapter is therefore devoted to outlining our suggested approach to accelerate heating fuel savings from the existing German homes. We call this the CUT approach, as it is based on a balance of: Cost-effective retrofit measures; User behavior strategies; and Top-end retrofit measures. We will be suggesting that the German Government has depended far too heavily on the third of these. It has pursued unbalanced policies, investing almost all its energies and legal powers in promoting expensive, technically difficult 'deep' retrofits that are often individually impressive but bring relatively little return per euro invested. In so doing, it has narrowed the appeal and accessibility of thermal retrofits to a small segment of well-off private homeowners and well-funded housing providers. Meanwhile, it has neglected other potential fuel and CO_2 savings that are waiting to be tapped, and that are found across the board in the German housing stock.

We will propose an alternative policy approach, which we hope will find fertile ground among Germany's policymakers—many of whom we have shared discussions with in the course of our research. First, however, we will summarize the results of our research as outlined in this book. This summary is given in Sect. 9.2. In Sect. 9.3, the CUT model is outlined in practice. Final concluding remarks are offered in Sect. 9.4.

9.2 Summary of Findings

9.2.1 The Current Policy

Germany has taken bold steps to improve the energy efficiency of its housing stock over the last decade. The Energy Saving Regulations (EnEV), brought into force in 2002 and strengthened in 2009, require homeowners to thermally upgrade their properties to specific standards when they do regular or incidental maintenance, repairs, or extensions. The maximum permissible theoretical (calculated) heating energy consumption for a comprehensively renovated building is an average of 100 kWh/m^2a, while that for individual measures, such as a wall or roof refurbishment, are the equivalent of a building designed to reach 70 kWh/m^2a. This compares with an average theoretical standard in the current building stock of around 225 kWh/m^2a.

The average depth to which homes have been thermally retrofitted increased steadily from the mid 1990s to the late 2000s, but has now reached a plateau. The limits of technically feasible, economically efficient thermal renovation now appear to have been reached, and this is reflected in the government's recent decision not to tighten the regulations further.

Germany's thermal retrofit policy is closely tied to its climate goal of 80% reductions in CO_2 emissions compared to 1990 levels by 2050. Despite progress made since 1990 in new build and thermal retrofit technology, in 2013 Germany is still left with a housing stock that would need its entire heating fuel consumption to be reduced by 80% for the climate goal to be reached in respect of this sector.

The average *theoretical* reduction being achieved in Germany's retrofit projects—including those receiving subsidies from the German Development Bank (KfW) for attempting to go beyond the EnEV requirements—is a disappointing 33%. The *actual* savings, based on measured pre- and post-retrofit consumption is even lower, at around 25%. The equivalent of around 1% of total living area is being retrofitted to this standard annually, putting the national annual reduction in energy consumption, through thermal retrofits, at about 0.25%. If this rate continues for the 38 years from 2013 to 2050, it will produce a saving of 9.5%. This is a long way from the required 80%.

The reasons this progress is slow can be discussed under three broad headings, though they are deeply intertwined: technical, economic and user-behavior challenges.

9.2.2 Technical Challenges

The biggest technical challenge is the 'law of diminishing returns'. A modest depth of insulation can provide relatively large fuel savings for a thermally poor dwelling, but as the thermal quality improves, it takes proportionately greater depths of insulation to achieve significantly larger savings. This is a physical, mathematical reality, which applies even in ideal shaped buildings. But actual existing homes present additional, practical difficulties: roof overhangs that are too short to accommodate 16 cm of wall insulation; basements that become too shallow with 10 cm of insulation attached to the ceiling; wall insulation that protrudes into driveways, balconies, and neighbors' properties; windows that seem to disappear down dark tunnels when wall insulation is too thick; roofs that need to be rebuilt to accommodate 22 cm of insulation under the tiles. Older homes also often have many corners, attached balconies and gables. These increase the outside surface area, thereby increasing the heat loss, and also present difficulties for attaching thick insulation. They can also bring conflicts between architectural values and measures to improve energy efficiency.

Further, the tight air seal required for high thermal standards leads to the need for good ventilation, but building a mechanical ventilation system into the structure of an old home is technically difficult and expensive. Without such a system occupants have to ventilate manually—which can lead to large wastage of heating energy—to ensure good indoor air and avoid mould growth. Challenges such as these have led to homeowners, academics and the construction industry giving increasing feedback to the government that the technical requirements of the EnEV are already too strict for many projects.

9.2.3 Economic Constraints

The second set of difficulties is economic. In Chap. 6, we saw that the EnEV sets thermal retrofit standards at the limit of what policymakers believe to be 'economically viable'—where the fuel savings over the technical lifetime of the retrofit measures are expected to pay for the costs of those measures. However, we identified six key problems with this approach. First, it only applies when a building is being retrofitted anyway, for regular cyclical maintenance, since only the 'additional thermal costs' are counted in the calculation of economic viability. Second, even for such cases as these, the technical difficulties outlined above can lead to step-wise cost increases. Third, the economic viability criterion assumes a pre-retrofit heating fuel consumption level equal to the calculated energy rating, whereas actual consumption is, on average, 30% below this—what we call the prebound effect. This drastically reduces the actual fuel savings achieved through thermal retrofits, as occupants cannot save fuel they were not already consuming.

Fourth, even if this were not a problem, the economic viability criterion depends on an exponential curve of future fuel price rises, so that investors suffer cumulative losses for some 14 years before the returns begin to pare back these losses. Many homeowners do not like investing over such long time horizons, and this reduces the appeal of thermal retrofits as a financial investment. Fifth, the economic viability models fail to take into account price elasticity of demand for heating fuel (Chap. 8). This reduces the return on a retrofit investment by around 25% and can lengthen payback time from a few years to many decades. Finally, the marginal costs of thermal retrofits to EnEV standards represent CO_2 abatement costs of €250–€1000 per tonne of avoided CO_2 emissions. This compares with typical costs in other sectors of less than €30, making retrofitting to EnEV standards a very economically inefficient way to achieve CO_2 abatement goals even in cases where it is economically viable.

These economic difficulties, we believe, are the main reason the annual rate of thermal retrofits has stalled at around 1%.

9.2.4 Challenges Presented by User Behavior

The way occupants behave in relation to their day-to-day home heating is one of the reasons for the low magnitude of fuel savings being achieved through thermal retrofits. To begin with, the prebound effect means that often there is not as much savings potential in a retrofit as expected. Further, homeowners who were fuel thrifty prior to a retrofit might feel they deserve to be warmer after spending large sums on the retrofit, and respond by keeping higher indoor temperatures. If these go above the 19 °C assumed in the calculated energy rating, the prebound effect may go into reverse, so that households consume more energy after a retrofit than the post-retrofit rating.

On the other hand, the prebound effect has the positive advantage of bringing heating energy savings *without* retrofitting. We saw (Chap. 7) that these savings appear to have been increasing steadily over the last decade. This could be partly a response to rising fuel prices (Chap. 8), or to demographic and lifestyle trends, or to increased ecological concern. We will return to this issue in our discussion of our CUT proposal below.

A further behavior-based reason for the low savings rate through thermal retrofits is that German occupants are not well skilled at ventilating their homes energy efficiently, a problem that becomes more acute for thermally retrofitted dwellings. A case study carried out in Aachen, a medium-sized city in northwest Germany, revealed that energy-efficient ventilation is the exception rather than the norm (Galvin 2013). To solve the problem of moisture build-up in air-tight dwellings, most households ventilate by putting windows on the trickle ventilation setting (tilted open at about 10° from the vertical) for several hours a day. This sends warm air out the window, cools the interior substance of the building, and can consume up to 30 kWh per day. The energy-efficient way to ventilate such homes is by 'shock-ventilation' *(Stoßlüften)*, in which all windows and internal doors are opened completely, for 2–3 min only, several times per day, and kept firmly shut the rest of the time. Each shock-ventilation consumes around 1 kWh, a fraction of consumption by trickle ventilation. The prevalence of trickle ventilation in Germany is no doubt a major reason for the low savings rate through thermal retrofits, and deserves to be more thoroughly investigated.

These types of factors—technical, economic, and behavioral—appear to be combining to make for a disappointingly low rate of annual reductions in energy consumption through thermal retrofits. Our most recent discussions with policymakers in Berlin indicate that there are two broad streams of thought as to what to do about this. Some are saying we must simply push harder: tighten the thermal standards further; increase the level of subsidies for top-end retrofits; legislate to require homeowners to thermally upgrade their properties even if not doing maintenance; introduce a strict inspection scheme with powers to impose heavy fines for noncompliance; pull down more old buildings and replace them with 'nearly zero energy' homes (for examples of this approach see BMWi/BMU 2010, 22ff; Tschimpke et al. 2011). We see this as impractical and economically inefficient. It would divert large quantities of money and expertise to top-end upgrades which give a low return on energy saved per euro invested and incur huge CO_2 abatement costs, not to mention possible human rights issues of forcing homeowners to pay for most of it.

Other policymakers, however, are hoping there might be some other way forward. We now introduce an approach that should cost no more Federal money than the present one but could unlock yet-unrealized domestic heating fuel saving potential, lifting the annual rate of reduction in heating energy consumption by a very significant proportion.

9.3 A Way Ahead: The CUT Model

The policy approach we are suggesting for thermal retrofits is based on a pragmatic balance of: Cost-effective retrofit measures; User behavior strategies; and Top-end retrofit measures. We propose that Federal policy needs to be re-thought and re-developed, so that all three of these are emphasized and promoted equally. This would require certain changes to the EnEV, but equally important, it would need three parallel, focused promotional and enabling thrusts, each well funded, and critically informed by ongoing, interdisciplinary research.

9.3.1 'C': Cost-Effective Thermal Upgrade Measures

We have argued that retrofits to EnEV standards are not, for a majority of homes, the benignly economically viable projects they are made out to be. However, we have also argued that some thermal retrofit measures generally are economically viable (Chap. 6), and that if these are done sensibly they can also be economically *optimal*—they can bring the greatest possible return in energy saved per euro invested. For example, a layer of 12 cm of insulation attached between the rafters of a roof (i.e. in a common accessible attic in an apartment building) might not only bring a positive monetary return from fuel savings, but also save more fuel per euro invested than any other thickness, larger or smaller. For a different roof, the economic optimum might be 10 or 16 cm or, if the loft is not used as accessible space, the economical optimum might be to lay 25 cm of insulation on the loft floor. There might also be an economically optimal thickness of insulation for the basement ceiling if the basement is shallow. Other examples might be filling cavity walls, installing hydraulic equalization in the central heating system, or applying air-sealing strips to stop draughts through the windows.

In some cases, wall insulation can also be both economically viable and economically efficient. If a wall needs major repairs or maintenance, a certain thickness of external wall insulation might pay back through fuel savings within a decade. But this may have to be less than the EnEV standard of around 16 cm to avoid roof realignment or repositioning of driveways etc. Alternatively, internal wall insulation can be far cheaper than external, but to preserve indoor living space this usually has to be much thinner than 16 cm. For example, a 4 cm layer, correctly applied with moisture avoidance gaps, can make a significant saving. It can reduce the U-value of a section of wall from a chilly 3.5–1.0 W/m^{2}K, a reduction in heat loss of 71%. This is not as thermally effective as an EnEV-standard 16 cm layer, which would bring a U-value of 0.25 W/m^{2}K and a reduction for that section of wall of 94%, but is far cheaper and many times more economically efficient.

A thermal upgrade measure which could work on a very large scale in Germany is roof insulation. The EnEV requires roofs to be insulated to achieve a U-value of 0.20 W/m^2K or less. This requires 20–24 cm of insulation. Since the rafters are generally only 12 cm deep, there are two main options to achieve this. The cheaper of these is to insulate both between and under the rafters, though this requires highly skilled labor and reduces the useable area of the loft considerably. The more expensive option is to insulate from outside: either rebuild the roof, or remove the tiles, fix a layer of hard insulation material on top of the rafters and place new tiles on top of that. This would require professional contractors and cost around €20,000 for a typical apartment building (Simons 2012, p. 19).

The cost-effective option, however, is often to fit a 12 cm layer of insulation between the rafters internally. Interestingly, the EnEV now has additional clauses, in appendices, that allow for this option if the existing building structure makes the standard 22 cm depth technically unworkable (GdW 2010). This is an example of how regulations for the existing stock can in fact be attuned in a more nuanced way to accommodate the characteristics of buildings and the economic restraints homeowners are under. However, because this is seen as a technically inferior option, it is not promoted by the government and our enquiries revealed that local authorities are often not even aware it exists as a legal option.

Nobody knows how many of Germany's 18 million roofs of residential buildings are uninsulated, but from our discussions with German Energy Agency we estimate this to be around 10 million. If 260,000 of these were insulated internally in a cheap, modest, economically optimum way each year, this could easily save 2,000 kWh per year for each building, reducing Germany's heating consumption by a further 0.52 TWh per year, or 0.11%. In 38 years, this would bring national reductions of 4.5%.

Based on a particular, typical apartment building roof in Aachen and current prices, we estimate that a problem-free job of this type would cost about €600. At the current fuel price of €0.10/kWh, this would pay back, through fuel savings, in 3 years. If at any time after that the tiles are ready to be replaced and it becomes economical to fit external roof insulation, there would be no net monetary loss from insulating twice (i.e. it would not cause 'lock-in' to a low standard). This genuinely easy gain is currently available, but the government does not promote it.

Another pair of cost-effective, easy gains are boiler adjustment and hydraulic equalization for distributing heat more evenly in multi-storey buildings. These cost little and can bring significant savings, and are already promoted, to some extent, by government campaigns and the literature. We are suggesting that a special branch of policy needs to focus on promoting cost-effective thermal upgrade measures, regardless of how technically interesting (such as hydraulic equalization) or commonplace (such as insulation placed between rafters) they might be.

What would have to change, for such a policy to be embraced? First, we suggest that a prevailing discourse of technological perfectionism would need to loosen its hold. Interviews with policymakers and their expert advisors at Federal, state, and municipal level have revealed a firm attachment to the notion that only the best technology is good enough: if we now have the know-how to attach 16 cm of external wall insulation, we must do it. Phrases such as *'es muss richtig sein'* (it must be done correctly) and *'wenn schon, denn schon'* (if a job's worth doing, it is worth doing properly) were frequently uttered in defence of the tight standards demanded in the EnEV (Galvin 2011; see also Simons 2012, p. 20).

In contrast, a researcher at GdW, the Association of German Housing Providers (www.gdw.de) pointed out that 15 years ago policy actors were excited that it had then become possible to attach layers of 8 cm of external wall insulation. 8 cm, she said, was 'all the rage' (*der letzte Schrei*). As thicker layers began to be used, however, 8 cm became passé, then substandard, then in most circumstances illegal. Even though there are severe economic and technical problems in attaching 16 cm, which make many homeowners shy away from retrofits, this was lauded as the correct standard that must be adhered to.

We suggest Fritz Schumacher's phrase 'appropriate technology' (Schumacher 1973) would be more suitable for the **'C'**-strand of policy than technological perfectionism, which can be confined to top-end renovation measures of the **'T'**-strand. The Housing Ministry (BMVBS), responsible for the EnEV, has developed a tight regime of promoting top-end thermal retrofits and discouraging attempts to retrofit at more modest levels. The quasi-independent German Energy Agency (DENA) has acted similarly, reaching into the community with exemplar retrofits, promotional literature and frequent press statements. The Ministry of the Economy and Technology (BMWi) and the Ministry of the Environment (BMU) have also made clear their view that top-end retrofits are the only acceptable standard (BMWi/BMU 2010). These bodies would need to shift gear so as to accept and accommodate the 'C' branch of a new policy initiative—not instead of but alongside retrofits at the top-end standard.

A second change of discourse would be an emphasis on the 'economic optimal' rather than on the outer limit of what is 'economically viable'. There is now a large body of research on the economic optimal in energy and CO_2 saving, and the EU Commission is now taking this issue seriously (Boermans et al. 2011). A case could be made for re-wording the EnEV to require those who retrofit to reach at least an economically optimum level of energy savings. Hence, instead of using 'economic viability' as a central motivating tool, the 'C' branch of policy would emphasise economically optimum retrofit measures, backed up with a flexible approach from energy advisors. Germany currently has no inspection regime for building upgrades, but we suggest that a combined advisory and inspection service could be formed out of its current home energy advisor networks to support these retrofit measures.

9.3.1.1 Saving Potential from ‘C’ Stream

Under the strict standards of the EnEV, around 1% of dwellings are thermally upgraded each year, producing average actual gains of around 25% per upgraded dwelling. If there were an energetic policy focus on economically optimum measures in this ‘C’ stream, we suggest this could produce an annual retrofit rate, at this modest standard, of up to 3%, while possibly producing actual savings of around 15% per upgraded dwelling. This would provide annual national savings of 0.45%. Continuing at this rate would exploit all such opportunities in the housing stock in 33 years, i.e. by 2045, and bring total savings of around 15%.

9.3.2 ‘U’: User Behavior

In this book, we have reviewed the evidence that user behavior contributes at least as much to the quantity of heating energy consumed, as does the technical quality of buildings. Research by the Environment Ministry (UBA) a decade ago found strong empirical evidence for this in Germany (UBA 2006). The EU Commission has recognized that household behavior change ‘…can result in large reductions of greenhouse gas (GHG) emissions in the EU, both in the shorter and in the long term’ (Faber and Schroten 2012). Qualitative studies in European countries are now revealing some of the key dynamics in this (e.g. Gram-Hanssen 2010). Our own work on the prebound effect (Chap. 5), on the fall in consumption in 2000–2009 (Chap. 7) and on ventilation practices (Galvin 2013) concurs with these findings and enables us to begin to quantify the effects of user behavior on heating consumption.

Many German households are already saving significant quantities of energy by adopting more economical day-by-day heating behavior. Average consumption is 30% below the calculated ratings of dwellings, and this figure masks a wide spread of differences between households. Some are consuming much less than this, others more. We have also found that, on average, this downward trend is increasing. We calculated that in the years 2000–2009, heating consumption in older, non-retrofitted homes not only fell by around 17.4%, but also made up over 80% of the total fall in Germany’s heating fuel consumption in those years.

These findings might point to some degree of fuel poverty in Germany, but their extent and magnitude suggest that energy-saving user behavior is commonly practiced in Germany and is becoming more widespread, without large-scale complaints of cold, uncomfortable homes.

We have good knowledge of the strategies occupants can use to reduce their heating energy consumption while remaining comfortable in their homes. The three most obvious ones are: heat only the rooms being used, wear sensibly warm clothes at home so as to keep lower indoor temperatures; and ventilate non-wastefully. In a test apartment in Aachen, a household following our advice applied these strategies in a disciplined way for a full year, without any reported loss of comfort. The apartment's calculated energy rating was 124 kWh/m^{2}a (based on 'useable' area), but the actual consumption over the year was 36 kWh/m^{2}a—a saving of 74%. This is significantly lower annual consumption than even the new-build standard of 70 kWh/m^{2}a.

But although we know the strategies that work, we do not know why some households implement them while others do not. There is increasing evidence that household energy-saving behavior is strongly determined by people's desire and willingness to save energy, and also by several other factors (Hargreaves et al. 2010). The main ones are: households' daily routines and how these fit with or compromise attempts to save energy; the discourse, or subtle messages associated with energy saving among household members; the skills occupants possess to manipulate technical systems; and the user-friendliness of the heating system's adjustment interface (Shove 2010). Attempts to induce occupants to develop energy-saving behavior need to address all these issues together. It is not simply a matter of giving out leaflets on smart ways to save heating energy, or of installing smart meters in homes. We suggest that a branch of policy needs to be developed that researches and implements effective ways to address these issues, and so to harness the large, untapped potential savings through user behavior change.

The Federal Environment Agency (UBA) has a record of proposing ambitious CO_2 reduction goals (e.g. Flasbart 2009) and has long promoted user behavior change as a means of reducing domestic heating energy consumption. This has not come across to the public with much force, but it represents the only long running, significant Federal initiative to induce user behavior change for household heating. Perhaps this Agency could be the one to head up a concerted, informed, well-resourced approach to engage households in fuel saving strategies. An early initiative could be a social science-based search for exemplar households that are successfully and comfortably living with low heating energy consumption in non-retrofitted homes. This would help policymakers better understand what motivations, attitudes, discourses, routines, skills and physical environment are associated with such savings. Findings such as this could lead to behavior models that might be able to be reproduced among other households of various types.

9.3.2.1 Saving Potential from 'U' Stream

The 17.4% reduction in heating fuel consumption through behavior change in German households in 2000-2009 represents an annual reduction of 1.8% (see Chap. 7). If these reductions could be induced to continue at only a quarter of this rate for the next 38 years they would bring a saving of 17%. If all possible savings of this kind were exhausted after 28 years, the saving would still be a healthy 13%. We believe that with robust and consistent policy support such a goal could well be achievable.

9.3.3 'T': Top-End Thermal Retrofitting

The thermal upgrade measures demanded by the EnEV can be very effective in saving heating energy, even if they do not pay back, within their technical lifetime, for the reasons we have considered in this book. These measures usually include: external wall insulation to EnEV standards; roof insulation that requires remodeling of the roof or replacement of the tiles; the replacement of serviceable windows with new, more energy-efficient models; and the replacement of boilers that are still serviceable. In some cases, solar water heating might also fit this category, depending on the building's orientation to the sun, and whether the boiler was due for replacement.

Although these measures are not likely to pay back when real, measured consumption pre-and post- retrofits is taken into account (see Chap. 6), and are very economically inefficient in terms of kWh and CO_2 saved per euro invested, they can have an important place. They reduce heating fuel consumption and CO_2 emissions, and can make homes more comfortable to live in.

The German owner occupiers we have interviewed who have adopted these measures have not told us they did so to save money (Galvin 2011). Their main motivations have been to reduce their personal CO_2 emissions and increase their level of thermal comfort in the home: to save the environment and keep warm. These have been people with above average incomes. Further, the housing providers we have spoken to who have upgraded their properties with such measures (including local authorities) have frequently also expressed the desire to reduce CO_2 emissions and provide warm accommodation for their tenants, with low heating costs.

We call these 'top-end' thermal upgrade measures for several reasons. They are at the top end of energy saving where the marginal costs are high and the marginal returns low. They include the top end of current thermal technology, such as triple-glazed, low U-value windows and highly efficient boilers. They tend to appeal to the top end of the market, where homeowners can afford to invest in their properties to make them more suitable to their needs. In some ways, they have the same appeal as renovating a bathroom or a kitchen: homeowners generally do not invest in these projects to save money, but to lift the quality of their dwelling.

We propose that the government should continue to promote 'top-end' thermal upgrade measures, as it does now—but not on the basis of their being economically viable as this is misleading. There are other good reasons to promote them: they help to protect the environment and mitigate climate change; they can make a home more comfortable to live in; they can make a house look more attractive; they bring thermal technology into the home; they can reduce heating fuel bills, even if not enough to pay back over their technical lifetime; they provide a kind of insurance against sudden, unexpected spikes in heating fuel prices, making household budgeting more stable; they can give a new lease of life to an old building.

However, retrofitting to this level should not be compulsory, especially not for households that cannot afford it. It is seldom economically viable in the commonly understood meaning of the term; it is often an economically inefficient way to save fuel and reduce CO_2 emissions; and as a compulsory standard it makes modest, economically optimum retrofit measures illegal and it puts thermal upgrades out of the financial reach of most homeowners.

We also suggest there is little justification for continuing to subsidize retrofits that go beyond the EnEV standards. As well as 'free-rider' effects that have been observed in several countries (Chap. 3), retrofitting to these standards is even more economically inefficient than to EnEV standards, so that public money is being spent for a fraction of the return it could get in other CO_2 abatement projects.

Government strategy of encouraging 'top-end' measures should adopt a market-led approach and try new, community-based local outreach strategies to address the barriers unique to each community—an approach that has offered clear advantages for example in the 'Neighbour to Neighbour' program in Connecticut US (see Gillich and Sunikka-Blank 2013). Further, since contractors are likely to play a critical role in the success of the policy, not only as builders but also as practical advisors to households, the outreach strategy should be formulated in consultation with contractors, while trying to ensure that the inclusion of the energy efficiency measures targeted by the program offers incentives in the contractors' business models.

We suggest that promoting thermal retrofits at the top-end level needs to be the third branch of heating fuel savings policy, but only alongside the other two. The policy infrastructure for this is already in place, as it represents the main thrust of current policy. But its message needs to be altered, to focus on a particular audience with financial resources, and to be realistic about the economic benefits of this level of retrofitting, based on the actual energy consumption.

9.3.3.1 Saving Potential from 'T' Stream

We have argued in this book that about 1% of dwellings are benefiting from these type of measures annually, achieving an average real, measured saving of 25% per dwelling retrofitted. If the government were to target better-off homeowners with the challenge of improving their homes and protecting the environment at their own personal cost, it is conceivable that this kind of more targeted campaign could increase the current 1% refurbishment rate at this depth slightly to 1.5%. A 1.5% annual retrofit rate at this depth would provide national savings of 0.15% in addition to those provided by economically optimum upgrade measures. This could amount to additional national savings of around 6% over 38 years.

9.3.3.2 Total Saving Potential from CUT Streams

With 15% savings from the 'C' stream, 13% from the 'U' stream and 6% from the 'T' stream this would give total savings of 34% by 2050. Admittedly, this is still short of the 80% goal, but it is far higher than the 9.5% we can hope for from the current policy. In any case, the figures suggested above are based on deliberately conservative estimates, and with a determined and properly informed policy approach they could be even higher.

9.4 Conclusions

In this final chapter, we have acknowledged the successes of the German project of thermal retrofits of existing homes, but highlighted its shortcomings. Its successes are the technical achievements of retrofitting a wide range of homes to high thermal standards; the development of a nationwide infrastructure to do this; and the motivating of a steady stream of well-financed individuals and housing providers to retrofit to these standards. Its main shortfall is its rigid demand for top-end thermal upgrades to the exclusion of other types of upgrades. This leads to economic inefficiency, and prevents homeowners undertaking modest, affordable measures that save far more energy per euro invested. It has also failed to engage vigorously with developments in household behavior change, which are already saving significant amounts of energy and CO_2, and can offer much untapped savings potential.

We have recommended a decisive shift in policy. The focus of attempts to save heating energy in the housing stock should be broadened to a balanced, three-prong CUT policy strategy. The ‘C’ stream would promote and facilitate modest, cost-effective thermal upgrade measures at an economically optimum level and increase the renovation rate. The ‘U’ stream would first research and then promote user-behavior strategies for reducing heating consumption without loss of thermal comfort. The ‘T’ stream would promote top-end retrofits to and beyond current EnEV standards in those households that can afford it and are willing to renovate—not on the basis that these are economically viable, but that they make a contribution to saving energy and CO_2, and can make a home more comfortable and provide insurance against spikes in fuel prices.

Based on our analysis presented in this book, we argue that the current German policy is leading to reductions in domestic heating fuel consumption of about 0.25% per year, whereas this would need to be about 2.1% to reach the goal of 80% reductions by 2050. If policy of the CUT model were to be vigorously pursued, we suggest it is not unreasonable to hope for savings of 34% by 2050, as it could lift the current 0.25% annual consumption reduction rate to well over 1%, without any significant increase in government spending. Further, we suggest that such a policy architecture might work well in other countries of comparable climate and economy that are also concerned to make deeper and cost-effective cuts in energy consumption and CO_2 emissions from home heating.

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