Integrating individual renovation plans and long-term perspectives into building policy instruments: an analysis of mechanisms and approaches

Dr. Martin Pehnt
ifeu – Institut für Energie- und Umweltforschung Heidelberg GmbH
Wilckensstr. 3
D-69120 Heidelberg
Germany
Martin.pehnt@ifeu.de

Keywords
retrofit, building regulations, building retrofitting, renovation, long-term policy, policy instruments, renovation roadmap, retrofit plan

Abstract
In the discussion over the future of retrofit policy instruments, long-term strategic elements including building individual roadmaps are increasingly being considered to avoid a "lock-in" of renovation activities. Such a plan develops a long-term strategy for an individual building, incentivizes a renovation as deep as possible, checks the compatibility of stepwise renovation measures against the long-term target, and develops optimal packages of measures and points to consider in the case of staged renovations.

The "Sanierungsfahrplan Baden-Württemberg" as one example is to be introduced in 2015 as a State-funded energy audit tool and includes checklists, calculation procedures and educational approaches. However, the individual building approach has also been expanded towards suggestions for a revised support scheme structure, a reward for "target compatible buildings" in the property and real estate purchase tax, changes in the energy certificate and other instruments.

This paper describes the underlying principles of a renovation plan, and investigates a potential implementation of the "long-term thinking" in information, financial support and regulatory systems. Based on an analysis of advantages and disadvantages, a two-step procedure for the further development of national policies is proposed. In the first step, long-term thinking is enhanced and methodological preparations are carried out. This involves introducing a renovation plan in audit and consultancy schemes. In addition, energy certificates and building rating systems have to be in place, long-term targets need to be defined, and craftsmen, architects, planners and end-users have to "take-in" the idea of long-term thinking in the building sector. Renovation plan elements in support schemes, such as funding of individual measures with a differentiated system (favouring deep-retrofit compatible measures), could help towards this end. In the second stage, the definition of long-term targets for renovations, as well as the implementation of bonus-malus elements integrated into an already existing tax system, would further spur the dynamics and depth of a renovation.

Introduction
Various scenarios on the long-term development of the building sector (both on a European level as well as for selected countries) suggest we must meet ambitious targets, such as the 80 % primary energy target for the German building sector (2008–2050), and that renovations have to increase significantly in terms of both renovation rate and depth. The various scenario studies demonstrate that the carrying out of sound and ambitious insulation standards is a sensible efficiency measure with respect to all the possible future development trajectories of the energy system. In contrast, the decision in favour of a certain type of heating system, is a measure that is dependent on the future development of the energy system. The exact role of cogeneration, electric heat pumps, biomass-based boilers, district heat, gas condensing boilers, solar thermal and PV systems depends upon various exogenous developments. These include, for example, the percentage and characteristics of the future RES electricity share, the technological and cost development, and energy prices.

However, for an individual house owner, uncertainty typically leads to retention with respect to renovation decisions. Therefore, instruments that trigger a long-term perspective which differentiates between robust and useful measures versus those that need to be adaptive and flexible, are useful and could enhance the rate of renovation. However, such instruments at present are only marginally developed and integrated into current policies (BPIE 2013).

This paper therefore investigates existing and new approaches. It deals not only with renovation plans as audit tools, but also with possibilities to introduce elements of such a plan into surrounding policy instruments to trigger "long-term thinking".

This "target-compatible thinking" is vital for various reasons:

- As long as the building shell is concerned, every decision today determines the future energy demand of the building stock over the next decades. If a wall is insulated today, it will not be renovated in the coming decades. Other buildings that have partially been restored, but with insufficient depth, will also be renovated to a lesser extent within the next few decades. This is because the following renovation steps are less economical due to lower savings.
- From a national perspective, a "timetable" is essential because various "insulations restrictions" (building-inherent technical, economic, social and other restrictions), limit the possibilities of insulation for many buildings (Jochum et al. 2012). The target of a nearly carbon neutral building stock by 2050 can only be viable when buildings without insulation restrictions have an even better carbon footprint, and every renovation opportunity taking place and every occasion that could trigger a renovation activity (like sales, inheritance or reletting) are used consistently.
- In addition, a renovation plan is an important stimulus for the construction industry. Only a long-term perspective creates planning and investment security. New business models in the field of building efficiency arise only if the industry is aware of the future demand for renovation services.

HISTORY OF THE "RENOVATION ROADMAP" OR "RENOVATION PLAN"

One of the first building instruments that addressed this long-term perspective for individual buildings is the Berlin "step model" (for details see Pehnt et al. 2011) that was developed as part of the discussion about a Berlin Climate Protection Act, whose purpose was to set mandatory standards for energy efficiency and greenhouse gas emissions for individual existing buildings over the next decades. Although this "renovation obligation" was not pursued further in the discussion of the Berlin Climate Change Act, the element of the underlying step model was introduced into the discussion on the energy concept of the federal government.

In parallel, the idea of a building individual renovation plan was discussed internationally. In a conceptual paper, the Regulatory Assistance Project announced the "long-term energy renovation plan ... which provides a blueprint for the staging of measures from an optimal efficiency investment perspective, while helping homeowners plan and pace their financial commitment as needed "(Neme et al. 2011). This report also captures other core elements of the renovation plan: the level of ambition of individual measures ("Encouraging as deep a treatment as possible for each measure being pursued") and the bundling of measures ("Encouraging bundling treatment of some efficiency measures").

In addition to an individual building approach, there are also hybrid variants, such as renovation plans for building ensembles. For example, the inventory of a local authority or a housing company that place greater reliance on prioritization and works with particular types of buildings and standardization (Table 1). Such an individual building renovation plan must be compatible with the overall nationwide renovation strategy, in that the sum of all individual buildings must fulfil the national targets.

Key elements of the individual renovation plan

In the individual building perspective, a long-term analysis of necessary measures seems essential. Behind this are the following key ideas:

Long-term perspective: The core content of the renovation plan is the integration of the long-term perspective. Based on the present condition of the building, a benchmark is to show how the building could develop in the short, medium and long term.

Target compatibility: Climate and resource protection require ambitious renovations, wherever they are possible. The goal of the federal government of Germany to make the building stock almost carbon neutral by 2050, means that today's building renovations must be done to a high quality/standard. Scenario calculations show that to achieve the target, more than two thirds of the renovations in the years 2021–2050 need to be of an ambitious level, defined by excellent U-values (for instance (W/m^2K): wall <0.2, roofs <0.18; window <1.0; basement ceilings <0.26) (Diefenbach, Enseling et al. 2013) as well as high shares of renewable heating and/or cogeneration.

Renovation strategy by promoting systematic total or staged renovation in a sensible order and packages: Frequently renovations cannot be performed in one go. That is why many buildings are only partially renovated. Early replacement of components may also result in economic losses (which are often only partially compensated for by higher financial support or lower basic costs). Rented stocks can often only be renovated gradually as well. In many cases, the financial situation of the owner allows no extensive refurbishment all at once. However, even a gradual modernization leads to the end goal, if at each step, the next steps are considered. The renovation plan is intended to ensure this.

In order to ensure that the individual renovation steps are technically based on each other, it is important to create an individual building renovation plan before the first measure. In it, the energetic properties for the individual components are specified that are necessary to achieve the overall objective. In addition, a technically meaningful order for each measure is proposed. For example, if a roof is insulated, roof overhangs, downspout connections, adjustment of the boiler, piping penetrations for future solar systems etc. are also pointed out (see Infobox below). The interfaces between the individual renovation steps are described, so that in spite of the intervals, a high quality can be guaranteed. The renovation plan is valid even after a change of ownership and documents the work already done and the measures still to be performed.

Table 1. Renovation plans or roadmaps on national and individual levels (Pehnt 2014).

	National renovation plan/strategy	Portfolio renovation plan (or roadmap)	Individual renovation plan (or roadmap)
Goal	Monitoring the national development, if applicable re-adjustment of policy instruments.	Assessment and renovation recommendations for building cohorts.	Assessment and renovation recommendations for individual buildings.
Methodological approach	Scenario development and modeling of building stock, normalisation with national energy balance and long-term targets.	Energy consultancy for typical buildings, definition of reasonable renovation measures, long-term timetable or milestone plan, transfer to the entire portfolio.	Energy consultancy for individual building, definition of reasonable renovation measures, long-term timetable or milestone plan.

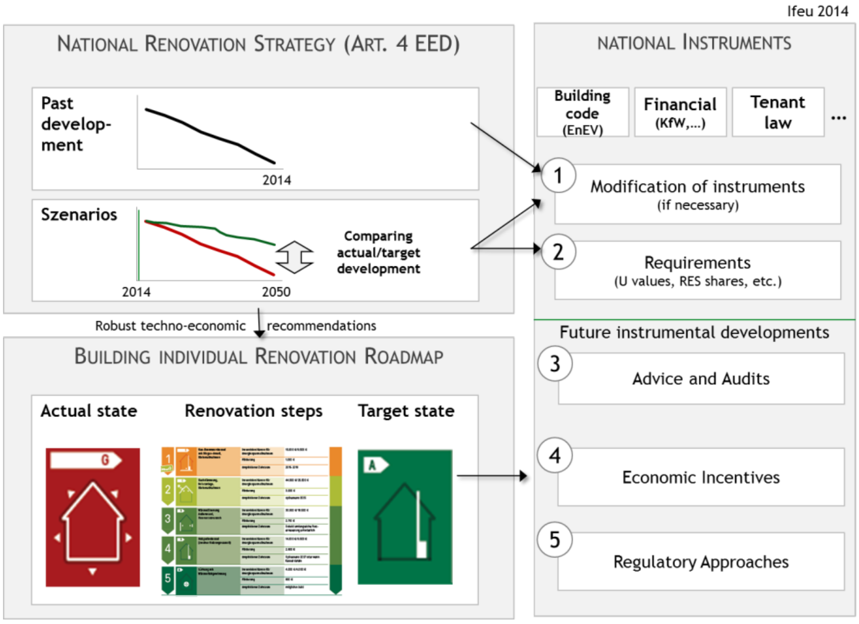


Figure 1. Relationship between the National Renovation Roadmap or Strategy and the roadmap for an individual building.

Consideration of individual renovation context: In an individual renovation plan, the situation of the homeowners must be considered. This includes, for example, financial opportunities, life planning, living space changes, or family planning.

For instance, advice receivers often want to rapidly implement financially manageable measures. The consultant should also consider this starting point in the context of the renovation plan. Examples of low-threshold measures include window seals, insulation of shutter boxes and pipes, high-efficiency heating circuit pumps, and hot water connections for dish washers or washing machines.

Challenges of a building individual renovation plan

The long-term design of the renovation plan is an important orientation, but also presents an analytical and methodological challenge. This applies especially to the temporal development of technical determinants. For example, the national power plant portfolios develop dynamically towards high shares of renewables and therefore also the evaluation of efficient electric heat pump changes. New, highly effective insulation materials, innovative building technology concepts or planning advances allow building concepts that were unpredictable 20 years ago.

Thus, technical development parameters along with building standards, and ultimately, calculation methods, change. The economic conditions also undergo changes: rising energy prices – depending on the energy source – can lead to a reassessment of strategic recommendations. With respect to real estate economic standards can shift. For example, the valuation of the property location, or user requirements may change over time.

Another methodological challenge is the economic evaluation of long-term measures. This is as it can only be done based on current knowledge. Future renovation measures will be especially difficult to evaluate. This is not only because of the uncertain future costs, but also because the interest rate, the energy price increase and the exact timing of the measures cannot be accurately predicted. Also because in step-by-step renovations, later renovation steps have a lower efficiency because they are applied in an already optimized building.

In view of these challenges, the consultant cannot meticulously plan the renovation path until 2050. However, a skilled energy consultant can take these factors into account and still propose measures that lead to a robust renovation strategy.

The good thing here is that primarily in the heating market, the developments have a high-speed of innovation. Heaters, and building technology in general, have in comparison to the building envelope, much shorter replacement cycles. Thus, a building strategy is also aligned such that it is adjustable and open for the future.

What is difficult is the establishment of a binding target for the individual buildings, especially against the background of uncertain technical conditions and calculation methods. The goal of a nearly carbon neutral building stock, which was operationalized in the form of a reduction of primary energy demand by 80 %, should be transferred as the benchmark to the individual buildings. As part of the "Sanierungsfahrplan Baden-Württemberg" (see below) an open way was chosen, which provides requirements for the quality of individual measures and the use of renewable energy sources. This approach combines:

- a general target for existing buildings as a guide for the level of ambition;
- a definition of the requirements of "ambitious individual measures" (e. g. minimum U values), but also
- the obligation for the energy consultant to state reasons if he deviates from it either to object or due to owner related reasons (Pehnt et al. 2014).

The thrust of the renovation plan attempts to realize the optimal level of technical feasibility possible. It does so by taking into account economic reasonableness and reconciling this approach with received wisdom, as well as structural and cultural realities. Ultimately, the renovation plan attempts to build a bridge between the individual requirements of the object and user, and the long-term goals.

Renovation plan as an energy audit tool

A first implementation step towards a future-oriented building design was the introduction of "energetic concept" in the funded energy consultancy ("Energieberatung vor Ort") by the German BAFA. "The advisory report is to show how the object can, through energy renovation, in one go or gradually, be brought to the "Effizienzhaus" level." (BAFA 2012).

The IFEU Institute has, together with ECONSULT, further advanced the idea of renovation plans and created a compact six page document that summarizes important information for the property owner in the state of Baden-Württemberg. It is suitable as a summary of an on-site consulting service.

The summary report starts with a description of the background and of the multiple benefits of restorations, and documents the actual state of the building, including the energy costs over the next decades. It highlights existing opportunities for improvement. The central "Roadmap" on page three shows coordinated packages of measures. Here, the consultant needs to define useful bundles of renovation measures, which should be carried out simultaneously in line with the individual preferences of the building owner. Here, the before-and-after comparison of energy costs and CO_2 emissions is documented. Subsequent pages describe the measures in detail, point to aspects relevant in staged renovations, such as preparatory measures, required U values, further co-benefits, possible funding and additional explanations (Pehnt et al. 2014). For instance, if a roof is renovated, the roof overhang shall be designed such that the future thermal insulation system will be adequately covered. Other aspects need to be considered, e. g. an adjusted regulation of the existing boiler and a hydraulic balancing of the radiators, provision of fresh air and exhaust air passages for later installation of a ventilation system, careful, airtight connections in the roof space, or pipe feed-throughs through the roof for a later solar thermal system.

In addition to the predefined structure, the software technical implementation of the renovation plan offers different proposed text elements in checklist form, concerning both the multiple benefits of renovations as well as the various aspects that must be followed in a step-by-step renovation.

The renovation plan is designed not only for residential buildings, but also for non-residential buildings. Lighting, cooling and air-conditioning are added to the fields of action.

Compared to average energy audits, such an approach offers various advantages:

- The option to analyse staged renovations is closer to the refurbishment reality. The central "roadmap" page clearly demonstrates the required renovation measures and sensible steps.
- Path dependencies and lock-ins can be avoided by pointing at challenges arising from staged renovations.
- All windows of opportunity for refurbishment should be presented.

Integrating elements of a renovation plan into economic policy tools

The building individual renovation plan is more than just an advisory tool for building owners. Its main components, the long-term target and the renovation strategy, can also be integrated into other political instruments. This chapter investigates approaches to use a renovation plan (or its elements) in other instruments to advance highly dynamic and deep retrofits. It also investigates, vice versa, how surrounding policy instruments can be used to promote a more strategic approach towards renovations.

INTRODUCING RENOVATION PLAN ELEMENTS INTO FUNDING SCHEMES OR TAX CREDITS

Support programs or tax credits can integrate elements of a renovation plan in various ways. The core element of support schemes, such as the KfW loan program "Energy efficient Refurbishment", is to increase the number of long-term target compatible renovations through funding programs, while at the same time strengthening the implementation and verification of the quality of the refurbishment.

Generally, support schemes providing direct subsidies and low-interest loans can be regarded as a central tool for climate protection for the housing stock as well as for achieving the specific targets of the renovation plan. This is true for various reasons:

- Quality criteria, such as the KfW "Efficiency House standard" or the minimum quality criteria for the used compo-

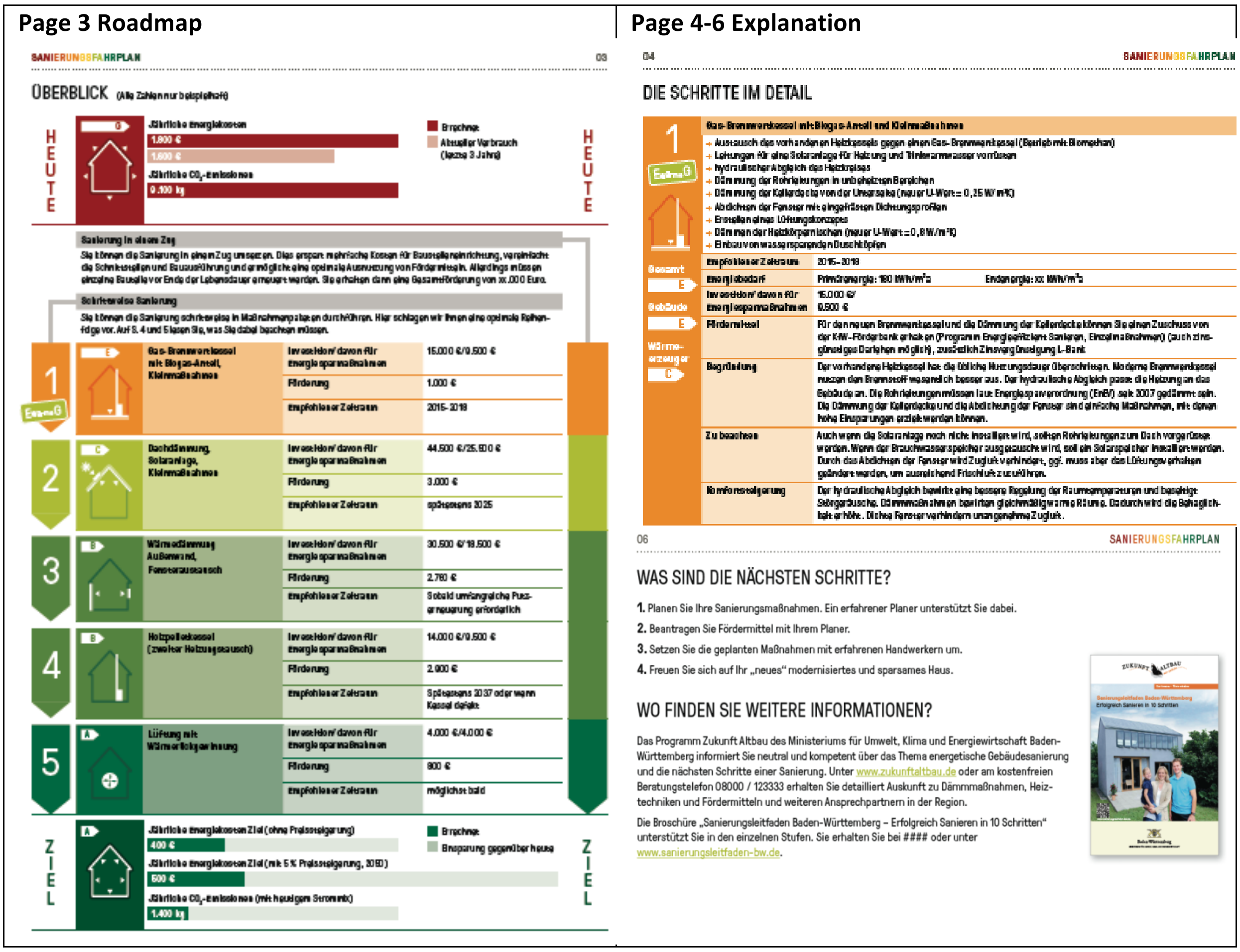


Figure 2. Example pages of the "Sanierungsfahrplan Baden-Württemberg" (Pehnt et al. 2014).

nents (e. g. U values, efficiencies or seasonal performance factors), diffuse into the market and deliver an impact even for buildings that were not directly supported, with concomitant changes in construction and consulting practices.

- Funding schemes can differentiate between the different components (e.g. wall and roof insulation, renewal of windows, modernization of heating, installation of ventilation, etc.) and can thus set individually required priorities. In the praxis of the KfW program, the share of funded individual measures or small packages is high and increasing, as compared to the number of total renovation to the KfW Efficiency House level.
- Funding schemes allow flexibility and openness to the future. The funding conditions can be flexibly adapted to new situations and knowledge. This is important because the effect of economic incentives cannot be reliably predicted. By monitoring the impact of the funding, information can be used for readjustment. In short periods of time (a few years), the funding conditions should nevertheless be reasonably reliable and predictable enough to produce the necessary level of investment protection.

In order to develop the support tools into the direction of a future-oriented support instrument, different ideas may be considered, based on the experiences of other European support tools:

STRENGTHENING THE FUNDING OF INDIVIDUAL MEASURES IN STAGED RENOVATIONS

The aim is to promote efficiency measures that are sufficiently ambitious and avoid negative lock-in effects due to suboptimal efficiency levels. For the determination of the technical requirements of the components (e. g. necessary U values), the results of the national renovation roadmap calculations should be considered. For components of the building envelope, the "target compatibility" is particularly important, as they will mostly be in place until 2050.

One interesting example which realizes such an approach is the funding scheme in Vorarlberg, where specific incentives are introduced for enhanced qualities. For example, incentives for increased insulation thickness/material qualities that go beyond minimum funding requirements (Table 2). In Vorarlberg, component renovations are promoted in five funding levels (level 1: 19 %, max €25,000; ... level 5: 30 %, max €50,000). This creates an incentive to realize very high insulating qualities.

INCREASING THE SPREAD OF FINANCIAL SUPPORT ACCORDING TO THE EFFICIENCY OF THE BUILDING

In the German KfW program, the renovation of houses to a standard that is 45 % below the primary energy requirements of the buildings code (a so-called Efficiency House 55) is financially supported with 25 % of the investment cost. In comparison, an Efficiency house 70 only receives 20 %, an Efficiency

Table 2. Financial support levels in Vorarlberg (Vorarlberg 2014)

Funding level U values (W/m²K)	Outer wall	Roof	Basement	Window (glass & frame)	Window glass
1	≤0.25	≤0.19	≤0.29	≤1.35	≤1.10
2	≤0.22	≤0.17	≤0.25	≤1.20	
3	≤0.19	≤0.15	≤0.21	≤1.00	
4	≤0.16	≤0.13	≤0.18	≤0.90	
5	≤0.14	≤0.11	≤0.16	≤0.80	

House 100 only 12.5 %, and individual measures 10.0 %. This spread could be increased even further to cover the marginal cost difference between the different Efficiency houses.

"Package Bonus"

To encourage simultaneous modernizations of several measures and thus avoid construction problems, support schemes could give a higher support, if bundles of measures are realized simultaneously (e. g. 10 % reimbursement rate for implementing one measure, 15 % for two, 20 % for three). This proposal is inspired by the French Tax Credit Scheme, which has provided two funding levels since 1 January 2014: 15 % is granted for implementation of one measure (e. g. boiler replacement, installing new windows, etc.). When two measures are implemented, the tax credit increases to 25 %.

"Achievement Bonus"

Another option to increase the importance of a systematic renovation process, is to provide an extra bonus for the successful realization of a renovation plan in addition to the already existing funding for individual measures. In typical staged renovations, the first renovation steps are realized consistently whereas the last – (typically less economic, but energetically vital) – measures are not carried out. To increase the success rate, such an additional bonus could create a helpful incentive to complete a renovation cycle all the way through until its end.

Mandatory renovation plan in the case of staged renovations

The renovation plan, as a detailed building integrated consulting product, can be made a prerequisite for funding individual measures. The idea of establishing a link between renovation plans and funding, is based on a sensible idea, namely the avoidance of path dependencies (e.g. to avoid thermal bridges and other problems caused by poorly coordinated individual measures). However, it should be noted that the renovation funding is supposed to stimulate the renovation dynamics. The creation of additional barriers to the use of funds must therefore be avoided. A renovation plan as an additional requirement could be such a barrier. In terms of thermal bridges and connection details, however, the question arises whether an abstract renovation plan can take into account all the necessary forecasts. If not, perhaps a good education and an "interface-oriented" direction of thinking for the craftsmen is likely to lead to the goal.

BONUS MALUS INSTRUMENTS

Whereas the above instruments try to pick up elements of the renovation plan and integrate them into support schemes, a further, more stringent possibility is to use an "orientation curve" as the basis of economic incentives, e. g. a bonus malus system.

In other policy fields and in other countries, bonus-malus systems are already established. One such example is the German health care system, with bonuses for doctors who prescribe affordable medicines, and penalties for for those who exceed the daily treatment costs). Another example is the Austrian automobile consumption tax. France additionally has introduced a bonus-malus system in the form of a purchase tax for environmentally friendly vehicles.

Such bonus-malus combinations can be interpreted differently "narrow":

- In bonus-malus systems in a strict sense, coupling occurs within the same instrument. An example would be a property tax, which is lowered for efficient homes and increased for inefficient homes. The revenues of the additional payments will be used immediately and in the same amount for the reduction.
- In bonus-malus systems in a wider sense, bonuses and penalties can be used in different regulatory contexts. For example, increasing the energy tax and using the revenues for KfW refurbishment funding.

The French experience points to an important problem of the bonus-malus design. France had originally planned a balanced budget between bonuses and penalties. In the French case, however, due to the tax, the average CO_2 emissions had abruptly fallen. The result being that the goal of a balanced budget was not achieved. Other mechanisms, such as a flexible bonus malus system, would be required to avoid this issue.

The following paragraphs describe briefly different options for a bonus-malus system and the respective interaction with a renovation plan.

Consumption dependent bonus-malus

In France, in a draft law from April 2013, the ex-post determined energy consumption of a building was used as a criterion for a bonus malus system. This was designed so that a building with a consumption below a calculated benchmark (depending on the location of the property, the energy, the size of the apartment, the type of hot water supply), received a bonus of between 5 and 30 €/MWh. Meanwhile buildings with a consumption level above the benchmark, were supposed to be penalized with a similar fee. In effect, the system works as a (non-linear) adjustment of energy prices.

Compared to a bonus-malus option, which is measured directly according to the quality of the building, the proposed system has the disadvantage that the stimulus/penalty is spread over time and not concentrated at the time of renovation. Given the relatively small financial effect (at moderate design), the question arises whether there is sufficient extra impact compared to the already occurring energy costs.

The consumption dependent bonus malus has only little connection to a renovation plan, as it does not start from a target for the building or from a description of the building quality, but rather promotes/sanctions the results of renovation.

On the other hand, it does not only consider the quality of the building, but also the way the building is used (number of people in household, user behaviour, etc.). This can be seen as a disadvantage, because in case the building is transferred to other users, the assessment could be drastically different. On the other hand, the system is an incentive towards a more "efficient manner of living".

Other more technical problems make it difficult to realize this system. For example, an estimation of annual consumption in oil or wood heated buildings is difficult, as are adjustments due to weather and geographical location that are required. Overall, the administration is complex, especially as the utility company or fuel distributor needs to be involved in the control mechanism. In France, the system was finally considered not to be compatible with law, as the Constitutional Council took the view that the system would oppose the "principle of equality in the payment of public spending".

Building dependent bonus malus

Another approach is to base a bonus malus system not on the real consumption, but on an assessment of the quality of the building. The basic idea of this kind of bonus malus, is to implement a long-term goal for the building, e.g., by defining a certain energy rating as target for the building stock in the year 2050. The malus can then be designed as a function of the energy demand/efficiency rating, e.g., in the shape of a long-term "orientation curve" which describes the desired efficiency rating in each year, with buildings above the curve having to pay a malus and buildings below the curve receiving a reward (either as a yearly re-imbursement or as a one-off support for renovation). Due to the freedom in the choice of means at least in the early stages of the orientation curve, the owner can, based on a renovation plan, decide how he wants to achieve the objectives "openness to technology".

The amount of the malus should be high enough to have more than just symbolic effect, i.e., to work as an incentive. On the other hand, the malus must not be too high in order to avoid a high number of cases of financial hardship. Preliminary considerations based on the damage costs of CO_2 led to an order of magnitude of between 0.2 (difference between efficiency categories B and C) and €4/sqm/year (difference between efficiency categories G and H). In Pehnt et al. (2013), it was calculated that if the malus was set to €0.5/sqm/year for the first renovation level not adhered to, and if it was gradually increased to up to €5/sqm^2/year by 2050 for six failed levels, it would, roughly estimated, generate a cumulative volume of approx. €50 billion for the German residential building stock. This amount would roughly equal the amount of support needed for a support scheme for building refurbishment.

The efficiency rating will be proven by providing an energy performance certificate. It will also display the energy consumption values measured, not only to display more information, but also to encourage the building users to change behaviour and adopt a renovation. Randomised checks of the implementation of these measures shall be carried out in accordance with the framework on quality controls of energy performance certificates, which have already been planned based on EU legislation.

If no energy performance certificate is provided for a certain building, it will automatically be assigned to the poorest or lowest proven efficiency category. As opposed to former concepts of renovation plans, this system shifts the "burden of proof" for the state of a building. This means that no building owner is obliged to get a certificate for his building or implement modernisation measures because he still can pay the rising malus. Postponing modernisation can, for example, be a reasonable decision if a building is planned to be modified or fundamentally reconstructed a few years later.

To make the roadmap more **flexible,** an individual renovation plan based on an extensive energy consultation may lead to a postponement of the malus. This may be possible in the early phase of planning.

Design Options for building bonus malus

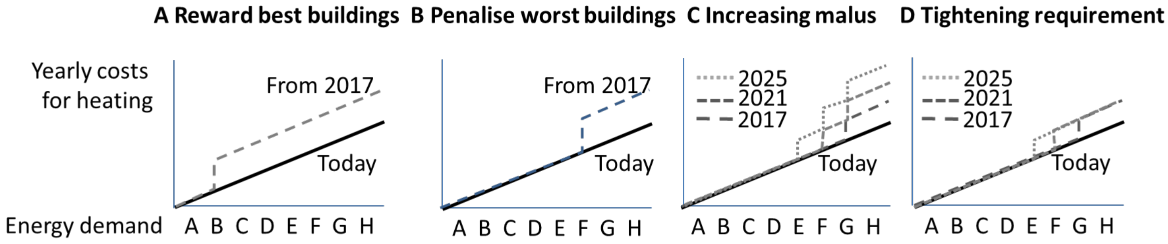
A bonus malus system may be implemented in various forms. In the following, we assume that a satisfying energy rating for buildings exists; it could, however, also be implemented based on, e.g., calculated energy demand.

A very simple option A, is to exempt the best buildings from the malus that are already fulfilling, or are close to, the nearly zero energy standard. This would increase the share of deep renovations, while also making refurbishments altogether more economic. This would be due to the increased yearly costs and the bonus for refurbishment. In Figure 3, this is illustrated showing the yearly costs for heating plus malus as a function of the energy demand (expressed here in terms of an efficiency rating, but this could also be expressed in terms of kWh/m^{2}a). On top of the (essentially linear) energy costs, a malus has to be paid for by all buildings that are worse than a class A rating from a given year (here: 2017).

An alternative option B, is to impose a malus only on the worst performing buildings. This procedure would increase the pressure for refurbishment. However, renovations are more economic in these buildings anyway due to the high energy costs. In addition, the level of bureaucracy would be high because all buildings below the threshold would need to demonstrate an energy rating.

A more dynamic design alternative is a malus that is increasing over time (option C) or that tightens requirements over time (e.g., in the year 2017, the malus has to be paid for by all buildings with worse than a rating F, in the year 2021 worse than E, etc.) (option D). Further options and combinations of these are possible.

Figure 3 discusses some of the advantages and disadvantages of the various options.



Revenues from malus used to fund refurbishment support schemes

	A Reward best buildings	B Penalise worst buildings	C Increasing malus	D Tightening requirement
Aim	Incentivize best building standards	Increase renovation pressure for worst buildings	Create dynamics through increasing malus and tightening requirements	Create dynamics through tightening requirements
Advantages	• Encourages deep renovations • Communicates the long-term target • Lower transaction because only best buildings have to demonstrate their rating	• Enhances economics of refurbishment	• Stimulus increasing over time • Allows time to reacts	• Stimulus increasing over time • Allows time to reacts • Less financial hardship comp. to C
Disadvantages	• No dynamic component • Additional impact compared to a mere increase in energy tax can be questioned	• Focuses on buildings with often high social hardships • High transaction cost because all buildings have to demontrate their rating	• High transaction cost because all buildings must prove	• Less financial volume for funding scheme → less incentive for action • High transaction cost because all buildings have to demontrate their rating

Figure 3. Examples of design options for the malus component of a bonus-malus system.

Policy implementation

There are various ways in which a bonus malus tool could be implemented in building policies.

- Creation of a new building bonus malus, e. g., in the shape of a new positive and negative tax or a tax combined with a funding scheme. This option will, in many countries, have the disadvantage that new fees often have, that being a very low acceptance in society. Additionally, in some countries, there are even legal restrictions with respect to the creation of new fees or taxes.
- Integration into already existing taxes, such as the property tax, the real estate transfer tax or the inheritance tax. In terms of administrative expenses, the integration into existing taxes is advantageous. Examples of the integration of bonus malus elements into real estate transfer taxes exist in the UK. As early as 2007, it was suggested to exempt all “Zero Carbon” homes from the real estate transfer tax (stamp duty land tax). Proposed variants for a realization of a relevant land transfer tax scheme include:
  – Tax relief for owners who renovate their buildings within a certain period of time (Waterson 2005). For example, based on the refurbishment recommendations proposed in the Energy Performance Certificate (or renovation plan).
  – Adaptation of the tax rate on energy efficiency through a “modifier” (Croft and Sunderland 2011;Croft and Preston 2013).For example, 0.5 % difference per efficiency class (efficiency Class D: tax rate as it is today, for example 5 % efficiency class A = (5 - 3 * 0.5) % = 3.5 % efficiency class G = (5 + 3 * 0.5) % = 6.5 %.

An implementation within the framework of a real estate transfer tax or inheritance tax has the advantage that the bonus-malus becomes effective when there is a high probability for renovation anyway. In addition, there is a one-off payment situation, whereas the property tax accumulates over time (and is typically also rather low, so that the economic incentive for renovation is limited). However, even a real estate transfer tax is financially limited. The tax rate in Germany, for example, depending on the Land, is between 4.5 to 6 % of the purchase price. For instance, for a building with a purchase price of €250,000, this equals to only €12,500. An efficiency differentiation, thus allows only for differences of a few thousand Euros.

On the other hand, the yearly “reminder” of a property tax usually falls away. For real estate transfer or inheritance tax, the speed with which the building stock is addressed, and thus the funds generated, is very limited (Croft and Sunderland 2011).

Discussion

One advantage of a bonus malus system based on building energy demand is that the malus will have to be paid by the building owner, i.e. by the person who makes the decisions for or against an energy-related modernisation of a building. This means that it will not only raise funds, but will also encourage the building owner to adhere to the targets in order to avoid payment of the malus. The annual malus notice will periodically raise the question of if it would not be better to renovate the building than pay a malus. Furthermore, the classification of buildings and the related amount of the malus, would serve as an objective means of differentiation for energy standards in the real estate market.

In addition, funds are generated, which are used as subsidies for inefficient buildings, preferably for severe cases, e.g., buildings in socially deprived areas. In contrast, funding via an increase of an energy tax/fuels tax would burden all building users, regardless of whether they own or rent the apartment or building. In addition, a building malus is capped, whereas a tax is linear to the energy consumption and thus unlimited to the top.

However, the malus does have some drawbacks. Firstly, the comments made above about the difficulty of making long-term and robust statements about the required building quality and rating, also applies here. If, for instance, the building rating is based on primary energy, and the primary energy factor for electricity improves significantly, then the assessment of the same building with an electrical heat pump will improve. What is important to note here is that improvement results without any action on the side of the building owner. The instrument must therefore be designed so that its structure affects the long term, but also offers scope for technical or social developments.

The process of raising the malus requires additional effort because energy ratings/certificates must be made available as the malus refers to individual buildings. All buildings that do not want to pay the maximum malus would have to be classified energetically. This means substantial transaction costs and the requirement for a simplified procedure for classification. For this purpose, the quality of the preparation of energy performance certificates must be ensured. Another requirement is the set-up of a building register, which can be prepared by using the real estate tax database.

There can be difficult cases, as for example, with buildings in value-impaired locations for which no renovation decision will be taken, or for buildings owned by older people who do not wish to renovate. These difficult cases should be solved by adequate regulations.

The main disadvantage is the financial relevance of the energy labelling, which always includes inaccuracies and may possibly be misused. Incentives to manipulate the efficiency class are likely to increase. Uncertainty in the classification of the building can have a serious impact. Thus, improved calculation methods are required, thereby narrowing the degrees of freedom of calculation.

As long as a certain level of a malus is not exceeded, the total costs for a household would still by far be dominated by energy costs. The question then is, how noticeable is the malus, and does it deliver the psychological effect of separately collected fees?

Another issue is the temporal distribution of money flows. For instance, in option C in Figure 3, malus money will become available only gradually, with increasing malus and tightening requirements over time. On the other hand, the money is also needed in the beginning to fund additional refurbishments.

The acceptability of an additional building fee is regarded as fairly low, especially if it is introduced as a new fee (and not integrated into existing taxes such as a property tax). The acceptance also depends on the implementation process. It can be expected that a gradual introduction that starts with poor buildings would be assessed more positively than a configuration which charges all buildings from the very beginning.

Integrating the renovation plan into regulatory policy approaches

MANDATORY RENOVATION PLANS UNDER CERTAIN CIRCUMSTANCES

The simplest form of integration of the renovation plan into regulatory approaches is the creation of a legal requirement to set up such a plan. For instance, this may be applied when larger renovation measures are carried out, when predefined energy consumption (or efficiency class) levels are exceeded, when certain building characteristics are present (such as single glazing, no facade insulation, night storage heaters, etc.), or when specific events occur (such as ownership, new lease, major changes in the resident structure).

An example of such a compulsory energy audit is the Austin Texas (U.S.A.) scheme, where audits have to be carried out for the sale of single-family homes and multi-family homes in the tenth year after establishment (Suna and Haasetal 2011). With the obligation to consult the renovation plan, a type of a “building inspection” is given. This has the advantage of a high liability option. However, the relationship of trust between the consultant and the owner is an important element in the motivation for renovation; a mandatory renovation plan might change this relationship. Basically, the question arises whether it can be useful for homeowners to get energy advice (especially in an ambitious and long-term approach, such as the renovation schedule) if they are perhaps not even interested in the content.

This puts into question the quality of renovation plans. There are few experiences which exist on this matter, and, at the same time, in a general obligation, many timetables would have to be created in a short time frame.

A further disadvantage is the administrative burden of checking for compliance of the new obligation, which, at first sight, does not lead to energy savings (only if triggered by the plan, are measures implemented).

BUILDING CODES

Long-term targets in building codes

Yet another possibility to integrate long-term aspects into regulatory approaches is to define long-term technical requirements. An example for this is actually demonstrated in the Energy Savings Ordinance (the German building code), which defines primary energy demand requirements for 2014 and announces an automatic tightening of that requirement by 25 % from 1 January 2016. The consequence this has is that building owners, designers and manufacturers of components can adapt to the development.

Another option would be to, step by step, tighten the renovation requirements for individual components in the case that renovations have to be carried out anyway. Example values of such an approach are shown in Table 3 and represent only exemplary values.

In the case that individual characteristics do not allow such technical requirements, exceptions need to be made upon confirmation by a building expert (buildings worth preserving, other insulation restrictions, etc.). This is possibly the largest disadvantage of these increasing component requirements. The number of exemptions will increase over time, for example,

Table 3. Maximum U values for components used in renovations.

	U_{max} (W/m²K)		
	2015–2016	2017–2020	2021–2024
Outer wall	0.24	0.20	0.18
Window	1.3	1.1	0.95
Roof	0.24	0.20	0.15

because wall insulation cannot be carried out to the required thickness.

Such long-term technical requirements increase the awareness of component qualities among not just building owners, but also among architects, planners and craftsmen. However, it might also happen that in order to avoid the next stage of requirements, building owners quickly renovate with the lower requirements of the previous stage. This psychological effect causes a short-term increase in renovation activities, but does so at the expense of the long-term goal.

What is essential for the effectiveness of such a regulation is that compliance must be ensured. To this end, an appropriate monitoring and control mechanism is necessary.

Renovation obligations

Among the approaches described, the most invasive policy instrument is the one which defines renovation obligations depending on the energy rating of a building. For example, in a study by Fraunhofer IBP, primary energy demand thresholds are defined above which a building must be renovated. In the respective proposal, old single family houses have to be renovated when their primary energy demand exceeds 390 (2020), 300 (2030), 185 (2040) or 75 (2050) kWh/m2a, respectively. For multi-family houses these values would be somewhat lower (Hoier et al. 2013). Whereas in the section above, such threshold values only serve as a trigger for economic incentives, here a binary condition is defined: renovation or non-renovation.

In other countries, such renovation obligations do not seem to be implemented in a consistent way (BPIE 2013, GBPN 2014). One somewhat similar example is that of the city of Boulder (Colorado, USA) with their SmartREGS system (LBL2012). There, owners of rented buildings must demonstrate certain minimum energy standards in their buildings by 2019. The valuation is either a detailed calculation of demand or a simplified point system. The later describes the insulating qualities of the individual components as well as the energetic quality of the technology used in the building by associated ordinal scores. In Boulder, however, this obligation does not refer to long-term goals or strategies.

Whereas from a legal standpoint, renovation obligations are – under German law – possible with certain constraints, there will be a very low degree of acceptance for such a regulatory intervention not only among owners, but also among policy makers, even if flexible elements are included. Here again, compliance and verification is an important issue, and misuse by false calculations or ratings could occur. In comparison to the flexible bonus-malus system described previously, renovation obligations without the possibility of a malus payment, seem too inflexible given the diversity of the building stock.

Conclusions

The analysis in this paper has shown that on the one hand, long-term orientation and goal compatibility are important, in light of concomitant challenges regarding the future development of the overall energy system/building technologies and how to assess the implementation of that for a renovation plan. There is, thus, an unresolved contradiction between the goal of reliability on the one hand and the objective of future openness on the other. Nevertheless, in our view, a “philosophy” of a renovation plan is important as long as it goes without compulsory long-term commitments of mandatory renovations. The message is this: We should refurbish as quickly and as deeply as possible. This is necessary for mitigation and economic considerations. Our analysis of instruments leads us to this conclusion.

Overall, key elements of renovation plans can be implemented in current policy tools to a varying degree. This applies to namely, the long-term perspective, the definition and implementation of a target, a sound, comprehensive and systematic renovation strategy (even in the case of staged renovations) and the consideration of the individual context.

Based on the international experiences, we propose a two-step procedure. In the first step, long-term thinking is enhanced and methodological preparations are carried out. This involves introducing a renovation plan in audit and consultancy schemes. The first field tests in Germany for such an approach are under way, i.e., in the Federal State of Baden-Württemberg and in test households across Germany. In addition, energy certificates and building rating systems have to be in place, long-term targets need to be defined, and craftsmen, architects, planners and end-users have to “take-in” the idea of long-term thinking in the building sector. Renovation plan elements in support schemes, such as the funding of individual measures with a differentiated system (favouring deep-retrofit compatible measures), or the “package and achievement” bonus, could help toward this end.

In a second stage, the definition of long-term targets for renovations, as well as the implementation of a bonus malus system integrated into an already existing tax system, would further spur the dynamics and depth of a renovation.

Literature

BAFA (2012). Richtlinie über die Förderung der Energieberatung in Wohngebäuden vor Ort – Vor-Ort-Beratung – vom 11. Juni 2012. Berlin, Bundesamt für Wirtschaft und Ausfuhrkontrolle.

Bastian, Z. (2009). Fallstudie: Schrittweise durchgeführte Modernisierung bei wirtschaftlicher Optimierung der Energiesparmaßnahmen. Modernisierung mit Passivhaus-Komponenten. Protokollband Nr. 39. A. Passivhäuser. Darmstadt, Passivhaus-Institut.

BPIE (2013). Boosting building renovation. An overview of good practices. Renovation requirements, long-term plans and supportprogrammes in the EU and other selected regions. Report of the Building Performance Institute, Brusseles.

Bundesregierung (2010). Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. Berlin, BMWi, BMU.

Croft, D. and L. Sunderland (2011). Addressing key barriers in the delivery of domestic energy efficiency improvements – the case for energy efficiency property purchase taxes. Proceedings of the ECEEE Summer Study 2011, p. 1163.

Diefenbach, N., A. Enseling, et al. (2013). Kurzgutachten zu einem Sanierungsfahrplan im Wohngebäudebestand, commissioned by the BBSR. Darmstadt, Institut Wohnen Umwelt.

GBPN (2014). Reducing Energy Demand in existing buildings. Learning from best practice renovation policies. Global Building Performance Network, Paris.

Hoier, A. und H. Erhorn (2013). Energetische Gebäudesanierung in Deutschland Studie Teil I: Entwicklung und energetische Bewertung alternativer Sanierungsfahrpläne. Im Auftrag des Instituts für Wärme und Öltechnik e. V. Stuttgart, Fraunhofer Institut für Bauphysik.

Jochum, P., P. Mellwig, et al. (2012). Technische Restriktionen bei der energetischen Modernisierung von Bestandsgebäuden. Berlin, Heidelberg, Beuth Hochschule, ifeu – Institut für Energie- und Umweltforschung Heidelberg.

LBL (2012). Boulder, Colorado's SmartRegs: Minimum Performance Standards for Residential Rental Housing. Berkeley, LBL – Lawrence Berkeley National Laboratory.

Neme, C., M. Gottstein, et al. (2011). Residential Efficiency Retrofits: A Roadmap for the Future, Energy Futures Group, Regulatory Assistance Project, Vermont Energy Investment Corporation.

Pehnt, M., U. Sieberg (2011). A step-by-step model for a long-term renovation schedule – a proposal for a new building renovation instrument. Proceedings of the eceee Summer Study 2011.

Pehnt, M., P. Mellwig (2011). Fiskalische Instrumente der Sanierungsförderung: Ausgestaltungsvorschlag für steuerliche Maßnahmen und Aufstockung der Förderung. Kurzprojekt im Rahmen des Begleitkreis Energiekonzept des Bundesumweltministeriums. Berlin, ifeu – Institut für Energie- und Umweltforschung Heidelberg.

Pehnt, M., P. Mellwig, U. Sieberg (2013). A strategy for the efficient renovation of Germany's building stock. eceee Proceedings of the Summer Study 2013, p. 1389.

Pehnt, M. (2014). Der gebäudeindividuelle Sanierungsfahrplan – Ein Instrument zur Steigerung von Sanierungsdynamik und Sanierungstiefe? In: J. Pöschk (ed.), Energieeffizienz in Gebäuden, VME Verlag.

Pehnt, M., P. Mellwig, K. Lambrecht, U. Jungmann (2014). Anforderungen an einen gebäudeindividuellen Sanierungsfahrplan. Im Auftrag des Umweltministeriums Baden-Württemberg. Heidelberg, Rottenburg, Stuttgart, ifeu – Institut für Energie- und Umweltforschung Heidelberg, ECONSULT. See also Downloads under www.sanierungsfahrplan-bw.de or www.ifeu.de/sanierungsfahrplan.

Suna, D., R. Haas, et al. (2011). Förderung von Energieeffizienz und erneuerbaren Energien bei Endverbrauchern - Internationale Beispiele von Städten und Stadtwerken. Wien, TU Wien, Institute for Sustainability, BZL Kommunikation und Projektssteuerung GmbH.

Waterson, E. (2005). How can whole house fiscal measures encourage consumers to improve the energy efficiency of their homes? Proceedings of the eceee Summer Study 2005.

Wohnbauförderung Vorarlberg (2014): Wohnhaussanierungsrichtlinie 2014, Voralberg.