

# DECISION SUPPORT TOOLS FOR ECONOMICALLY VIABLE ENERGY EFFICIENCY RETROFITTING IN THE EUROPEAN RENTAL HOUSING STOCK

Tomáš VIMMR<sup>a</sup>, Andreas ENSELING<sup>b</sup>, Thomas LÜTZKENDORF<sup>c</sup>, Iris BEHR<sup>b</sup>,  
Martin VACHE<sup>b</sup>, Alexandra BEER<sup>b</sup>

<sup>a</sup> STU-K, a.s., Saveljevova 18, 14700 Praha 4, Czech Republic, [t.vimmr@stu-k.cz](mailto:t.vimmr@stu-k.cz)

<sup>b</sup> Institut Wohnen und Umwelt GmbH, Rheinstraße 65, 64295 Darmstadt, Germany, [a.enseling@iwu.de](mailto:a.enseling@iwu.de),  
[i.behr@iwu.de](mailto:i.behr@iwu.de), [m.vache@iwu.de](mailto:m.vache@iwu.de), [a.beer@iwu.de](mailto:a.beer@iwu.de)

<sup>c</sup> Karlsruher Institut für Technologie, Kaiserstraße 12, 76131 Karlsruhe, Germany,  
[thomas.luetzkendorf@kit.edu](mailto:thomas.luetzkendorf@kit.edu)

---

## Abstract

The current level of energy efficiency investments in the rental housing sector is in danger of missing EU policy targets. The Horizon 2020 project RentalCal aims to develop models and tools for assessing the economic viability of energy efficiency retrofitting measures in the rental housing stock. This will reduce split incentive barriers, activate the green added value and show a clear roadmap towards a sustainable rental housing market. In this paper, the RentalCal approach is described in terms of how to achieve the following key targets:

1. Developing and promoting an innovative standardised methodology for assessing retrofits in the private rental housing sector. Although rental housing represents the majority of Europe's multi-family housing stock, current profitability calculation methods for energy efficiency retrofits discount some inherent characteristics of specific national rental markets such as split incentives, rental regulations, tax regimes etc.
2. Improving transparency in the investment conditions within the EU housing industry. RentalCal will provide transparent information on the profitability of energy efficiency investments based on legal, technical and financial conditions in eight participating member states. The standardised framework will enable comparison of investment conditions in the EU, help to remove investment barriers in national housing markets and stimulate cross-border investment activities.
3. Disseminating key insights into the 'Green Value' proposition to specific target groups. RentalCal will provide rental property investors with target-group-specific information regarding the impact of a proposed retrofit investment. All information will become available on RentalCal's web-based calculation tool and information platform which is currently under development.

**Keywords:** *rental, energy retrofit, green value, investment*

---

## 1 Introduction

The effects of improving the energy efficiency of the European rental housing stock go far beyond the immediate reduction of final energy demand and decreased heating costs. Improving the energy performance of the existing building stock is likely to contribute to:

- reduced consumption of non-renewable resources (environmental aspect)
- reduced greenhouse gas emissions and emissions of airborne pollutants (environmental aspect)
- improved thermal comfort during winter and summer (social aspect)
- reduced risk of black mould formation and structural damages (social and technical aspect)
- reduced heating costs and therefore stable cost of living (social aspect)
- value stability and performance of property market (economic aspect)
- reduced risk of rent reduction (economic aspect)
- improved image (social and economic aspect)
- extended technical life spans of outer walls (technical aspect)
- extended life cycles of existing buildings due to energy modernisation and consequently conservation of the embodied energy and resources (environmental aspect)

The prerequisite for this is the professional planning and implementation of measures, choosing products and technologies that neither pose a risk to health nor the environment. The objectives ‘conservation of resources’ and ‘climate protection’ should and must be achieved by means that are considered sustainable themselves. This includes the analysis of environmental, social and economic aspects. This raises the question which benefit can be attributed to which actor and how these benefits could possibly influence the economic approach, respectively be expressed in economic terms. These questions are discussed within the European research project **“European Rental Housing Framework for Profitability Calculation of Energy Efficiency Retrofitting Measures” (RentalCal)**.

RentalCal focuses on the current level of energy efficiency investments in the rental housing sector, which is in danger of missing EU policy targets. RentalCal aims to develop models and tools for assessing the economic viability of energy efficiency retrofitting in the rental housing stock. The project is funded by the European Union (Horizon 2020) and will be implemented from 2015-17. Eleven partners from eight countries are participating.

## 2 Integration of the added value for investors

Usually, the economic goals of investors focus on profit maximisation, cash flow, value stability, and performance of the buildings contained in their portfolio. Nowadays, efforts to gain a positive image relating to social and environmental responsibility are added to these goals.

As a consequence, possible measures for improving energy efficiency will be evaluated to find out whether, and to what extent, they contribute to achieving the above objectives. Profitability not only depends on the type and scale of the measures applied, but also on the specific context of the respective submarkets (e.g. tenants’ market) or tenants’ willingness and ability to pay, and a range of framework conditions need to be considered:

- potential for rent increases
- reduction or exclusion of rent decrease risks due to phenomena such as black mould or poor heating comfort
- reduction of vacancy risk

- acceleration of (re-)renting
- extension of the technical life span of outer for selected measures, with consequences for value assessment
- positive contribution to value stability and performance (valorisation strategy)
- positive contribution to CSR – respectively sustainability – reports due to reduced energy consumption and environmental pollution, improved tenants’ satisfaction, with consequences for image and possibly shared value
- access to government subsidies and fiscal benefits

Moreover, the following effects and impacts arise, that should be considered regarding the economic benefits of such measures:

- reduced rentable living area in case of interior wall insulation
- possibility of increased non-apportionable costs after the installation of additional building technology (higher maintenance costs, possibly additional insurance costs)
- risk of operational interruptions due to immature technology or missing adjustments of heat supply systems which can affect the risk for rent reduction
- risk of building damage due to immature products, incorrect installation or lack of quality management
- risk of lacking user acceptance and operational errors in case of complicated technology with effects on tenant satisfaction

Consequently, possible impacts on building and operational costs are to be taken into consideration. Increased expenditure for planning, as well as quality management (for planning and particularly implementation) and for commissioning or adjustment or tenants’ information could impact on retrofitting costs. Increased maintenance costs possibly affect the non-apportionable costs once the properties are being rented. However, this depends on the legal situation as well as the specific rental agreement.

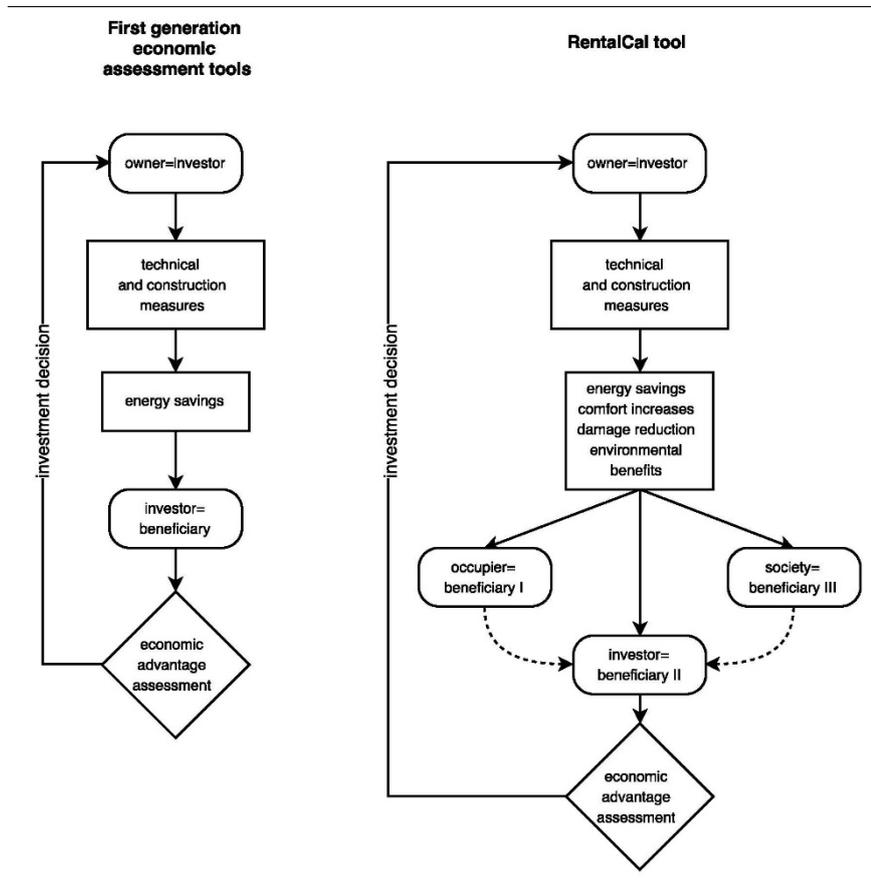
In future, these aspects should be considered in decision making more than has been the case. The requirements for a calculation tool, currently under development, for the analysis of the economic advantages of energy saving measures applied to existing buildings are being developed on this basis.

### **3 How to improve the existing investment support mechanisms?**

One further objective of RentalCal is to improve the existing support mechanisms for energy efficiency investments by developing a wide-ranging, straightforward calculation tool providing an independent comparison of the retrofit opportunities available to investors in the residential rental market. The proposed web-based tool will adopt established methodologies and valid input parameters to evaluate various energy retrofitting measures and the costs for such investment opportunities.

Compared with first generation tools for the economic benefit assessments like the cost-optimality approach [1], future tools need to account not only for the multidimensional perspective of possible “added values” of energy efficiency improvements in the housing sector, but also for the fact that the entity of decision taker (= investor) and beneficiary is just one possible case. In reality, there are multiple constellations, e.g. in the rental market, the main beneficiary is the occupier, while the owner is only a secondary beneficiary, who might profit from tenants’ increased willingness to pay a higher rent. In addition, external effects like greenhouse gas reductions or reduced local heat island effects benefit society as a whole or local communities indirectly. The RentalCal tool will therefore focus on the rental housing

market as a clear example of the problems that arise from the existence of split beneficiaries and investors (see Fig. 1).



*Fig. 1 RentalCal tool architecture*

This split of decision taker and beneficiary poses three challenges for an economic assessment tool:

- First, the split of incentives that arises between decision taker and beneficiary also eliminates the deterministic causality between measures (e.g. the installation of energy efficient heat supply systems) and the reduction of heating costs as an economic advantage that used to be the core of the economic assessment algorithm in first generation tools. It must, therefore, be replaced by calculation schemes that are able to calculate with non-deterministic relations. These might exist due to institutional barriers, e.g. in case of legal barriers to rent increases that prohibit rent compensation, due to market mechanisms, e.g. in case the market does not pay a premium for thermal comfort increases, or due to a lack of existing compensation schemes, e.g. in the case of external environmental effects. The RentalCal tool will incorporate both legal, institutional and market based factors that influence the causal relation between benefit for the beneficiary and economic advantage for the investor.
- Second, the multitude of benefits makes an accurate quantification of economic advantages more difficult. This might be due to a lack of empirical evidence, e.g. on the economic effects of thermal comfort, due to the complexity of interactions, or simply because some benefits are difficult to measure, as is the case with greenhouse gas reductions. To solve this problem, the RentalCal tool will rely on empirical evidence

and on qualitative assessments. This is in line with the key principle of the tool to suggest parameters where possible, but leave the final decisions to the user.

- Third, barriers to economic viability are often based on institutional or legal issues. In the RentalCal tool context, this requires modelling national institutional settings that may influence the assessment of economic advantages.

## 4 Identification of relevant investors and stakeholders

Sustainable energy investments in the rental housing stock are not only of interest for the property owner but also for various other stakeholders. As RentalCal builds on the EU directive 2012/27 on energy efficiency [2], the focus is no longer solely on the owner occupier but on all those property owners that rent out accommodation on a market basis and have a certain interest in energy efficiency investment.

### 4.1 Investor typology

When identifying different investor categories the starting point is the **private landlord**. Their share of the market varies strongly from country to country as a residual part besides the owner-occupier. Countries like Poland, Czech Republic, Spain or The Netherlands show very small private rental housing shares whereas the share of private rental housing is of much greater relevance in Germany, France or Denmark [3]. There are different types of private landlords: *Private non-professional landlords* who rent out one or just a few apartments and do not make their entire living from rental income. They understand the property as a means of retirement provision, have a long-term perspective, a high equity ratio and are risk averse. Often they know their tenants personally. *Professional private landlords* rent out a small to medium number of flats and derive a large fraction of their earnings from rental income; they often have a property sector background and let out apartments for a living and as an investment. They need less external advice and are more organised than the non-professional private landlord. They also plan for the longer term but at smaller equity ratios and are less risk averse.

Besides the private landlord-investors there are also **housing cooperatives** that should be distinguished from the group of housing companies. Cooperatives, owned by their members who are simultaneously tenants, are run in a collective business operation that is mainly interested in providing appropriate living space instead of profits. They have more knowledge and can be quite organised (using experts within their operation) compared to private landlords. They have long (to infinite) time horizons, high equity ratios and are risk averse. Established cooperatives do not differ substantially from housing companies in that they focus on rental housing with a long term perspective of keeping the housing stock. Meanwhile, new rather small, innovative housing cooperatives are coming up in the market, offering a focus on the environment, ‘caring and sharing’ and a contribution to community life.

**Housing companies** such as municipal or social housing associations, church owned housing companies, or not-for-profit associations follow a similar business model. They construct and maintain rental stock in order to provide affordable living space. They are well organised employing their own experts, consider rather long time horizons, high equity ratios and risk aversion.

Also distinct are **private companies** that are professionally managed and (mainly) owned by private natural or legal persons. This for-profit business model is well organised

with in-house experts, operates within a medium to short timeframe and a low equity ratio and there is a willingness to take some risks.

The investor typology reflects the RentalCal focus which is on investors with a long term perspective that are prepared to invest in sustainable energy efficiency measures. Investors with a ‘quick exit’ strategy, e.g. buying and selling the property as real estate investment funds, are not within the scope of RentalCal.

## 4.2 Relevant stakeholders

Looking at the relevant stakeholders, tenants are the direct beneficiaries of the energy efficiency investment as their energy bills should remain stable or even fall, and their indoor climate will improve. However, rents may increase to pay back the investment but would ideally be offset by the reduced energy costs. Stakeholders with an indirect benefit are “the public” as greenhouse gas reduction and contribution to climate goals are of common interest.

The established investor typology will help identify individual investment strategies, the very distinct investor ambitions and goals. The challenge for the RentalCal tool will be to mirror this wide range of interests.

## 5 Consideration of the technical, legal and financial framework

RentalCal aims to demonstrate the (added) benefit of an energy efficient retrofitting differentiated by the range of investor types in the rental housing sector. Therefore, national differences in technical, legal and market/financial framework conditions in the partner countries need to be incorporated. The description of the framework conditions has to cover a variety of investor types, from major housing company to small private landlord, and should focus mainly on economic but also other benefits. This includes an analysis of the technical; legal and institutional; and market and financial framework of the rental housing sector.

The **technical framework** of RentalCal is based on national residential building typologies developed during the IEE projects TABULA [4] and EPISCOPE [5] (see example of Czech residential building typology in Fig. 2 below). These classification schemes using geometric and physical parameters to describe the national building stocks will be revised and, if necessary, modified to take into account the specific features of the private rental stock in every country involved in the project.

| Building Type Matrix |                            |                         |                           | Czech Republic   |   |   |   |
|----------------------|----------------------------|-------------------------|---------------------------|--|---|---|---|
|                      | Region                     | Construction Year Class | Additional Classification | SFH  | TH  | MFH   | AB  |
|                      |                            |                         |                           | Single-Family House  | Terraced House  | Multi-Family House  | Apartment Block   |
| 3                    | national (Česká republika) | 1946 ... 1960           | generic (Standard)        | <br>CZ.N.SFH.03.Gen | <br>CZ.N.TH.03.Gen | <br>CZ.N.MFH.03.Gen | <br>CZ.N.AB.03.Gen |
| 4                    | national (Česká republika) | 1961 ... 1980           | generic (Standard)        | <br>CZ.N.SFH.04.Gen | <br>CZ.N.TH.04.Gen | <br>CZ.N.MFH.04.Gen | <br>CZ.N.AB.04.Gen |
| 5                    | national (Česká republika) | 1981 ... 1994           | generic (Standard)        | <br>CZ.N.SFH.05.Gen | <br>CZ.N.TH.05.Gen | <br>CZ.N.MFH.05.Gen | <br>CZ.N.AB.05.Gen |

**Fig. 2** Selection from the Czech residential building typology covering the period 1946-1994

Following this approach, a set of example buildings representing the national rental stock and a set of the most relevant refurbishment measures at the levels "standard" and "advanced" as well as exemplary calculations of the energy savings will be developed.

The retrofitting measures will be specified in packages and these data will provide the basis for various calculation scenarios of the model. The results will be evaluated in terms of the cost-efficiency and energy-efficiency of the investment, as well as in terms of other added value benefits.

The analysis of the **legal framework** will mainly cover regulations on rent setting and the recovery of energy efficiency investments. It will show if, and how, an investor can pass on investment costs to the beneficiary, e.g. the tenant. Identifying and divvying up running costs between landlord/investor and tenant is of importance as energy efficiency investments are expected to reduce energy bills which is one major element of the running costs. The tax regimes that impact on the investment activities will be considered as well. Regulations are also of relevance when looking at minimal technical requirements that have to be fulfilled during modernisation. Financing and subsidy programs form another relevant part of the framework condition as they support climate goals and provide incentives to investors. While looking at legal regulations, the actual market situation shall not be ignored: "tenants' markets" will make investment recovery more difficult than "landlords' markets". A different market situation will strongly influence common legal regulations.

The analysis of the **market and financial framework** will demonstrate the heterogeneity of market and regulatory conditions across EU countries. These comparative results form the basis for the design of the RentalCal tool and for the development of best practice approaches to tackle the challenge to increase profitability of energy efficiency investments.

Therefore, it is important to compile, interpret and discuss the empirical evidence of the market pricing of energy efficient investments and buildings. Besides carrying out econometric analyses in selected European markets, the analysis of the market framework conditions requires a comparison of the relevant national, regional and local trends in the take-up of energy efficient buildings and the potential constraints for pricing energy efficient building features. This includes, among others, a collection of current research results on "green payoffs" with reference to energy efficiency investments in rental housing, and an analysis and description of premiums distinguished by value drivers (rents, vacancy rates, multipliers etc.).

Besides the market framework, the financial framework also has to be taken into account. RentalCal wants to outline and analyse existing subsidies and financing mechanisms for investments in energy efficiency for rented residential properties in participating countries (financial framework conditions). The widespread availability of green mortgages and other debt finance instruments with favourable interest rates and conditions is another important factor. Finally, more advanced models of financing and risk-sharing such as Energy Performance Contracting (EPC) are analysed.

## 6 Conclusion

The RentalCal project aims to help reduce split incentive barriers, to activate green added value and to show a clear roadmap towards a sustainable housing stock. In particular, RentalCal has the following key targets:

- *Developing and promoting an innovative standardised methodology for assessing retrofits in the private rented housing sector.* Although rental housing represents the

majority of Europe's multi-family housing stock, current profitability calculation methods for energy efficiency retrofits discount some inherent characteristics of specific national rental markets such as split incentives, rental regulations, tax regimes etc.

- *Improving transparency in the investment conditions within the EU housing industry.* RentalCal will provide transparent information on the profitability of energy efficiency investments based on legal, technical and financial conditions in eight participating member states. The standardised framework will enable a comparison of investment conditions in the EU, help to remove investment barriers in national housing markets and stimulate cross-border investment activities.
- *Disseminating key insights into the 'Green Value' proposition to specific target groups.* RentalCal will provide rental property investors with target-group-specific information regarding the impact of a proposed retrofit investment. All information will become available on RentalCal's web-based calculation tool and information platform [3].

## Acknowledgement

*We would like to express our very great appreciation to all project consortium partners for their kind support.*

*The RentalCal research project (European Rental Housing Framework for Profitability Calculation of Energy Efficiency Retrofitting Measures) received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 649656.*

## 7 References

- [1] EUROPEAN COMMISSION. *Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings (recast) by establishing a comparative methodology framework for cost optimal levels of minimum energy performance requirements for buildings and building elements.* Official Journal of the European Union L81, 2012, pp:18-36.
- [2] THE EUROPEAN PARLIAMENT AND THE COUNCIL. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency, Amending Directives 2009/125/EC and 2010/30/EU and Repealing Directives 2004/8/EC and 2006/32/EC. Official Journal of the European Union, L315, 2012, pp:1-56.
- [3] RENTALCAL – *Project description and national pages* [online]. RentalCal Consortium, 2015. [cit. 2015-12-01] WWW:<<http://www.rentalcal.eu>>
- [4] LOGA, T., DIEFENBACH, N., STEIN, B. (ed.): *Typology Approach for Building Stock Energy Assessment. Main Results of the TABULA project; Final Project Report and Appendix Volume;* with contributions by NOA Greece, ZRMK Slovenia, POLITO Italy, ADEME France, Energy Action Ireland, VITO Belgium, NAPE Poland, AEA Austria, SOFENA Bulgaria, MDH Sweden, STU-K Czech Republic, SBI Denmark, IVE Spain, University of Belgrade Serbia; IWU Darmstadt / Germany; October 2012 (43 + 172 pages)
- [5] STEIN, B., DIEFENBACH, N., LOGA, T. (ed.) *Tracking of Energy Performance Indicators in Residential Building Stocks – Different Approaches and Common Results (EPISCOPE Synthesis Report No. 4).* IWU, Darmstadt / Germany – November 2015 (unpublished).