Barriers and drivers to energy-efficient renovation in the residential sector. Empirical findings from five European countries

Véronique Beillan
EDF Recherche & Développement
ICAME Department, *Research Group Energy, Technology, Society (GRETS),*
1 avenue du Général de Gaulle
BP 408
92140 Clamart, France
+33 (0)1 47 65 43 69
veronique.beillan@edf.fr

Dr. Elena Battaglini
IRES (Economic and Social Research Institute)
Coordinator of the Research Area on Environment & Territory
Via di S. Teresa, 23
00198 Rome, Italy
+ 39 6 85797216
e.battaglini@ires.it

Aurélie Goater
Alphéeis – Energy & Environment Consulting
1200 route des Lucioles
06560 Valbonne, France
+33 (0)4 92 90 65 52
aurelie.goater@alpheeis.fr

Andreas Huber, Ines Mayer
EIFER – European Institute for Energy Research
Emmy-Noether-Straße 11
76137 Karlsruhe, Germany

Régine Trotignon
ADEME
500 Route des Lucioles
06560 Valbonne, France
+33 (0)4 93 95 79 68
regine.trotignon@ademe.fr

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Abstract

In many European countries the share of existing old buildings – built before the first heat-conservation regulation – is large. Thus, these buildings represent a huge potential for energy saving but which is hard to exploit. Achieving this challenge depends not only on technical solutions but also on socio-economic drivers (willingness and skills of stakeholders, regulation and incentives, norms and values).

Our paper stems from a study involving five European countries. It aims to analyse the weight of these socio-economic factors in the decision making process, and to identify the conditions for energy-efficient retrofit supply to meet the demand of the households. To do so, several energy-efficient-retrofitted houses in the private sector have been selected as case studies in Germany, Switzerland, Italy, Spain and France. For each case, on-site surveys have been conducted, including qualitative interviews with the owners, the residents and the involved professionals.

In addition, a thorough context analysis has been conducted in each country in order to reveal specificities regarding the retrofit market, the housing building stock, energy uses and the support measures implemented by local or national authorities as regards energy refurbishment.

This study allows to compare experiences and to share knowledge about support actions able to boost energy-efficient retrofitting. The paper will examine what policies and measures are in use and how effective they are in the different countries, what is the role of financial incentives, what are the different levels of action (national/local) and which are the motivations and practices of actors involved in these energy saving projects.

Results show in particular that:

- people getting involved in projects of energy-efficient refurbishment aren't mainly and exclusively motivated by energy savings;
- there's a lack of skilled work force able to meet the requirements of energy-efficient retrofitting;
- public support schemes for retrofitting measures play a crucial role;
- the local embedding of projects is important.

Introduction

Considering the amount of energy consumption in the housing sector, efforts need to be made to reduce energy demand and boost efficiency in this sector in Europe. In France, for example, housings account for two-thirds of existing residential and tertiary buildings' energy use.

Recognizing that the energy saving potential in this sector is important, compared to other sectors, national institutions, such as the French Research and Experimentation Programme on Energy in Buildings (PREBAT), have identified the energy-refurbishment of residential buildings as a top priority. Within this specific sector, the private housing units are particularly hard targets to reach, given the market stakeholders' extremely diffuse character (many professionals and small contractors), the non-professional project owner, the unique technical spe-

cificities of each housing unit (in particular of individual houses) and the existence of many obstacles to refurbishment on both sides of the equation (shortage of consumer information and of appropriate financial instruments on one side, lack of training, of professional culture and of a global technical approach and offer on the other side, etc.).

In order to better understand how energy-efficient refurbishment in the private housing sector can spread in Europe**,** public and private energy and environmental European organisations and companies (including the ADEME, Alpheeis, and six other European partners[1]) and the energy provider EDF, have conducted an exploratory study – discussed in this paper. This exploratory study has consisted in observing and comparing various European experiences on this market. It specifically aimed at identifying the mechanisms enabling the supply side and the demand side to efficiently match.

A cross-cultural study

To carry out this cross cultural study, five countries in northern and southern Europe with different levels of implementation of energy-efficient retrofit operations were selected: Germany, Switzerland, Spain, Italy and France. In order to better characterise the different national contexts, an analysis of the socio-economic, political and regulatory contexts of each country as regards the housing sector and the energy retrofit market has first been realised on the basis of the European project partners' contributions.

Subsequently, a field study was carried out. For each country, four to six energy-efficient-retrofitted buildings in the private sector were selected as case studies and qualitative interviews with the owners, the residents and the professionals involved were conducted to explore how the private-sector housing refurbishment market might become an energy efficiency market.

NATIONAL CONTEXT ANALYSIS IN PREPARATION OF ON-FIELD INTERVIEWS

A previous European field study has shown that the efficient deployment of high-energy performance buildings in the residential sector is based on a combination of various factors. This kind of operation is initiated due to specific motivations of the project owners, but is also influenced by energy and research policies, favourable regulations, or even regulatory obligations, and financial incentives (Beillan, Goater & al., 2009). It is therefore important to know the specific context of each country considered in the study to set the stage, to correctly analyze the information collected from the on-field investigation and to make informed choices as regards the selection of case studies.

This national context analysis has been carried out in this study based on the project partners' contributions (Goater, 2009). It enabled to put the five countries' contexts into perspective as regards: the housing structure, the level of development of the energy retrofit market in the private housing sector, the regulatory and financial policies and measures implemented to support energy-efficient refurbishment of existing buildings and their effective impacts on the refurbishment market (as far as these impacts are known). Only the main primary conclusions that came out of the national context analysis will be presented hereafter.

The housing sector in the five countries: important features related to the energy-efficient renovation matter

We will briefly shed light on a few evidence regarding the housing sector in the five countries, related to the matter of energy-efficient refurbishment. First, housing units that belong to blocks of flats account for a larger share of the residential units in Switzerland and in Spain (70 %) than in the three other countries. In particular, it is interesting to note that Spain has many blocks of flats in co-ownership without management companies, which entails problems for their renovation and, as a consequence, for their energy retrofit.

In all five countries, over half of the housing units existing in 2000–2008 were built prior to the earliest heat-conservation regulations in the late 1970s and, consequently, have poor insulation and high heat demand. Still, we observed that authorities have a rather poor knowledge of the technical characteristics of the housing stock and of the refurbishment works that are carried out in the sector. This lack of knowledge is a barrier to a precise evaluation of the energy saving potential in the housing building stock and to the definition of targeted support action to encourage energy-efficient retrofit in the sector. This observation should nonetheless be modified for Germany, where an in-depth evaluation of the building stock was carried out (IWU, 2007), first on a local scale and second on a national scale. This work enabled German authorities to conceive a precise typology of existing building stock as regards its technical characteristics, its heating needs and the retrofitting works that should be implemented to reduce it energy consumption. This work proved to be very useful to professionals and local authorities, by helping them to define the optimal actions to undertake. Still, this database does not include information on the refurbishment works that have been carried out on the buildings since their construction and therefore dose not reflect the true state of the building stock.

As regards the occupancy status of the housing units, we observed that renting units predominate in Switzerland and Germany compared to units occupied by their owners. It is therefore expected that the conflict of interest between tenants and landlords that typically affect renovation projects are more prominent in these two countries than in the other countries, thus potentially affecting the pace of renovation in these two countries, if not addressed properly.

The energy-efficient retrofit market is not at the same stage of development in the five countries

If we attempt to draw a global picture of the renovation markets in the five countries, we would say that this market hardly exists in Spain, where housing-unit renovation consists of structural improvements and does not really take energy into account, whereas it appears to develop steadily in Germany and Switzerland, and more recently, in certain parts of Italy (the Northern part) and in France.

1. – EIFER, Germany (Ines Mayer and Andreas Huber)
– Studio Cafiero, Italy (Giovani Cafiero and Elena Battaglini),
– Pouget Consultants, France (Elodie Lecart),
– En+, Switzerland (Dusan Novakov),
– Transsolar, Germany (Ulrich Rochard),
– EnergieHaus, Spain (Micheel Wassouf)

In Germany, the concept of global energy-retrofit of buildings is now well disseminated thanks to the support programs of the public bank KfW (from 2005 to 2008, 450,000 dwellings have benefited from this financial support) and to the demonstration programs developed by the German Agency for Energy (dena). In Switzerland, the concept of global-energy retrofit is also well disseminated, but the maturity of the market varies from one canton (local district) to the other. The public policies developed by the cantons play indeed a key role in this market. In France, the situation appears to be intermediate. An important rise of the private demand has been observed in recent years, partly as a result of the new financial tools put in place by national authorities, and of a rise of the public awareness, but this phenomenon is still recent and fragile, and it concerns mostly owners of detached houses – energy-efficient renovation of blocks of flats is still rare. In Spain, few energy-efficient retrofits are observed in the private housing sector, and when they exist, they are generally arising from a public authority initiative. Finally, in Italy, a strong contrast is observed between the northern part of the country and the southern part. The tax deduction system for instance is much more used by inhabitants of the North of Italy than of the South of Italy; likewise, initiatives like energy certification of houses are observed in the North and not as much in the South.

Whatever the differences between countries, it appears that, in all countries, many windows of opportunity for energy-efficient retrofits of housings are not used and energy retrofits are optimal only in a small share of cases. Some surveys conducted in France (Ademe, 2008) and Switzerland (survey from Federal Office for Energy) (Jakob & al., 2004; Ott, 2004) show, for instance, that energy renovations, when they are undertaken, seldom achieve optimal results in terms of energy efficiency (Goater, 2009). The renovations are made step by step over time and rarely follow a global approach. Changing windows is the most common type of energy-efficiency intervention in all the countries (although still rare in Spain); insulation work is the least frequent.

Common features and singularities regarding the regulatory and support measures in the five countries

The regulatory context related to energy-efficient retrofitting

France, Germany, Spain and Italy have transposed the European EPBD (Energy Performance Building Directive) into their national law. Still, regulatory obligations applying to building renovation vary greatly from one country to another. Germany's regulations seem relatively strict compared to the other countries: the performance requirements applying to each "refurbished elements" is particularly high; global performance requirements apply as soon as 10 % of a structural element's area is refurbished, whatever the size of the building may be, or if the building surface is increased by more than 15 m^2; moreover, the thermal insulation of the high living space must be carried out by 2011 if the roof void is unoccupied and non-heated (Energieeinsparverordnung – EnEV, april 2009, 29). Regulations currently in force in France, Spain and Italy appear looser as only major renovations of buildings exceeding 1,000 m^2 are subject to a global performance requirement. As for Switzerland, regulations vary greatly from one canton (local district) to another.

Besides the regulatory obligations that address specifically the energy performance of buildings, other areas of regulation have an impact on the energy retrofit of buildings. Rules affecting the decision making process in buildings held in co-ownership are one of them. Germany adjusted its home ownership law in 2007 to facilitate renovation work in blocks of flats held in co-ownership; more recently, Spain, France and Italy have taken similar measures. Little evidence on the effective impact of these facilitating measures is available however.

As for the energy performance certificate introduced by the EPBD in order to raise the public awareness on the energy performance of the buildings and to encourage energy retrofitting, it is not yet perceived as a strong decision-making factor in the countries where it is implemented, although it is becoming more well known and recognized. In this respect, it is worth mentioning that in Switzerland, which is not party to the European Directive, a similar certificate was introduced in 2009 by the cantons and under which the first 15,000 certificates (which were subsidized), were taken up very quickly.

Common features and singularities regarding the financial incentives in place

Germany, France, Switzerland and Italy all offer financial incentives to promote energy-efficient retrofit of housing units, including direct support (subsidies, low-interest loans). These support mechanisms have been highly successful in all four countries and appear as key incentives. Spain on the other hand offers few financial incentives specifically dedicated to improving energy performance in existing housing units and, where they do exist, few people take advantage of them. This is partly due to a lack of communication on these financial incentives (few people are aware of them and the eligibility criteria are not clear).

It is interesting to mention that several of the financial incentives that are in place in Germany, France and Switzerland encourage the combination of several works in order to rich a high energy performance for the building (i.e. encourage insulation works on the same time the heating equipment is replaced). For instance, this is the case concerning the loans granted by the KfW public bank in Germany, the subsidies of the Building Programme of the Centime Climatique Foundation in Switzerland (2006–2009), the subsidies of the Swiss cantons for Minergie renovations, and the zero-interest ecological loan put in place in 2009 in France.

Besides subsidies and low-interest loans, one should also mention the existence of: tax deductions and credits systems (in France and Italy), financial support to perform energy audits (in Germany, France and Switzerland) and the "white certificates" mechanism (in France and Italy) which functions as indirect financial incentive for individuals.

The effectiveness of these various financial incentives, in terms of energy saving and greenhouse gas emissions reduction, may be challenged. In fact, their effective impacts are poorly known in the five countries, even though efforts are made to evaluate them (for instance, an annual survey was conducted in Germany to evaluate the impact of the 2005–2008 financial incentives). Qualitatively speaking, though, the mechanisms that finance various kinds of interventions, without en-

couraging a global approach to renovation (such as tax credit in France and tax deductions in Italy) are usually perceived as inefficient and too flexible. Quantitatively speaking, the rate of energy-efficiency retrofitting appears still too low to meet the adopted targets for greenhouse gas emissions reduction. Even in Germany, where the energy retrofit market developed earlier than in the other four countries studied, only 0.3 % of housing units have benefited from KfW financial support each year from 2005 to 2008.

The importance of local actions

Various local actions to stimulate energy-efficient retrofitting were reported in Switzerland, France, Italy and Germany (Goater, 2009). In most of the cases, homeowners receive additional financial support and technical advice on their refurbishment. This type of support action usually appears to be very effective as it leads to consistent and relevant technical choices – but it generally involves large financial resources.

France for instance has several local-level intervention tools to promote energy-efficient retrofits of existing housing units: Planned Housing Improvement Operations (OPAH); Planned Building Heating and Energy Improvement Operations (OPATB); and regional calls for pilot projects, encouraged by the French Research and Experimentation Programme on Energy in Buildings (PREBAT). It is interesting to note that all three French case studies in housing blocks benefited from this type of local support: in France, energy-efficient retrofit of housing blocks is rather rare and does not happen unless strongly supported.

Spain, on the other hand, has developed an urban approach to building renovation, with ARI (*Area de rehabilitación integral*) and ARU (*Area de rehabilitación urbana*) "total renovation" plans integrating fairly advanced urban renovation concepts. Those programmes are not dedicated to energy efficiency but they may become useful tools for the energy-efficient retrofit of private-sector housing.

Concluding remarks about the national context analysis

Incentives and regulation: what is the optimum balance between sticks and carrots?

In Germany, where incentives have been put in place since the nineties, overall energy-efficient retrofits seem more common but still only 0.3 % of all housing units were benefiting each year from the KfW bank support programme in the period of 2005 to 2008. Many rehabilitation measures still fall short of energy-efficiency targets and there remains still a lot to be done in the coming years to achieve the required reduction in energy consumption across the housing sector.

Financial incentives in Switzerland, France and Germany stimulate insulation works but, depending on the incentive, not always to the same extent. The most frequently implemented work supported by zero-interest rate loans in France is exchanging the heating or hot-water equipment and replacing windows whereas thermal insulation of the roof or the walls is seldom carried out (Ademe, 2008). Global energy-efficient renovations undertaken in the framework of Italian tax incentives (ENEA, 2008) also seem to be rare.

Relieving the identified obstacles to energy-efficiency renovation and providing public funding is crucial but not sufficient: studies indicate that individuals are still not sufficiently informed about the need to insulate their homes (Barenergy, 2009; Francfort, 2009; Ademe, 2008) and, despite its benefits, insulation is still not emphasized enough as a housing quality criterion. It also seems important to increase people's knowledge about opportunities to improve energy efficiency (work on the building envelop, extensions, etc.) and ways of carrying out the right steps when renovating (i.e. insulation to reduce heat demand before changing heating equipment).

Blocks of flats that are in co-ownership appear to be the most challenging cases for energy-efficient retrofit. Even though the five countries have recently taken steps to facilitate renovation work in blocks of flats in co-ownership (modification of decision-making rules, energy audit subsidies), new regulations, incentives, etc. will certainly have to be devised to push energy-efficient retrofittings in this type of building.

Based on an analysis of case studies in the five countries, the second part of the study aims to shed light on the necessary conditions for matching supply and demand, and to identify the levers driving the transition from a traditional, piecemeal approach to a more encompassing retrofitting approach for better performance of the building stock.

FIELD INVESTIGATION: CASE STUDIES SELECTED IN THE 5 COUNTRIES AND METHODOLOGY

The aim of the field study was to provide an analysis of the ways energy-efficient refurbishments are implemented in the field. 28 energy refurbished buildings were selected together with our European partners: the architectural and thermal design offices in Germany, France, Italy, Spain and Switzerland. The 28 projects include:

- collective housing in Germany (4 cases)
- detached houses (3) and collective housing (3) in France
- detached houses (2) and collective housing (4) in Italy
- detached house (1) and collective housing (5) in Spain
- detached house (3) and collective housing (3) in Switzerland

The renovation projects' decision-makers and the stakeholders they perceive as key to the project (professionals or individuals that played a major role in the projects' decision-making process or completion) were interviewed for each of the operations studied.

Altogether 61 interviews were conducted: 34 with decision-makers and 27 with key stakeholders in the projects' decision-making or completion process. All the interviews followed a semi-directive interview guideline. Interviews with decision-makers focused in particular on their residential history, the context conditions of projects, motivations for undertaking the works and factors influencing the decision-making process. Interviews with key stakeholders explored their experience in energy-efficient retrofitting, their perception of homeowners' needs and factors impeding or encouraging the implementation of ambitious refurbishment projects.

Main findings of the case studies in the five countries

THE DECISION MAKING PROCESS: SAVING ENERGY IS NOT THE MAIN ISSUE

Cutting energy use was never the main or only issue in the renovation projects studied in the five countries. In most cases, decision-makers did not even consider energy when they started thinking about the project. A conjunction of various factors led them to integrate energy into their renovation project, confirming a finding from previous studies in France, Belgium and Denmark (Ademe, 2008; Gram-Hanssen, Bartiaux, 2006). Sometimes decision-makers did not really consider the issue at all. In those cases it was the project manager, totally trusted by the owner, who integrated the energy aspects into the planning.

The renovations' overall context and triggering factors

The main goal of retrofitting detached houses was usually to adapt them to the needs of the families who live there or have just acquired their home. Typically, the owners wish to expand their housing unit as children grow older; they bought a new home and would like to improve the comfort; they purchased an old farmhouse and would like it to become their primary residence. In these cases, the works were a key step in the families residential itinerary and lifecycle. The work is a way of fitting the building to the family; at the same time the work symbolically contributes to building the family as a previous study found (Ademe, CAH, 2005). The buildings' poor condition itself does not seem to have triggered the studied refurbishment projects, although they were often dilapidated and warranted the work. The households' residential project had more to do with prompting the renovation: the confrontation between the residential project and the buildings' rundown condition spurred the decision to renovate.

In contrast, the poor building conditions were the trigger for retrofitting the blocks of flats owned by landlords and co-owners. Those owners made their decision because there was an urgent need to renovate or local officials had required the works (e.g. the obligation to retrofit façades in France and Spain). For landlords, the building's bad condition was an opportunity to bring it up to standards, increase the property's value and facilitate renting.

Motivations for improving energy efficiency

Motivations related directly to the energy issue

The interest in the energy issue can be explained often by similar reasons, but their respective weight varies depending on whether the interviewees were owner-residents of detached houses, landlords of collective housing units or co-owners.

Many owner-residents of detached houses aimed to reduce their energy use. Some of them expressed their will to reduce their dependence on increasingly expensive fossil fuels. The desire for a comfortable, good quality home which is prominent in the bioclimatic philosophy (solar panels and "living with the sun", especially in Switzerland) is the second main motivation behind the objective to reduce energy consumption. Environmental protection plays a more or less important role depending on the project. Most decision-makers consider that aspect a side benefit rather than a triggering factor. However, in Switzerland some homeowners indicated that "conserving resources" was a basic driver for their decision. They are not necessarily ecologically minded, but believe that it is normal to pay attention to natural resources and energy use – a finding that demonstrates that they have integrated environmental concerns into patterns and practices. More seldom, homeowners expect that energy-conservation measures would increase their properties' value.

In comparison, many owners of units in collective housing explained they were aiming to increase their properties value and improve their chances for renting (France, Germany and, to a lesser extent, Spain). Those landlords expect energy efficiency will become a quality criterion in the real estate market in the near future. Furthermore, they consider energy efficient retrofitting as an opportunity to rent their flats more easily. Tenants are expected to appreciate lower heating bills and better comfort. Some may also aim at environmental protection.

Some co-owners considered cutting their own or their tenants' energy bills, improving comfort and/or environmental protection as positive side benefits but those motivations were not a key factor in their decision-making process.

Other factors that encouraged owners to take energy efficiency into account

Energy savings, better comfort and living quality are main motivations for owners of detached houses to undertake energy-efficient measures (France, Switzerland and Spain), but other factors also strongly influenced the decision for owners of units in blocks of flats.

National and local support programmes and awareness of that assistance pushed many flat owners in collective housing not only to carry out energy-efficient renovations, but also to opt for more comprehensive works (France, Germany, Spain, and, to a lesser extent, Switzerland). Most of the collective housing projects in France and Spain received important financial support, which shows that the steps taken to make these kinds of refurbishments more widespread must be large. In France the support is provided within the framework of regional calls for tenders or a local OPATB[2].

Regional or municipal support and incentive programmes thus played a key role in the decision-making process which is not only due to the financial means provided, but also due to the technical support coming with it. Being able to take advantage of collective dynamics played an important role in the case of French projects in the framework of regional calls for tender and those carried out as part of OPATB.

The prospect of tighter energy standards can also play an important role. In France, for example, the possible introduction of stricter energy-efficiency requirements, put forward by OPATB officials, convinced co-owners of the importance of the topic.

Overall, public policies play a decisive role when it comes to the deciding on energy-efficient refurbishments.

2. Planned Heating and Energy Improvement Operation

Stakeholders that have led or encouraged landlords to take energy aspects into account

For many French and Swiss and most Spanish cases, architects played a key role for orienting homeowners towards comprehensive energy-efficient retrofitting. All architects involved in the studied collective housing projects in Spain were particularly receptive to the energy topic, which is rather rare in that country, and integrated it into their projects. In most cases, Spanish landlords never considered this issue, leaving all decisions to architects as the trusted experts.

Existing local advisory bodies also played an important role in starting up projects. They have various forms and can act on different levels depending on the country. For many French cases, for example, local energy agencies advised individuals wishing to reply to a call for tenders.

Another type of "intermediate stakeholder" has emerged in the co-ownership decision-making process in France: a person from the community, mandated by the town, does important work supporting and communicating with the building held in co-ownership in the framework of their OPATB mission. Because of his or her impartiality and thorough knowledge of available support for low-income persons, that expert has real added value and provides "customised" information.

In one Spanish case study, an insulation manufacturer explained the benefits of insulation to co-owners. That type of intervention is important in Spain, where homeowners pay little attention to energy issues. A previous study (Zelem et al., 2010) already pointed out the growing influence of this "secondary network" (institutional and, in the economic sphere, manufacturers and retailers).

PLANNING AND CARRYING OUT THE WORK

Planning of concrete measures with the various stakeholders

The concrete planning of the refurbishment programme is reported to be highly variable depending on the housing category (detached houses or blocks of flats), country and project. No model process was observed that could be replicated in a project. However, some converging points were found cross the countries. For example, local advisory bodies in Germany, Switzerland and France are often involved in the choice of the concrete refurbishment measures. It was also observed that in all countries similar problems were experienced in the decision-making process, in particular in the collective housing sector.

The role of advisory bodies for the projects' upstream side

Our interviews in Germany, Switzerland and France, report that local advisory bodies inform individuals before they start their projects and continue accompanying them in the later stages, for example by directing them to the most qualified professionals or in the framework of pilot programmes by offering technical support to professionals involved in the project. The advisory bodies are often attached to a city or region (or to a canton in Switzerland). Their value added is providing decision-makers with information on locally available financial support. They also centralise information that is sometimes scattered and confusing where many financial support programmes co-exist on national and local levels.

However, there are considerable differences with regard to their actions. For example, for most of the German cases energy consultants in Germany visited the property that will be renovated and performed a pre-assessment whereas in the French cases consultants helped owners to carry out their projects rather than performing a pre-diagnosis. Moreover, there is no specific reference to a pre-assessment in the French case studies.

In any case, these bodies played an important role in several projects, especially in Germany and France. Owners received precious information, often leading them to modify the initial programme to make it more ambitious and eligible for financial assistance. In the French case studies, the decision-makers received more help from the advisory bodies than usual because they had applied for regional pilot projects partly managed by these bodies.

Defining the refurbishment programme: with architects or, in Germany, with "energy consultants"

In Germany, "energy consultants" were involved in defining the refurbishment measures of the four studied projects. These consultants should not be confused with consultants belonging to the previously mentioned advisory bodies. These professionals—energy specialists in building technologies—are registered on two lists which are available to the general public administered by dena (the German Energy Agency) and BAFA (Federal Office of Economics and Export Control). Despite this public listing, some interviewees are confused about the roles and responsibilities of the "energy consultants" due to the fact that this title can be obtained by people from different educational venues.

In any case, the German situation does not seem to have any equivalent in the other studied countries.

Project architects in France, Switzerland and Spain usually have advisory skills in terms of energy efficiency. Most of them are collaborating with a specialised advisory firm. Spain is an exception, as architects do not seem to draw upon the skills of consultancy firms. Spanish professionals have not yet achieved competences to assess buildings' energy performance. Simplified software helping to calculate the energy efficiency performance during the design process is only now starting to be developed. The networkof professionals taking care of buildings' energy performance is smaller compared to the other countries – a sign that the issue is only emerging.

In the six French projects studied, integrated project management companies were intervening and are grouping several skills. These included the expertise of at least one architect and one energy efficiency expert, and sometimes of an economist. This organisation that had not been observed in France in the previous study on new buildings[3], has added real value to the examined projects. It enables managers to offer clients several refurbishment scenarios, which, according to the interviewed homeowners, facilitated the decision-making process. The scenarios allow decision-makers to compare several refurbishment projects based on costs, energy performance and financial support available in each of the cases.

3. Project HabitEnergie: analyses factors of success in building low-consumption houses in France, Switzerland and Germany. Study co-financed by ADEME (2006–2008). (Beillan, Goater, Cayre, 2009)

Table 1. Importance of various factors for energy efficiency refurbishment measures.

	(I) detached houses	(II) private landlords	(III) buildings in co-ownership
A. Points support for energy issues	(+++) lower bills (+++) comfortable temperature/quality of life inside the home (++) environmental dimension (awareness of the environmental benefit or symbolic value) (+/-) higher property values	(+++) higher property values (+++) easier to rent (lower bills, more comfort) (++) environmental benefit	(+/-) lower bills (+/-) comfortable temperature/ basic comfort (+/-) environmental benefit (slight difference depending on the country: these three factors' influence is weak in Spain and France, medium in Germany)
B. Other factors that influenced the consideration of energy aspects	(+) financial support (+/-) local dynamics/ technical support	(+++) financial support (++) local dynamics/ technical support	(+++) financial support (+++) local dynamics/ technical support
C. Stakeholders who influenced the decision	Architect Energy consulting bodies	Architect Energy consulting bodies	Architect Energy consulting bodies "intermediate" stakeholder from the community Insulation manufacturer
	(slight difference depending on the country: these stakeholders' influence is strong in Spain and medium in the other countries)		

Colour key:

Little influence (of A, B or C) in the sector considered (I, II or III)
Strong influence (of A, B or C) in the sector considered (I, II or III)
Strong influence (of A, B or C) in the sector considered (I, II or III)

Meaning of the (+++), etc.:

(+++) a very important factor
(+/-) a factor with little influence

Difficulties in decisions making in co-ownership buildings

Spanish interviewees did not report any particular problems with regard to the decision-making process for buildings held in co-ownership[4], but in France and Germany it seems hard to carry out comprehensive energy refurbishments in co-ownerships. Those problems are apparently related to high costs and uncertainties coming with the planned refurbishment measures. Young owners are more inclined than older ones. Third parties – energy consultants in Germany, municipality agencies or a co-op leader in France – often had to intervene to convince owners of the suggested work. The decision-making process therefore was often reported to be long and complicated: agreements on refurbishments are hard to find, and voting is only possible at general assemblies, which usually take place only once a year. However, final decision-making is facilitated by majority voting (rather than unanimously).

4. In Spain, co-ownership buildings that are required to undergo refurbishment for security reasons, received very high subsidies. This did of course facilitate the decision-making process, and owners often mandated the architect to decide on measures.

Doing the work

Difficulties in recruiting qualified companies

In France and Switzerland many owners paid high attention to the recruitment of qualified companies, capable to implement the required technical solutions and to collaborate with other involved professionals. This is because energy-efficient retrofitting projects require special qualifications that only a few professionals possess.

Hence owners sought companies that meet these requirements or got closely involved in the worksite themselves to assure the project success.

Spanish landlords did not share these preoccupations to the same extent. However, the expected levels of energy performance are not truly comparable.

Landlords involvement in the work

In several French, German and Swiss case studies owners either monitored the worksite or took part in the technical refurbishment works. Some of them strived to supervise companies' work to assure the project success; in other cases the need for coordination explains this involvement, which helped to avoid harmful consequences, in particular concerning deadlines. In a few cases owners also aimed to cut costs. However, such a close

involvement means huge efforts for owners and the willingness to look into technical details. Some of the interviewed German landlords who coordinated extensive works themselves considered it as a burden.

Quite differently, in the Spanish and Italian projects owners were not closely involved in the work and entirely trusted the mandated architects. This can probably be explained by the smaller scale of those projects (and therefore of a less intrusive nature) or done at an unoccupied site.

Technical difficulties

All in all, only a few major technical problems occurred in the studied projects. The problems concerned the ventilation system in a block of flats and, in another case, the airtight seal under the roof. These problems were not considered as major obstacles, but illustrate the need of professionals who are capable of adapting to unexpected worksite incidents. The latter occur more frequently in such projects than in conventional refurbishment projects. The issues were resolved thanks to the professionals' ability to innovate and adapt.

After the works

Residents' satisfaction, impacts on their living patterns

Overall, residents expressed their satisfaction with the works, despite the inconveniences some of them may have experienced during the realisation of measures. They generally like the comfort and good quality of living inside their refurbished homes (convenient, more even temperatures at summer and winter time, good light and air quality), except for rare cases where air quality is a problem or a feeling of confinement was reported. Some people emphasize savings on their energy bills, although it is hard to have very precise quantitative information.

However, the study revealed that the new thermal qualities do not encourage residents to adopt more energy saving behaviours. Those who had always paid attention to their consumption simply continued to do so. The others haven't changed theirs habits either.

Finally, some of the studied projects helped to spread knowledge about energy-efficiency, either by providing the involved professionals an opportunity to upgrade their skills or, in some cases, through publicity about the works carried out.

Assessments of the achieved energy performance level

Only in very few analysed projects was post-work performance precisely monitored. According to the interviewees, this type of follow-up is not common practice but might be part of a research project. In Spain, consumption was monitored in two projects. In the first case the architect wanted to evaluate the effectiveness of the refurbishment works he had done in order to improve his future projects' performance; in the second public institutions required information as they were co-financing the project. A German interviewee reported that for ambitious projects – such as the ones carried out in the framework of the dena (the German Energy Agency) programme – consumption is being monitored for three years in order to evaluate if results match objectives.

Most of the interviewed professionals agree that monitoring consumption would be worthwhile, but are not willing to do it because it is not part of their mission.

Outlook

The field survey presented here helped to identify and understand various factors at work that can either facilitate or impede energy-efficient retrofitting projects. In conclusion, we want to sum up the key factors that, according to our observations, will encourage or impede ambitious energy-efficient refurbishments in the private housing sector. Where available, we complement our findings by additional evidence from other studies.

DRIVERS AND BARRIERS

Contexts favouring refurbishment: events in relation to people's lives and the life cycle of the building

An obligation or a need to carry out major building refurbishment or adaptation work was behind all studied energy-efficient retrofit projects. Particular events were seized as opportunities to carry out major refurbishments: typically, the purchase of a detached house or the expansion of a dwelling unit, or, in the case of collective housing, the obligation to perform maintenance work.

Factors favouring energy efficient retrofitting

The prospect of increasing the real estate value of housing units that undergo energy-efficient retrofits and/or the benefits associated with such renovations, such as lower bills and greater comfort, often led decision-makers to opt for "ambitious" energy components in refurbishment projects. The study shows that the prospect of boosting real estate value was a bigger driver for implementing energy-efficient refurbishment measures in case of blocks of flats than in detached houses; benefits such as lower bills and greater comfort mattered more to owners of detached houses than co-owners.

A set of factors influenced both these aspects—the prospect of higher resale value and benefits associated with energy-efficient renovation. They have to do with social and cultural values attached to housing and to the idea of well-being in the local socio-economic context and, in a certain manner, in the normative context, which has a positive impact on real estate values.

Two other factors encouraged the adoption of an ambitious energy component into renovation projects: the prospect of tighter regulations and owners' concerns for environmental protection.

A need for incentive schemes to make energy-efficient retrofitting a reality: attendant measures and financial support

Owners' access to information often played a preponderant role in the decision. In several cases, technical and financial advice before the project, and accurate information about available financial support, appeared as key factors prompting the decision to carry out an ambitious energy-efficient retrofit instead of a conventional one. In some cases, local advisory bodies provided owners with important information; in other cases, pro-

fessionals did. Yet, some owners were themselves well informed due to their profession or personal network.

In cases where individuals trusted the building or project manager's choices, the stakeholders' ability to recommend an ambitious energy-efficient retrofit was decisive.

Another decisive aspect was the amount and nature of financial support available and individuals' knowledge of that assistance. This was a key factor for most of the collective housing renovation projects. One person interviewed in Germany said that at first she had no intention to undertake a total energy renovation but the possibility of obtaining support convinced her to do it.

Local embedding favours energy-efficient refurbishment measures

In addition to support and incentive measures, local authorities' actions had a big impact on several projects. Some of them made access to information easier by creating a advisory service for private individuals; others set up support programmes combining financial support and advice services and launched local dynamics to promote energy-efficient retrofittings.

Regarding barriers to energy savings, this study confirms a number of obstacles found in other research projects (Ademe, 2009; Pierre, 2008; BarEnergy-WP4, 2010; Beillan, Goater, 2009; Francfort, 2009), in particular:

- *Lack of households' information on available solutions and the saving potential of comprehensive measures*[5]. Individuals are insufficiently acquainted with the energy performance of their building (insulation and performances of equipment) and with the comfort and quality of life an energy-efficient retrofit can bring, although the degree of unfamiliarity varies depending on the country. In Switzerland, there has been a major communication effort on the Minergie standard that emphasized the relationship between energy-savings and comfortable temperatures.
- *High expenses and opaqueness of costs*. In every sector studied, not just detached houses, energy-efficient retrofits entail costs that few people can actually afford. Some landlords with small properties may have trouble financing extensive work. For buildings held in co-ownership, including insulation in a renovation can add 40 % to the bill, which is considerable for some owners. Financing is an issue for all types of residential buildings to spread energy efficient retrofits on a large scale.
- *Lack of incentives and changing policies*. Some interviewees in Germany complained about confusing political signals during the past two years. Budget cuts due to the economic and financial crisis have temporarily eliminated the economic development promotion programme, which supports facilities using renewable energy. Such political signals are confusing and may have harmful consequences on owners' and professionals' decisions to invest in energy-efficient buildings.

5. This lack of information explains the incredibility of households before the energy savings to be made with this work [energy efficient renovation and heat insulation] (Francfort, 2009).

That problem had not appeared in France at the time the interviews took place, but the "budget reorientations" the government has decided for in 2011, including less support for energy efficiency and renewable energy in the construction industry, may cause some confusion. Contractors, for example, have long feared a rise in the 5.5 % VAT on renovation work, but the rate will be kept steady for now.

In addition to these destabilising political signals, some people interviewed in Germany complained that regulations are changing too quickly for contractors to keep pace. This finding is not confirmed by the French case studies, although the changes in energy efficiency regulations have sped up since 2005.

In Spain, the lack of regulatory constraints and incentives (such as energy performance labels) was lamented.

The supply side appears insufficiently structured and specialised and access to information is sometimes difficult. The industry's supply may appear as sufficiently mature (ventilation systems in collective housing, heat pump sizes) but the bigger impediment is that the offer lacks structure. Skilled, qualified energy-efficient retrofit professionals in every building profession—engineers, architects and contractors—are still few and far between (see also outcomes from the European study BarEnergy (BarEnergy WP4, 2009)). Many contractors seem to lack knowledge about new products, be insufficiently aware of the need to coordinate with other professionals involved in the project (lack of "meta-skill") and require an overview of the building. This assessment appears especially true for Spain, Italy and France, but in some cases, also, for countries more advanced such as Switzerland and Germany. There is consensus among experts in France on the need for better coordination between professionals to refurbish to create more low energy consuming buildings (Lagandré, 2007, Beillan, Goater, 2009; Zelem, 2010).

The wide range of intervening professionals caused some confusion, especially since there is not necessarily a good coordination between the various organizations involved. All in all, it was often hard for individuals to access information, which tended to discourage them from undertaking energy-efficient retrofits: people in Spain and Italy emphasized the lack of readability and the difficulty of accessing financial support. Often, the local institutional context (local consulting organization) encouraged the creation of a network facilitating information access. It also encouraged or penalised energy-efficient retrofit projects depending on whether building regulations were applied (in particular, the Italian ones on heritage and landscape preservation).

Social conventions and diverging priorities on the demand side

In addition to these economical and technical barriers which might hinder a move forward in the building sector, there are also social and cultural obstacles on the demand side, amongst them:

- social norms in relation to thermal and acoustic comfort, light, air quality (perceptions of inside air quality can affect technology diffusion as seen, in the previous study (Goater, 2009), in Germany and Switzerland with mechanical ventilation system;

- diverging priorities. In a context of high real estate prices more floor space is prioritised over environmental protection (some people reject certain kinds of thick insulation materials or façade insulation in order to preserve old building's aesthetic value)
- pre-conceived ideas on energy uses and ways to save it (information on inefficient appliances, potentials for savings and solutions at hand e.g. insulating before installing renewable energy.

IN WHICH AREAS SHOULD ONE ACT?

Considering this body of evidences: key factors and impediments, which measures might be pushing energy-efficient retrofittings? In which areas should one act?

Creating financial incentives for households (tax reliefs, loans and subsidies), establishing regulations based on an overall energy approach to buildings and training professionals seem crucial to tackle these barriers. The eco-building market needs to be boosted. The local level, in particular through calls for tenders, appears to be very appropriate to boost energy efficiency initiatives in building.

Financing policy measures in regard with raising awareness of all stakeholders

Financial measures, such as tax relief or low-interest loans in France, KfW subsidies in Germany, and Centime Climatique or Minergie financial assistance in Switzerland, played an important role in the countries case studies. They are a necessary but not sufficient support measure. Other support measures need to be implemented for them to be effective.

This involves improving the professionals' awareness of the overall approach and training them in the specificities of energy-efficient retrofits, as well as giving residents information they may not always have (for example, the availability of incentives to perform energy audits). It also seems important to pursue communication efforts to valorise the economic benefits. "Publicity" surrounding projects, in particular by organising tours, is a popular way of spreading information. Open houses organised in Germany (Tag der Energiespar-Rekorde)[6] or in Switzerland by Minergie collective[7] are an interesting approach, which is spreading to some French regions with the aim of welcoming homeowners as well as professionals wishing to find out about these kinds of projects.

- *Defining the optimal level of energy requirements for existing building*. Based on our findings, new regulations would be useful to encourage energy-efficient refurbishment measures, in particular for those buildings held in co-ownership. Energy performance labels or certification that go beyond regulatory requirements also have a positive impact on the energy-efficient refurbishment market. In countries where label requirements are already at the cutting edge, though, the tightening of the label requirements must be done with particular care as too strict requirements may be too challenging for existing buildings and favour demolition instead of refurbishment.
- *Energy efficiency improvements in building require new skills and new jobs.* Newcomers in the interface between different professions, such as energy consultants in Germany, are emerging in the sector. The crosscutting skills required for energy efficient retrofitting challenges the traditional divisions between professions because the energy saving potential is partly located at the interfaces (thermal bridges, for example) (Zelem &al, 2010).
- *Promoting local companies that appear very dynamic in all analysed countries*. Local organisations seem to have an important role for stimulating the refurbishment market, for example by financing the initial energy audit while fostering the creation of expert networks with specific responsibilities, skills and interests. Thus local governments play a key role in increasing refurbishment and the creation of sustainable buildings.

6. http://www.dena.de/infos/veranstaltungen/archiv/veranstaltung/tag-der-energiespar-rekorde/

7. http://www.minergie.ch:journees-nationales-minergie-p.html

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