The Franklin district of Mulhouse: first French experience of low energy building renovation in a historic area of the city centre

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Summary: The project for the Franklin district of Mulhouse is the first French experiment in the renovation of old buildings in the context of a deteriorating urban area with a historic character to preserve incorporating firm energy objectives. Its first phase has just been completed with the publication of a feedback report [1] regarding its energy concept, large parts of this paper are based on these findings. The latter is in line with the Annex 51 programme of the International Energy Agency, *Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers*. The aim of this paper is to clarify the main elements enabling this project and to present the first results after two years of monitoring.

Keywords: *Urban Renovation, planning instruments, financing schemes, historical area*

In the European context a large part of the activities in urban development planning focus on the rehabilitation of existing areas. Today's approaches for rehabilitation schemes have to address the urgent environmental questions by increasing the energy efficiency of our cities but at the same time have to find answers to social difficulties and in many cases respect historic characteristics of the city. These were the main objectives for the City of Mulhouse in 2004 when it began to renovate a large part of its city centre and simultaneously intensify its sustainable development policy, especially focusing on climate change. Much of the city centre at that time was experiencing social difficulties and the inhabitants saw their everyday surroundings deteriorate. For this reason, the city chose to combine urban renovation and low energy use concepts by launching out one of the first projects in France regarding renewable energy in a historic city area formed by the legacy of the city's working-class past. The Franklin scheme is in line with the definition and the set-up of sustainable development policies at the national and European level. The aims at the outset were high and the conditions for getting there were difficult. This paper will discuss the first results and show that the project succeeded to nut just conduct a renovation programme but to fit and interlock with a policy and city planning logic on the agglomeration scale. Energy efficiency is thus closely linked with social and economic considerations. First results from the time span between 2004 to 2010 are discussed here based on a follow up report published in May 2010 [1], first of all by presenting the contextual specifics on which the operation depends; by focusing on the elements necessary for setting it up and finally, by presenting the necessary determining factors in the success of low energy building renovation measures that this experiment produced.

1. Context and energy targets

1.1. Operational Context

The district of Mulhouse (112 000 inhabitants) and its metropolitan area m2A (Mulhouse Alsace agglomeration - 255 000 inhabitants) occupies a unique geographic position in close proximity to Switzerland (Basel) and Germany (Freiburg). In the early 20th century it was one of the biggest European industrial centres. After de-industrialisation and the sweeping economic changes which followed this age, the town experienced harder times which it has been trying to overcome for many years. In order to achieve this, it can count on a young population and recognised technological know how mainly in the automobile industry.

Having something of an image problem, and looking to make the area more attractive, the Mulhouse agglomeration was one of the first actively to embark on sustainable city planning. Its climate plan, drawn up in accordance with the National Climate Plan, is one of the first in France (2007). This first step also includes the hope to revitalise the agglomeration's centre and to slow migration of commercial activity and the middle classes towards the periphery. To this end, work was undertaken in 2001 as part of a vast programme to renovate the city centre which included public spaces, economic activity and housing. It is within this framework that the local authority decided to renovate a number of particularly run-down buildings in line with low energy use targets. Thus first and foremost it is an approach linked to city policy, within which an environmental and energy aspect is formulated.

1.2. Energy Objectives

The Franklin district was built by the leaders of the Mulhouse textile industry between 1880 and 1910 to house their workers. It was very run-down and heading towards abject poverty, which resulted in a sizeable lack of renovation of buildings, some of these becoming outdated without a corresponding fall in housing costs falling behind in terms of comfort and basic facilities as well as security problems. In 2004, the city therefore launched a consultation process as part of the city centre's renovation. The local authority wanted to preserve the strong working-class identity of the area while implementing a thorough renovation which could have a practical impact on the urban environment and on the inhabitants' quality of life. Eventually the low energy building standard (BBC[1]) was set as target. Back then, and still today, renovating buildings according to the BBC standard is regarded ambitious in the French context, with energy use twice as low as the requirement of new buildings at that time. This level was set by the ALME (Agence locale de la maîtrise de l'énergie – Local Energy Agency) one of the very first French agencies created within the framework of the 1999 European SAVE programme. The ALME was given a mandate by the city of Mulhouse to develop energy optimisation and the use of renewable energies on the buildings to be renovated in Franklin. It also coordinated and led the operation, being responsible for accompanying the contracting authorities and project managers in applying their energy limits.

The neighbourhood consists of 300 buildings of which 106 were identified as not being in an adequate condition. Almost a third of the 106 buildings were potentially involved in the renovation work. Most of the dwellings in question are identical terraced town houses (i.e. adjoining on two sides) which contain 2 to 4 levels. To reduce the primary energy demand from an average of 450 kWh/(m²a) in primary energy to the set target, a modest intervention was not enough. From the outset, ALME, which engaged the services of a specialist energy research department (ENERTECH), decided to develop "standard technical solution" (solution technique universelle - STU) [2] in order to gain simplicity and efficiency in the implementation and also to reduce the costs. An initial comparison based on the dynamic simulation of individual buildings allowed assessing different combinations of existing efficiency technologies in order to define the targets which would be adapted to the Alsace region. To reach the BBC level, several main themes were defined. Insulation was reinforced for the walls and windows (triple glazing), taking summer comfort into account. External insulation was preferred where possible but the historic character of the façades or the encroachment onto the pavements often rendered this solution impossible.

[1] The French BBC standard limits primary energy use to 50 $kWh_{primary}/(m^2a)$. This value includes heating and cooling needs as well as energy for domestic hot water, ventilation and lighting.

The existing distribution system (i.e. radiators) were maintained but supplied by new wall mounted condensing gas boilers. The air exchange was ensured via mechanical ventilation with heat recovery, centralised for each building. From the point of view of electricity consumption, savings were identified in specific uses of electricity (appliances on standby, buying class A appliances or better). Domestic hot water (ECS) was taken care of by solar water heaters, from 5 to 7 m² per building, representing about 40% of the needs. At the same time, devices reducing water consumption were installed (e. g. pressure reducers).

Integrating all these solutions into a renovation project was sometimes complicated. The installation of some particular devices such as the double flux ventilators required ducts inside the dwellings. Alongside these technical problems, complexity also arose around the set-up of the project which had to obtain the maximum amount of financial backing and attain the energy targets.

2. A combination of mechanisms for the renovation scheme

2.1. The process

The city of Mulhouse delegated the project's implementation and management to SERM, a local mixed enterprise for developments in the Mulhouse region. The firm was mandated by the city of Mulhouse to carry out the operation in strict collaboration with ALME.
SERM was in charge of the renovation operation in 2004 for the old historic parts of town. Within this perimeter, some buildings from the Franklin district were particularly run-down, which meant their owners could have been forced to carry out renovations on their property. If they weren't capable to do so, the work would be declared in the public interest for these buildings, which allowed SERM to acquire the buildings. The buildings were then resold at the market rate to private landlords with an obligation to carry out the work according to the low energy standards contained in the conditions of the contract. The resulting incremental costs for investors were compensated by the community authority through subsidies and tax benefits. To support them in the application of the contractual conditions, the investor and his project manager received free assistance from ALME throughout the realisation of the project in order to respond to their enquiries and to ensure conformity for the intended work. The aim was to integrate the energy constraints and to form teams contributing to the installation of the technology. ALME also carried out checks during construction time and was available for the entire operational phase. This monitoring led to an optimisation along the way, following difficulties which arose during the implementation of technology which at that date was not in widespread use. Once the buildings were finished and the inhabitants had taken possession of them, ALME supported the tenants by informing them about the aims of this low energy renovation and by explaining how to operate the devices.

So that these aims and this support would be feasible and financially realistic, the local parties involved sought to take advantage of the financial opportunities the project was able to claim.

2.2. The implementation

In this paper the main focus is put on the implementation process. Therefore technical aspects will be treated in a lesser detail while primarily planning and financial instruments applied in the project will be described. Urban renewal operations as the one described depend on a sizeable number of financial aids to be called upon for the actors within the given area who do not have the necessary funds at their disposal (local authorities as well as private property owners). The necessity as traditional mechanisms to renovate buildings are ineffective (e.g. the property market or economic activity). As a result, the success of a project such as the one

in Franklin relies on the ability of the project manager to obtain financial backing and its effective usage. The city of Mulhouse – and indirectly the private investors in the district – managed to do this. In addition to their own funds, they received significant subsidies which the diagram below summarises, indicating the level of origin and whether or not they were transferred directly to the public project manager.

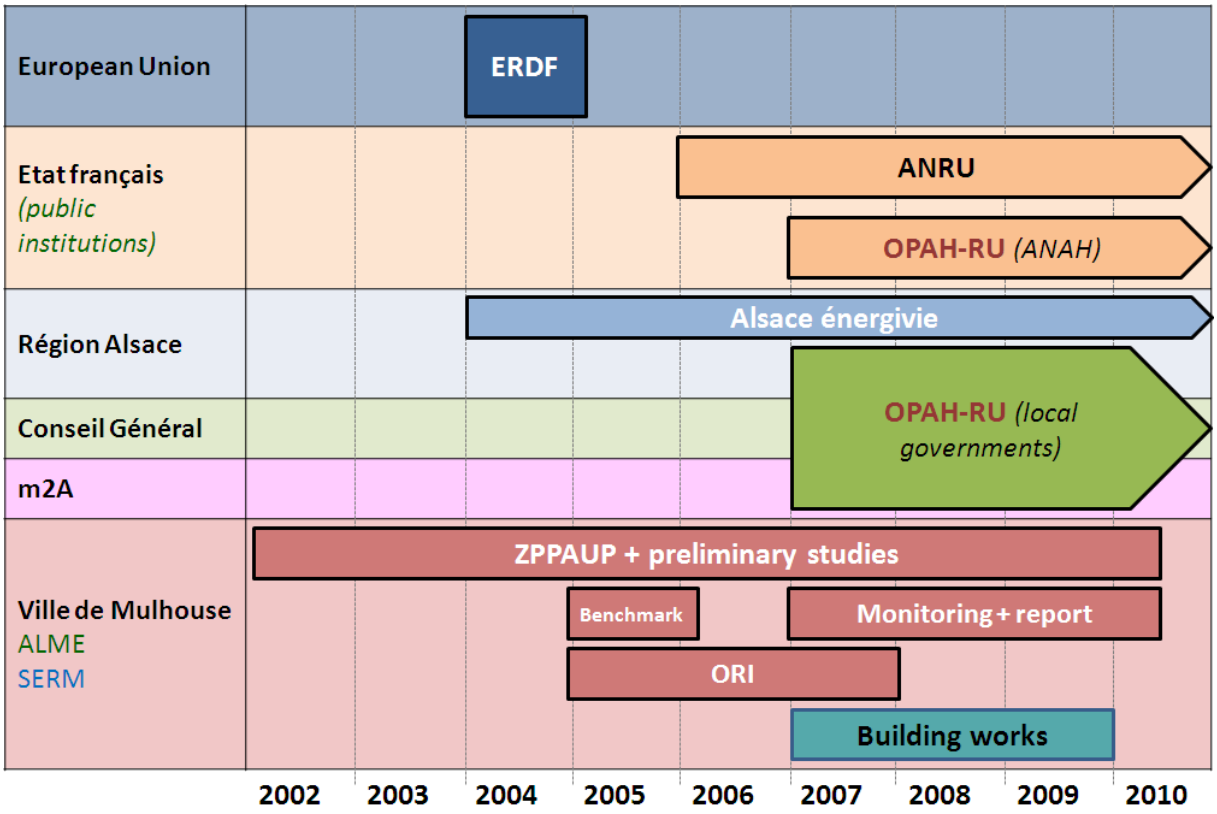

Figure 1 : Summary diagram of programmes and financial schemes in place within the Franklin district project

The European Union contributed via the European Regional Development Fund (FEDER) by financing for two years the preliminary research and the benchmarking. It was also a partner in the programme *"Alsace énergivie"* [4] led by the Region of Alsace in partnership with the ADEME which funded all the organisational engineering and the project's technical support assistance between 2004 and 2010. This programme has been designed since 1998 to promote energy saving and renewable energy by supporting private entities as well as local governments in their projects (awarded the 2008 European Commission Regiostars prize). Alongside this involvement, the state plays a specific role both by contributing direct funds to the local authority, but also by subsidising private entities. The City of Mulhouse came to choose the Franklin district project because it presented an ideal configuration, allowing urban renovation funds set up by the French state to be drawn on as part of the implementation of a city policy. This area is affected by four main mechanisms which are strongly interrelated.

An agreement was signed with the National Agency for Urban Renovation (ANRU) concerning the old city-centre districts such as Franklin (€270m of which 18m were allocated to the programme in 2006). ANRU is a public institute charged with funding and setting up the urban renovation programme across the country in urban zones which have experienced

difficulties (lack of social/functional mix, lack of opening up to the rest of the city, etc.). In the Franklin district and the old districts surrounding it, it was expected that the housing on offer would be renewed, and that a series of public places would be rearranged: the Franklin public square, several schools, extracurricular centres, etc. The ANRU funds went directly to the public body charged with carrying out the work.

Furthermore, a scheme designed to improve the housing sector (OPAH) has been launched, dedicated to zones containing a high number of buildings potentially hazardous to health, run down (both internally and externally), empty or subject to social dysfunction. The OPAH-RUs (Urban Renewal, specific to urban zones), solely dedicated to the rehabilitation of urban zones, are organised as a partnership between districts, local authorities and the state. Here, it's the Alscace regional authority, the agglomeration of Mulhouse m2A and the City of Mulhouse who contributed to the funding. The ANAH subsidies rose to about €350/m² transferred to the new owners of the property for a renovation cost of €1450 /m² (exclusive of tax).

The fourth mechanism is the setting-up of an scheme for property restoration (ORI) for old districts, which can be applied when the building is especially dilapidated and after a public investigation has been carried out. It is applicable within a reduced perimeter and differs from the OPAH-RU operation because of its coercive character. In fact, the owners, once they have been notified of the requirement for work, run the risk of expropriation in the event of non-compliance. This was one of the levers used in order to impose a thorough renovation in the Franklin district.

Finally, tied in with this ORI, the municipality demarcated an architectural and urban heritage protection zone (ZPPAUP) which made it possible for owners to exempt a part of the cost of the renovation work subject to them by renting the building out.

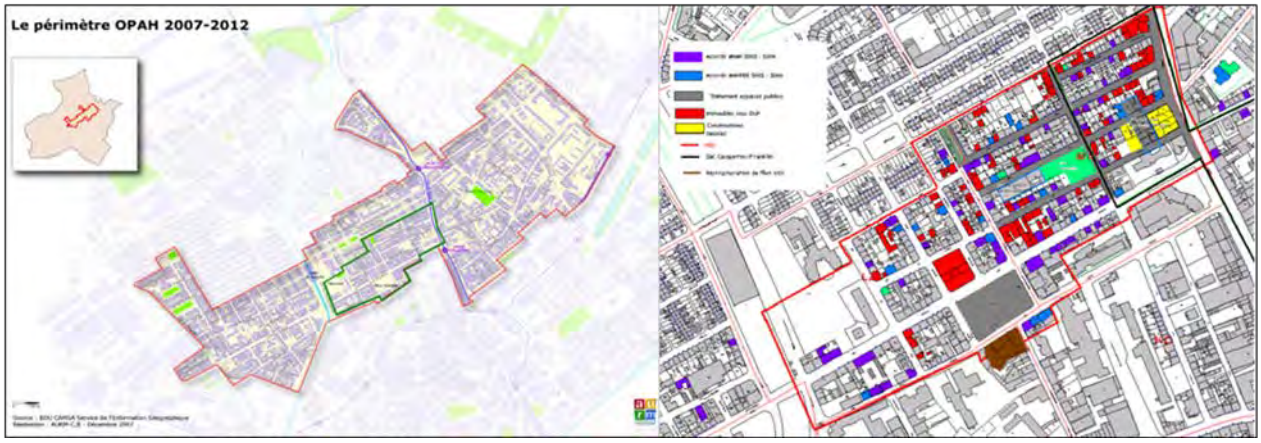

Figure 2 : The boundary of the OPAH and, that of the ORI (Source: ALME, AURM)

Within the framework of the aforementioned financial sources, SERM offered to help the owners for free. Firstly by providing for a dossier allowing all available subsidies to be claimed. Secondly by transferring the part directly subsidised to companies in form of upfront capital fund so that the owner wouldn't have to pay in advance. It therefore created a one-stop-shop for private entities. This action made the process of distributing subsidies easier, and so increases the attractiveness for private investors.

3. Energy efficiency at the linking technology and behaviour

3.1. The occupant, key element in low energy schemes

From the outset of the project, the Franklin district was intended above all to be a city planning experiment for renovating a city centre, as well as a turning-point taken by the agglomeration in terms of sustainable development. To follow its progress and develop it was therefore the motor for the management of the project. A very unusual approach which could even give rise to disappointment faced with the uncertainty of the results. However, aside from a few pitfalls, the positive outcome of the renovation scheme could clearly be demonstrated.

In financial terms, the additional costs associated with the requirement for low energy renovation ("universal technical solution ", STU) was estimated in 2006, at the start of the project's implementation, at €315/m² (exclusive of tax) relative to usable surface (figure 3). Other costs linked to energy rise to €524/m² (excl. tax) for a total cost for the implemented measures of €1551/m² (excl. tax). The individual measures are described in figure 3 and included the insulation of the roof and the walls, mechanical ventilation and exchange of the boiler.

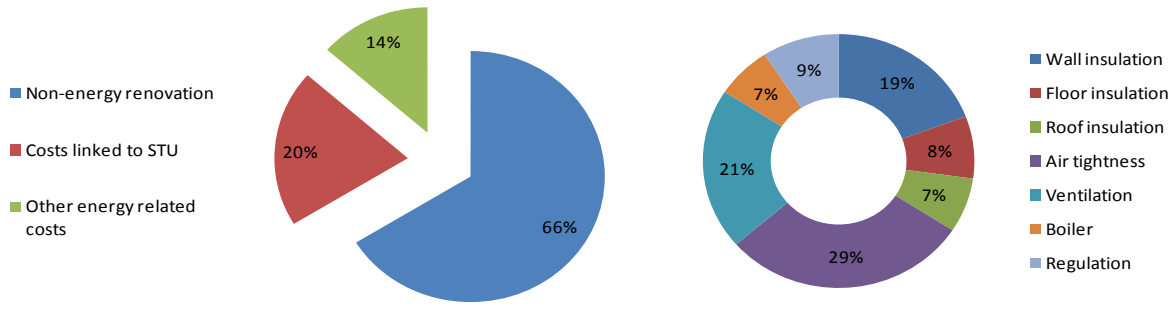

Figure 3: Cost breakdown of the renovation and ventilation of STU average costs in € and € /m² (excluding tax) of liveable surface area [3].

The investment costs, however, have had a tendency to go down since the start of the implementation in 2006 (-20% between 2009 and 2010). In addition, it became desirable to give up on some technical features which remained expensive such as triple glazing, and to develop air tightness in compensation which was found to provide for a higher energy efficiency potential [3] for the same investment. Concerning energy mechanisms, the 12 first buildings were the object of a thermal assessment and 2 years' monitoring. In addition, ALME's presence and its observations identified problems on site which couldn't be measured by instruments.

Yet Franklin is above all a city planning operation which, with or without ambitious energy targets, was a necessity for the neighbourhood. Its primary objective was the renovation of a run-down area improving the quality of life of its residents. The first return of experience on this subject is encouraging. The quality of using the dwellings has been improved: reduction of noise problems thanks to the insulation, greater thermal comfort, etc. This is accompanied by a significant lowering of costs for tenants who today pay rents similar to those in force prior to renovation but with charges considerably reduced (heating costs divided by 8). This advantage is vital because it sizably diminishes the vulnerability to energy price. More generally, the whole set of energy efficiency measures offers an added resale value for investors and increases the maintenance of the buildings over time.

From a specifically energy related perspective, one of the primary factors for success or, alternately, for failure, lies in the residents' acceptance of the systems put in place. An observation which has been highlighted in other analyses already carried out on new construction like in Grenoble's De Bonne district. The first results confirm that technology alone does not reach the full potential of the energy efficiency measures. First of all, the trial of communal areas for washing and drying made up part of the recommendations. However, this solution showed itself to be a failure as the designated spaces were not used very much. Also, some of the residents didn't follow the advice given to them during their moving in and kept the same habits as in a traditional dwelling (e.g. opening windows in winter, high heating temperature). The summer comfort was generally good but the results could have been even better with improved habits (e.g. night time ventilation). As often observed the users regulated the heating system to a higher indoor temperature as was initially assumed - heating to 20°C compared with the recommended 19°C. The final report cites the neutralisation of the thermostatic radiator valves regulated to a maximum of 19°C or the obstruction of the ventilator openings [3]. Besides traditional behavioural problems, one of the factors identified in this misuse lies in the problem of communication with the tenants. Sometimes this was linked to a poor command of the French language (suspicion regarding the measuring devices in the apartments, unworkable advice). In a more general sense sometimes the ALME had difficulties to stay informed of the arrival of new tenants which is due to the magnitude of owners and landlords in the area. However, the options for tackling this area of problems remain few, and their results hypothetical.

3.2. Energy efficiency: know-how and quality of implementation

Another behavioural factor depends on the implementation of the chosen energy efficiency measures. In Franklin, no revolutionary technology was used. On the other hand, in 2004 they were quite unusual compared to those traditionally used in French refurbishment market.
Some of the engineering offices in their approach did not distinguish between low energy buildings and traditional buildings. That notably led to an over sizing of the heating installations and therefore a poor efficiency. Moreover, the monitoring drew attention to the need, from the start up and the receiving of the dwellings, to take particular care of the auxiliary energy as well as ventilation or domestic hot water production.

Moreover some of the building professionals had not been informed about the installation quality required to achieve the low energy objectives. Problem also known in traditional construction yet its consequences become more visible when it comes to achieving this level of performance. Explanatory information had indeed been put together but it didn't work very well, notably because of the fluctuation of involved companies. This lack of care led in some examples to a poor air tightness of the building envelope. After the first applications this point has been added to the contractual conditions. Due to this, energy consumption for heating varied from one building to another partly caused by differences of air tightness. The average energy use is about 70 $kWh_{primary}/m^2$ of usable surface area per year in primary energy. Electricity consumption on the other hand was well managed, excluding that which was consumed by general maintenance services. A malfunction linked to incorrect application of the engineering office's instructions (e.g. continual running of pumps, ventilators) is strongly suspected and will be subject to further investigation. Finally, the thermal solar panels made it possible to attain the domestic hot water objectives.

Monitoring of the construction work will eventually allow the problems to be limited without however managing to avoid them completely. The aim therefore was achieved, which represents a success. Another positive note, the companies involved got used to the specific requirements of low energy buildings and are today more operational than when the project

started. Creating a skills centre on low energy building ("pôleBBC") is one of the means by which this is managed today. This centre is in close contact with the previously mentioned Alsace centre for energy [4]. Thus an important aspect of the Franklin district remains its capacity building aspect as a place for the application of energy efficient building techniques. It makes it possible to crystallize experiences, to create a space for discussion and to draw on other similar experiences from professionals. The benefits are threefold: acquire a recognised low-energy skill, bring this economic sector to life and create jobs.

4. Conclusion

The renovation of buildings in the Franklin district contributed a lot to the diffusion of low-energy buildings in Mulhouse and met many of the targets which were originally set. Numerous links have been set up in France and in Europe between Mulhouse and other cities facing similar problems via conferences and visits. The reproducibility of such an operation, which brings together the financial support mechanisms, is however scarcely conceivable in its present state. Some of the funds received were within the framework of promoting renewable energy or energy efficiency. But above all, these were only possible in derelict urban areas. As a result, what made it a success might to a degree be responsible for its non-reproducibility. These measures were chosen partly according to the prerogatives given to the public project manager to impose certain kinds of renovation, and partly according to the subsidies they could obtain with a view to making the project viable and attractive for private investors.

Franklin has become a part of the city's sustainable development policy which now can draw upon a set of good practices and lessons learned. In addition it bears testimony to the synergies between questions of energy efficiency, traditional urban renewal and, to a certain extent, the policy pursued on the scale of an entire agglomeration. Beyond the contribution to improving the urban quality of the city centre and social cohesion, core elements of the project, this experiment focussed above all on energy efficiency in an existing urban area, which remains today the real challenge to which we must respond.

Acknowledgements

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