



Enhanced Building Renovation Strategy

Additional strategies and measures

Luxembourg, July 2017

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This report was written in conjunction with the architect Martin Ploss and myenergy.

Special thanks go to all the institutions and people that took part in the introductory workshop and the theme-based workshops, without whom this document could not have been compiled in its present form.

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Abbreviations

CdM	Chambre des Métiers
CNCD	Conseil National pour la Construction Durable
FdA	Fédération des Artisans
FNR	Fonds National de la Recherche
IFSB	Institut de Formation Sectoriel du Bâtiment
LIST	Luxembourg Institute of Science and Technology
MDDI	Ministère du Développement durable et des Infrastructures
MINECO	Ministère de l'Économie
MLog	Ministère du Logement
OAI	Ordre des Architectes et Ingénieurs-Conseils
SNHBM	Société Nationale des Habitations à Bon Marché
SSMN	Service des Sites et Monuments Nationaux
SYVICOL	Syndicat des Villes et Communes Luxembourgeoises
TIR	Third Industrial Revolution

The report: background, aims, approach and structure

a. Background

In its 'Roadmap for moving to a competitive low carbon economy in 2050', the Commission presented pathways which allow the EU's objective of reducing CO₂ emissions by 80 to 95 % to be met [1]. Given that the buildings sector accounts for 41 % of the EU's overall final energy consumption [2], it is particularly important to increase efficiency in buildings.

As the potential of building energy renovation has so far only partially been exploited in Europe, the Commission stipulated in Directive 2012/27/EU 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 (hereinafter EED) that Member States should establish long-term strategies which outline how potential energy savings can be made in the building stock through the mobilisation of investment in the renovation of private and public residential and commercial buildings [3].

The national building renovation strategies should be published and presented to the Commission and updated every three years.

In December 2014, Luxembourg notified the Commission of its national renovation strategy in accordance with Article 4 EED [4]. This strategy was classified in the Commission assessment as 'almost fully compliant' [5]. The assessment praised the detailed overview of the building stock and the information and training programmes in particular.

In view of the significant energy saving potential in the building stock and its importance in Luxembourg energy policy, it was announced in December 2014 that, as part of the national building renovation strategy, a national energy renovation initiative would be implemented through which the energy renovation strategy for Luxembourg should be developed in conjunction with relevant stakeholders in the construction sector. This report details the enhanced building renovation strategy and was compiled as part of the energy renovation initiative. It builds on, supplements and develops the national building renovation strategy.

This report focuses on residential buildings. Given the leading role played by the public sector, public buildings are also included.

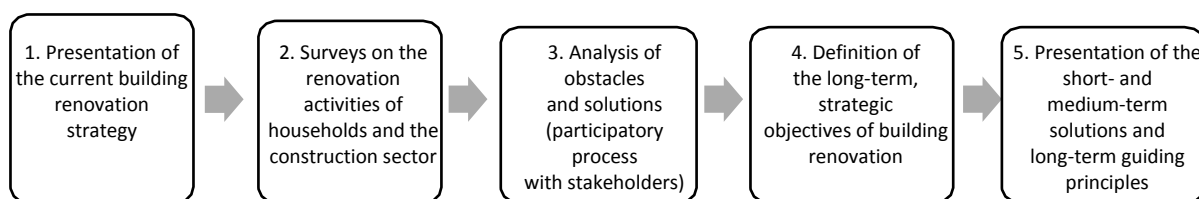
b. Aims and approach

The aims of this report are as follows:

- To summarise the latest information required for the development of the national renovation strategy in one document;
- To formulate guiding principles for broader strategic approaches;
- To compile an action plan based on current hurdles.

Approach of the enhanced building renovation strategy

The Ministry of the Economy launched the national initiative on energy renovation in May 2015 in conjunction with myenergy and architect Martin Ploss, who, together with the stakeholders of all relevant sectors, were given responsibility for developing the national building renovation strategy further. The process was as follows:



- The building renovation strategy was presented at an introductory workshop with the relevant stakeholders on 19 May 2015. This gave the invited participants the opportunity for an initial exchange of views and allowed them to present and discuss renovation strategies of other EU Member States and specific projects that have been implemented. Information and assessments regarding obstacles to and restrictions on building energy renovation in Luxembourg were compiled from the literature and from discussions with individual experts and presented in a report [8]. For comparison, experience from other countries was also included. The written positions proposed at the workshop were summarised by myenergy in a paper [9].
- Two surveys were carried out at the end of 2015 and the beginning of 2016 by TNS ILRES on behalf of myenergy [6], [7]. Building owners and residents were surveyed alongside experts from the construction sector.
- Five topic-based workshops were held (180 participants in total) by myenergy in collaboration with Martin Ploss with the aim of systematically analysing the current hurdles to energy renovation and developing solutions together with the planning and construction sectors. In terms of content, the workshops were based on the national building renovation strategy, the report [8] and the position papers submitted in relation to these documents and were held between October 2015 and February 2016. The topics were dealt with based on the findings from the introductory workshop. Participants were shown the results of the two surveys carried out by TNS-ILRES.

The following workshops were held:

- Workshop 1: 'Architectural requirements and solutions' (27.10.2015)
- Workshop 2: 'Legal obstacles and solutions' (18.11.2015)
- Workshop 3: 'Motivation of the owners' (16.12.2015)
- Workshop 4: 'Financial obstacles' (13.01.2016)
- Workshop 5: 'Opportunities for the construction sector' (03.02.2016)

Obstacles to building renovation and initial solutions were also discussed with municipal representatives in an additional workshop which was held in May 2016.

The results of the workshops were summarised by myenergy in writing and can be found in their entirety in the Annex (see Annexes 1 to 6).

- The strategic elements and principal measures from the individual topic-based workshops were analysed in collaboration with myenergy and Martin Ploss and then set out in the form of guiding principles.
- The key elements of the enhanced building renovation strategy were then presented and discussed in a final workshop.

c. Link with the enhancement of support programmes

Government incentive programmes for funding energy renovation measures were enhanced at the same time as the national building renovation strategy. Comments and solutions put forward by those attending the participatory workshops were incorporated in the plan for the new support programmes starting in 2017. These include checking the eligibility of renovation measures before carrying out work and introducing reduced-interest loans to finance energy renovation.

d. Report structure

On the basis of the outlined aims and content, the report is structured as follows:

- Summary of the status quo analysis (Chapter 1)
- Guiding principles of the enhanced building renovation strategy (Chapter 2)
- Analysis of the current obstacles to building energy renovation in Luxembourg (Chapter 3)
- Catalogue of measures to eliminate the current obstacles (Chapter 4)
- Prospects for developing the building renovation strategy further (Chapter 5)

Chapters 1 to 5 present the most important information in a concise form. Important background information can be found in the Annexes.

1 Status quo analysis

1.1 National building stock

Building typologies are a good tool for analysing the energy status of regional or national building stock. These typologies classify the building stock into groups according to age and size (volume structure). Energy quality is predominantly shown via buildings which are representative of their age and size groups in terms of geometry, structure and heating supply.

The most important findings in the report [8] on the national building stock are as follows:

absolute figures						
	DH	SDH	TH	AB	Others / Not given	Total per building age
	No of HUs	No of HUs	No of HUs	No of HUs	No of HUs	No of Hus
before 1919	4 267	4 363	4 787	5 066	1 990	20 473
1919 - 1945	2 849	5 321	7 996	7 601	903	24 670
1946 - 1960	4 003	5 278	5 165	8 481	577	23 504
1961 - 1970	4 712	3 378	2 255	7 908	319	18 572
1971 - 1980	8 484	3 717	1 934	9 683	272	24 090
1981 - 1990	8 427	2 695	1 197	6 757	216	19 292
1991 - 2000	8 899	3 034	1 266	13 584	287	27 070
2001 - 2010	5 575	4 114	1 758	16 876	376	28 699
Not given	3 085	2 599	2 584	12 220	1 101	21 589
Total per type	50 301	34 499	28 942	88 176	6 041	207 959

Figure 1: Number of housing units (HU) according to building age and size groups. Data compiled by myenergy on the basis of official statistics [8]

Residential building stock in Luxembourg comprised 207 959 housing units in 2011, of which 88 176 were in apartment blocks (AB) and 113 742 were in detached houses (DH), semi-detached houses (SDH) and terraced houses (TH).

proportion (%)						
	DH	SDH	TH	AB	Others / Not given	Total per building age
before 1919	2.1 %	2.1 %	2.3 %	2.4 %	1.0 %	9.8 %
1919 – 1945	1.4 %	2.6 %	3.8 %	3.7 %	0.4 %	11.9 %
1946 – 1960	1.9 %	2.5 %	2.5 %	4.1 %	0.3 %	11.3 %
1961 – 1970	2.3 %	1.6 %	1.1 %	3.8 %	0.2 %	8.9 %
1971 – 1980	4.1 %	1.8 %	0.9 %	4.7 %	0.1 %	11.6 %
1981 – 1990	4.1 %	1.3 %	0.6 %	3.2 %	0.1 %	9.3 %
1991 – 2000	4.3 %	1.5 %	0.6 %	6.5 %	0.1 %	13.0 %
2001 – 2010	2.7 %	2.0 %	0.8 %	8.1 %	0.2 %	13.8 %
Not given	1.5 %	1.2 %	1.2 %	5.9 %	0.5 %	10.4 %
Total per type	24.2 %	16.6 %	13.9 %	42.4 %	2.9 %	100.0 %

Figure 2: Percentage of housing units of the various building age and size groups. Data compiled by myenergy on the basis of official statistics [8]

Housing units in apartment blocks constitute 42.4 % of the total stock across all building age groups.

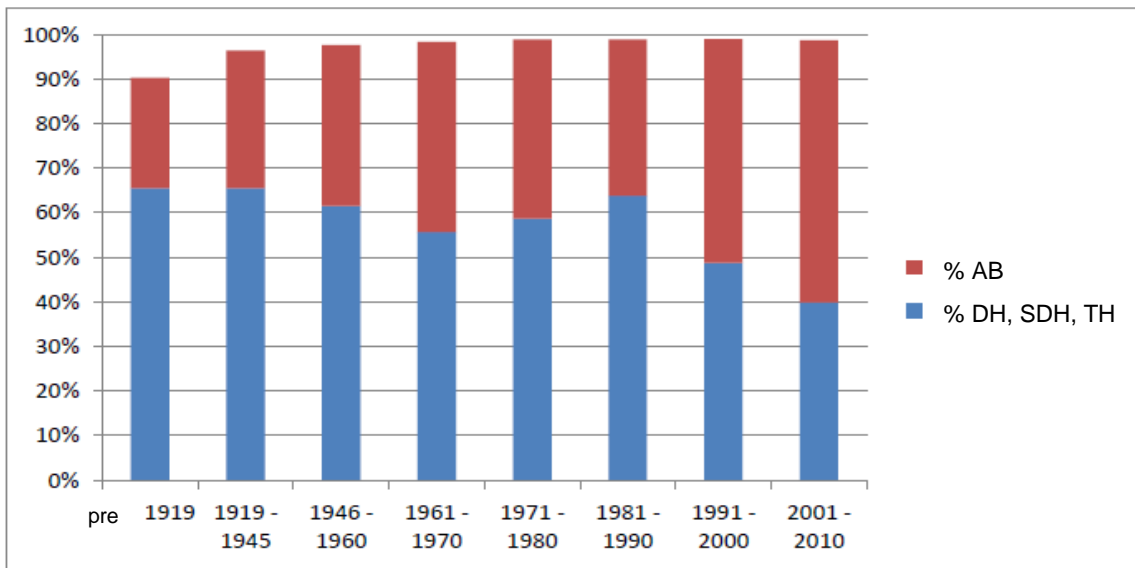


Figure 3: Percentage of housing units in detached houses, semi-detached houses, terraced houses and apartment blocks in the various age groups. Data compiled by myenergy on the basis of official statistics [8]

The proportion of housing in apartment blocks is continuously increasing, whereas the proportion of detached, semi-detached and terraced housing is decreasing. While the proportion of DH, SDH and TH was between 55 and 65 % until 1990, since that year it has fallen to below 40 %.

The majority of housing units are found in buildings with four to ten housing units. Only a small proportion are found in buildings with up to three housing units.

Summary of building stock

The most important findings of the building stock analysis with regard to energy renovation are as follows:

- Luxembourg's residential building stock is, on average, younger than that of Austria and Germany.
- The proportion of listed buildings is still rather small but may increase over the next few years.
- The demolition rate is relatively high [11].
- In view of the aforementioned points and the significant increase in population that is forecast for the future, construction will play a more important role in the effort to reduce energy consumption and limit the CO₂ emissions of the buildings sector than in other EU States.
- The proportion of housing units in detached houses, semi-detached houses and terraced houses is comparatively high.
- The proportion of owner-occupied housing units is comparatively high, and the proportion of rented properties is low.

- The proportion of social housing is, at around 3.6 %, low in comparison to neighbouring countries.
- The proportion of apartment blocks owned by homeowner associations is high.
- The average living space for all types of housing unit is, at 129 m², large in comparison to neighbouring countries.
- The average living space of detached houses is, at 175 m² on average for all building age groups, very high and has increased over the past decade to over 200 m².
- The average number of residents per housing unit is 2.46 and is decreasing.
- The proportion of one- and two-person households is over 60 % and is increasing.
- The average living space per person is, at 52.4 m², high when compared internationally.
- The energy mix for heating Luxembourg's residential building stock is very much dominated by fossil fuels.

Additional, more detailed information on the volume structure of the building stock can be found in the report [8].

1.2 Summary of the status quo analysis

Besides Luxembourg's building stock, other aspects of the energy renovation status quo were also analysed in the report [8]. The results can be summarised as follows:

- Numerous projects show that in practice big energy savings can be made for both listed and non-listed buildings.
- Studies show that if they are effectively planned and executed, energy renovations offer important non-energy benefits, such as a notably lower risk of mould and moisture damage [16].
- Other non-energy benefits of energy renovation include the creation of additional jobs in the construction sector and a significant reduction in dependence on energy imports.
- The Luxembourg cost optimisation study [12] indicates that the optimum cost of energy renovation is already without funding in a more efficient energy class than that stipulated in the national minimum requirements. This provides a certain degree of scope for tightening up the minimum requirements in relation to the efficiency of renovations.
- The total costs for investment, maintenance and energy over 30 years are so low in buildings in efficiency class A that they can be offset by low levels of funding.
- As the renovation rates in Luxembourg are currently still low, there is a great deal of savings potential; the 'lock-in effect' resulting from poorly renovated buildings is only present to a very limited extent¹.
- The number of specialists trained on energy efficiency is high in comparison with other European countries.

¹ In building energy refurbishments, the lock-in effect refers to a situation in which the energy standard put in place as part of a renovation is fixed for a long time: if a developer decides to apply 8 cm of exterior insulation to an exterior wall today, he will only be able to renovate this wall in around 50 years' time when, for example, the rendering on the thermal insulation system starts to crumble. The far greater savings potential of exterior wall insulation (insulation thickness of between 18 and 24 cm would be efficient) cannot be realised until the date of this second renovation, i.e. it is 'locked in'.

- Use of support programmes is currently relatively low (35 % of those who implemented measures are not aware of the programme).
- Statistical analysis of the quantity and quality of energy renovations is currently underway; so far very few high-value energy renovations have been documented.

As the number of energy building renovations in Luxembourg is rather low, despite very good training opportunities and support programmes, and there have so far only been very few deep renovations, i.e. of the highest energy quality, obstacles and restrictions will be analysed next.

2 Guiding principles of the enhanced building renovation strategy

After the workshops, the Ministry of the Economy developed long-term guiding principles for the enhanced renovation strategy in conjunction with myenergy and Martin Ploss. This was done based on the results of the status quo analysis, the TNS-ILRES surveys and the results of the workshops. Findings from other parallel processes, such as the enhancement of the support programmes, were also used. In order to implement these guiding principles it is important to take into account competence, which in this case is shared among several ministries. At governmental level the guiding principles act as a framework for inter-ministerial cooperation. They also constitute a framework for cooperation with relevant stakeholders.

The guiding principles are as follows:

1. Priority to high-efficiency renovations;
2. Affordability of energy renovation measures;
3. Alignment of energy policy and heritage protection objectives;
4. Inclusion of elements of sustainable construction and the circular economy.

The guiding principles outline the long-term renovation strategy beyond 2020 and try to provide an implementation framework for the stakeholders who are responsible or involved. They should be transmitted to the construction and property sectors by means of better communication. Myenergy adapts its consultancy services and its activities as a facilitator to the content of the guiding principles and thereby helps to disseminate and implement them.

As part of the implementation of the guiding principles, myenergy should, for example, coordinate meetings, create the foundations for discussion and decision-making (e.g. surveys, studies, statistics, analyses, discussion papers) for the relevant ministries and act as an interface with the planning and construction sectors.

The measures from the workshops which are presented in Chapter 4 fit into the framework of these guiding principles, but primarily provide answers to current hurdles.

2.1 Priority to high-efficiency renovations

The EED defines 'deep renovations' as *'[...] cost-effective deep reservations [...], which lead to a refurbishment that reduces both the delivered and the final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance.'* Based on the results of the workshops and the TNS ILRES surveys the objectives of 'deep reservations' were further specified for Luxembourg in view of the so-called 'lock-in effect'.

Accordingly, in future it will be considered a priority to increase the efficiency of energy renovations in comparison to the increase in the number of residential buildings refurbished with low-thickness insulation. Increased efficiency should be achieved through high-efficiency insulation via individual measures and complete renovations. Energy renovations with low-thickness insulation are detrimental from both an economic and an energy point of view, as they are relatively expensive and do not allow for big energy savings.

The savings potential of a building is not fully utilised if the renovation is of poor quality and, moreover, is blocked for the duration of the renovation cycle (30-50 years). The 'lock-in effect' is counterproductive, as it prevents energy efficiency from being increased in the building stock in the long-term.

In addition, high-efficiency renovations are the most cost-optimal solution for the owner. The Luxembourg cost optimisation study illustrates that the total cost (i.e. investment, maintenance and energy) of renovations for buildings in efficiency classes A to E are almost the same. High-efficiency renovations in classes A and B are economically feasible even with relatively limited financial incentives. As feasibility studies on building energy renovation show, energy renovation measures are particularly feasible if they are combined with other pending renovation measures (replacement of rendering, fitting of new windows which is otherwise necessary).

In order to implement these guiding principles, the support programmes and planned new investment assistance must be reviewed on a regular basis so that they can be developed further.

2.2 Affordability of energy renovation measures

The workshops and the status quo analysis show that cost is the biggest obstacle to high-efficiency renovations.

The objectives behind improving the affordability of energy renovation measures are twofold. On the one hand, the number of high-efficiency renovations should be increased. On the other hand, it is important to prevent energy 'segregation' and the risk of people getting into debt as a result of low-income households not being able to afford high-efficiency energy renovations.

The Luxembourg government has already taken the first steps to increase the affordability of energy renovations. The 'climate bank' announced for 2017 gives homeowners the funds to pre-finance energy renovation projects. Low-income families in particular will be able to benefit from the '*Klimaprêt à taux zéro*', an efficient means of funding energy renovation projects. At the same time, the existing PRIME House support programme will provide more support for high-efficiency renovations. Furthermore, elements of sustainable construction and the circular economy will be incorporated into the programme.

In addition to government financial assistance, improving the efficiency of renovation measures also plays an important role. High-efficiency renovations are cost-optimal and therefore profitable throughout the whole period of use. However, combining the work with

otherwise necessary maintenance work also plays a key role in increasing the efficiency of the renovations.

Reducing the cost of renovation measures improves their efficiency in the long term. Standard solutions for the most common measures could be developed in conjunction with the construction sector in order to design the renovation work in a more reasonable and therefore more cost-effective way.

Monitoring should be carried out in order to continuously improve the support programmes and the financial assistance so that the available financial resources are used in an effective way.

2.3 Alignment of energy policy and heritage protection objectives

In a country with a rapidly increasing population and high construction and demolition rates such as Luxembourg, architectural heritage protection plays a particularly important role.

During the enhancement of the building renovation strategy, however, it became clear that the objectives of energy policy and heritage protection need to be coordinated in a more effective manner. On the one hand, an EU Directive obliges the Luxembourg government to implement the building renovation strategy and the objectives it contains across the board. On the other hand, architectural heritage protection promotes the preservation of a cultural identity whose destruction could be considered a problem by society and could therefore become a significant challenge when implementing the building renovation strategy.

In order to allow for more convergence in the pursuit of these two objectives, points were identified during the enhancement of the building renovation strategy for which more coordination is needed as a matter of priority.

Coordinating both objectives via common guidelines on ensuring energy renovations are carried out in line with heritage protection requirements should above all allow for better coordination at government level. Savings potential in the renovation of listed and architecturally valuable buildings should also be identified in each project in future and exploited when economically feasible and possible from a design point of view.

2.4 Inclusion of elements of sustainable construction and the circular economy

One of the criticisms of building energy renovation is that so far it is primarily only the impact on companies' energy requirements that has been assessed and other elements, such as the energy expenditure required for production and the environmental impact of insulation materials have not been taken into account. Over the last few years, effective methods of holistic sustainability analysis have been developed based on scientific research, and these should be used more in the future in the assessment of (energy) renovation measures.

Renovation measures should therefore be seen as more holistic and thus as a means of preserving resources, and as a result should be designed in a more sustainable way. This should apply to both the energy-efficient construction of new housing and the renovation of building stock. Particular emphasis should be placed on the effects for health and the environment and the recycling of building materials. The upcoming LENOZ certification and the re-launch of the PRIME House support programme already represent a first step in this direction. Alongside other elements of sustainability, a requirement of the circular economy is that in future it will have to be possible to dismantle building materials.

In addition to this, with the 'Third Industrial Revolution Study' and the activities of the CNCD and the EcoInnovation Cluster, there are already parallel developments and processes taking place in Luxembourg, particularly with regard to the circular economy. This guiding principle should refer to these processes, as part of which building (energy) renovation has been identified as an important field of application. The conclusions and recommendations from these processes in relation to the enhanced building renovation strategy should be analysed and incorporated into the building renovation strategy as implementing measures in order to ensure implementation of this guiding principle.

3 Analysis of the current challenges of and obstacles to building energy renovation in Luxembourg

The current challenges of, obstacles to and restrictions on building energy renovation were first of all analysed in the report [8] and presented and discussed in the introductory workshop on 19 May 2015. The five topic-specific workshops expanded upon this analysis and the results of the TNS-ILRES [6], [7] surveys were used as an additional source. The results of the analysis of obstacles and restrictions were then summarised for each topic. The solutions developed in the workshops were used as the foundation for the action plan (Chapter 4) and are summarized there.

3.1 Architectural challenges

The most important challenges in the energy renovation of listed buildings can be summarised as follows:

1. Energy efficiency and heritage protection requirements are not sufficiently aligned:
 - The requirements and support programmes of the relevant authorities for energy efficiency and for heritage protection are not sufficiently aligned with one another.
 - Interdisciplinary cooperation between specialists in heritage protection and energy is not yet an established part of the planning process. There is currently no systematic coordination of renovation options for the various historical building types.
2. Lack of consultation options for owners of listed buildings in relation to keeping energy renovations in line with heritage protection requirements:
 - Owners have to try to reconcile the different requirements for listed buildings via various points of contact.
 - Developers are currently not sufficiently informed about the energy renovation options for listed buildings.
 - The administrative burden for projects is significant and there is no single point of contact which covers all necessary functions.
3. Lack of a specific incentive programme for energy renovations which are in line with heritage protection requirements.
4. Lack of specialist knowledge of the planning and execution of renovation projects:
 - Planning and execution know-how are of key significance in the renovation of listed buildings. This know-how is currently lacking in both areas.

3.2 Legal obstacles

The most important legal obstacles to building energy renovation are as follows:

1. Lack of rules on creating reserves for renovations for homeowner associations and home owners.
2. Existing decision-making rules in homeowner associations:
 - The decision-making procedures for building renovations in homeowner associations are complex and can be an obstacle.
3. Insufficient harmonisation of municipal building regulations:
 - Lack of flexibility in the event of subsequent insulation as a result of building regulations (e.g. PAP level 'quartiers existants' or 'Règlement sur les bâtisses')
4. Existing support programmes are not attractive enough:
 - Difficult to plan financially, as applications for and approval of funds take place after the renovation work has been carried out.
 - Long processing times for funding applications.
 - Complex funding application with extensive documentation of evidence.

3.3 Obstacles relating to the motivation of owners

The most important obstacles to energy renovation in relation to the motivation of owners are as follows:

1. High investment costs:
 - Cost is the most important factor and therefore the potentially biggest obstacle to owners making the decision to renovate a building.
 - It is primarily cost that stops owners from carrying out deep renovations or implementing several measures in the same time period.
2. Lack of awareness of and appreciation for the need for energy renovation:
 - For the majority of owners (62 %), a high standard of energy in their property is not important and they therefore do not see any need for an energy renovation (they do not appreciate the value of an energy renovation).

3. Administrative hurdles and unattractive existing support programmes:

- The conditions of support programmes in the context of residential construction (decision-making criteria and administrative procedures) are seen as too complex by property owners.

4. Lack of awareness of government support programmes and consultancy services:

- Many property owners are not aware of government support programmes and consultancy services and these are therefore only used to a limited extent.

5. Low awareness of myenergy consultations:

- A large proportion of households do not feel that they are well informed about energy renovation options and are therefore unable to assess what their own energy renovation needs are.

The motivation to carry out an energy renovation and the obstacles to doing so vary depending on the situation the owners are in. In the 'Motivating owners' workshop, different 'renovation types' were analysed based on owners' situations. Classifying renovations in this way will allow solutions and communications strategies to be developed in future which are specifically targeted at the group in question. The following main 'renovation types' were identified:

- 'House buyers and heirs' can combine energy measures with other renovation work and therefore make big savings and achieve the highest degree of efficiency.
- 'DIY-ers' are often very motivated to carry out a building renovation. However, they rarely make use of public advisory services and usually do not exploit the savings potential of their properties when carrying out the renovation work. If they make use of the appropriate consultations more consideration could be given to energy in their renovations.
- 'Low-income households' in particular could benefit from building renovations given the prospect of 'energy poverty' as a result of increasing energy prices, however they do not have the financial resources for such renovations.

3.4 Financial obstacles

The most significant financial obstacles to building energy renovation are as follows:

1. High investment costs:

- Cost is the most important factor in the decision on whether to carry out a deep renovation of a building or individual renovation measures.

- The obstacles to deep building renovation are even higher than in the case of individual renovation measures.
2. Profitability of energy renovations:
 - The profitability of energy renovations is reduced by relatively low energy prices. The fact that the average income in Luxembourg is relatively high while energy prices are relatively low means that there may be far less of an incentive to carry out building energy renovations.
 - Owners are also under the impression that building energy renovations are not economically viable.
 3. Owner-user dilemma:
 - There is no clear motivation for landlords to carry out building energy renovations, as it is only the tenants who enjoy the savings that result from them.
 - Tenants often have misgivings about renovations, as they believe that they could lead to an increase in rent. This applies in particular to low-income households, who do not have much financial leeway.
 4. Lack of reserves:
 - The owners of dwellings and buildings usually do not have the capital reserves required to carry out a building energy renovation. They are therefore not able to cover the associated costs without using credit, however they are not prepared to take out loans or loans of too high an amount. It is left to the homeowner associations to decide whether reserves are created in the absence of a legal framework.
 5. Specific situation of low-income households.

3.5 Obstacles for the construction sector

The construction sector also mentioned motivation obstacles 1 to 4 (see pages 20 and 21) and the architectural obstacles 1 to 4 (see pages 19 and 20):

- High investment costs
- Low awareness of the need for energy renovations
- Administrative burden and unattractiveness of the current support programme, PRIME House (2012 version)
- Lack of awareness of the current support programme and government consultancy services

In addition, the following obstacles were identified in relation to the construction sector:

1. Lack of qualified personnel in energy renovation:

- Many stakeholders in the construction sector believe that Luxembourg tradespeople are insufficiently trained in this area.
2. Lack of knowledge of customer needs and customer-specific services:
- Experts tend to underestimate owners' real reasons (e.g. need for renovation, complexity of work, lack of confidence in the construction sector) and are therefore unable to adapt and communicate their services to their customers specifically enough.
 - Furthermore, customers prefer comprehensive solutions.

3.6 Obstacles for the municipalities

The following obstacles were reiterated in the municipality workshop:

- Lack of harmonisation of municipal building regulations
- Lack of alignment between energy efficiency and heritage protection requirements

In addition, the following new obstacles and solutions were identified:

1. Sometimes there is uncertainty in relation to rules and requirements that can be stipulated in PAGs (e.g. stipulation of material quality)
2. Lack of flexibility in the event of subsequent insulation as a result of building regulations (e.g. PAP level 'quartiers existants' and 'Règlement sur les bâtisses')
3. Given that an application for funding from the Fund for the Protection of the Environment (FPE) must be submitted before the start of the project, many municipalities feel that the procedures for renovations within the context of this funding are too cumbersome
4. Complexity and clarity of the rules for citizens and a lack of knowledge of municipal procedures
5. Lack of information about the energy consumption of municipal buildings
6. Uncertainty as to the municipality's building control responsibilities (compliance with the energy certificate)

4 Catalogue of measures to deal with the current challenges and to eliminate the current obstacles

The following measures were selected from workshop participants' proposals and offer one or more solutions to each obstacle listed in the previous chapter. Annex 7 contains a comparison the measures and the relevant obstacles. The measures fit in to the framework of the guiding principles in Chapter 2, but are more specific than the overarching implementation framework in order to be able to address current hurdles.

In its role as facilitator and in close cooperation with the Ministry of the Economy, myenergy will support the implementation of the enhanced building renovation strategy by further expanding the interface with the construction and property sectors.

4.1 Measures to deal with architectural challenges:

The challenges identified in the first workshop predominantly relate to planning and execution know-how among the relevant stakeholders in the construction sector, a lack of interdisciplinary cooperation and developers' lack of information about renovation options in listed buildings.

In order to implement some of the measures identified here, the alignment of energy policy and heritage protection objectives (Chapter 2.3) must be addressed, as the results of this process will have an impact on the specific design of the measures.

The specific measures to eliminate the identified architectural challenges are as follows:

Measures to deal with architectural challenges			
No	Description of measure	Bodies preferably involved	Timescale
M14	See Point 4.3 (Table)		
M1	Coordinate and outline scope for energy renovations in protected buildings according to the different historical building types, taking into account the heritage value and condition of the building. Set guidelines for buildings of the various building types.	SSMN	2018 - 2019
M2	Create new support measures for listed buildings ('PRIME House Heritage Protection'), set funding amount as required based on pilot projects in conjunction with SSMN	MDDI, MLog, SSMN	2019
M3	Architecture competition + energy in listed buildings	SSMN, OAI, myenergy	2017 - 2019
M4	Expand existing 'myenergy certified' labels to include elements of heritage protection	myenergy, SSMN	2019
M5	Increase training opportunities for energy renovation of listed buildings	OAI, FdA, CdM, IFSB, SSMN	2018

4.2 Measures to eliminate legal obstacles:

The legal obstacles identified in the second workshop predominantly relate to rules for homeowner associations, building regulations at municipal level and legal or procedural uncertainties in the support programmes.

The measures required to eliminate the identified legal obstacles are as follows:

Measures to eliminate legal obstacles			
No	Description of measure	Bodies preferably involved	Timescale
M6	Make it compulsory to create reserves for renovation work	Ministère de la Justice, Ministère des Finances, MLog	2018
M7	Introduce a simple majority vote for decisions taken in homeowner associations	Ministère de la Justice	2018
M8	Harmonise municipal building regulations, especially in relation to exemptions from spacing requirements in the event of subsequent insulation	Municipalities, Ministère de l'Intérieur	2019
M9	Make the 'PRIME House' incentive programme more attractive: <ul style="list-style-type: none"> • Simplify funding procedures • Introduce eligibility test before work is carried out 	MDDI	In preparation

Interdisciplinary cooperation between relevant ministries should be stepped up in order to eliminate or reduce the legal obstacles.

4.3 Measures to eliminate obstacles relating to the motivation of owners:

The measures identified in the third workshop to eliminate obstacles to the motivation of owners primarily relate to developers' lack of knowledge of the total cost and economic viability of renovations, a lack of information about renovation, and the complexity of building regulations and support programmes.

The implementation of these measures is particularly in line with the framework of the guiding principles for high-efficiency renovations and their affordability (Chapters 2.1 and 2.2).

The specific measures to eliminate the identified obstacles are as follows:

Measures to eliminate obstacles relating to the motivation of owners

No	Description of measure	Bodies preferably involved	Timescale
M10	Develop support programmes and investment assistance: <ul style="list-style-type: none"> • Introduce a 'climate bank' and reduced-interest loans • Introduce pre-approval to increase the financial planning security of the 'PRIME House' programme • Focus funding on deep renovations through increased progression in 'PRIME House' funds 	MDDI, MLog, MINECO, Ministère des Finances	In preparation
M11	Increase appreciation of energy renovations and raise awareness of the need for energy renovations: <ul style="list-style-type: none"> • Award 'best practice' prizes for categories including 'energy renovation of a listed building', 'energy renovation with significant personal contribution' and perhaps also 'homeowner associations' • Marketing campaign on the value of carrying out renovations and on the existing support programmes (myenergy in conjunction with the property and construction sectors) 	myenergy, OAI, FdA, CdM, SSMN	2018
M12	Make the 'PRIME House' incentive programme more attractive: <ul style="list-style-type: none"> • Create a central office for all funding applications in the area of residential construction ('guichet unique') • Simplify the funding procedures • Introduce pre-approval to increase financial planning security 	MDDI, MLog, MINECO	In preparation
M13	Increase awareness of the 'PRIME House' incentive programme: <ul style="list-style-type: none"> • Communication campaign for the 'new' PRIME House • Marketing campaign (myenergy in conjunction with the property and construction sectors) on the value of deep renovations (and the relevant funding options) 	myenergy, OAI, FdA, CdM, MDDI, MLog	2017
M14	Adapt and develop myenergy consultation services in relation to energy renovations: <ul style="list-style-type: none"> • Introduce 'on-site consultations' by myenergy across the board as part of infopoint activities • Adapt to modified procedures in the consultation process • Adapt consultations to the customer profile • Focus consultations on key aspects of the building renovation strategy • Introduce myenergy consultations for 'DIY-ers' • Increase developers' awareness: <ul style="list-style-type: none"> ○ by publishing guidelines on carrying out energy renovations in line with heritage protection requirements ○ by publishing the results of competitions (cf. M3) ○ through visits ○ through best practice examples 	myenergy, SSMN	2017 - 2019

Raising owners' awareness of and advising them on energy renovation will play a significant role in motivating them to carry out such renovations. The aforementioned measures are aimed at creating consultancy services which are geared to the target group in question. The target groups outlined as part of the 'motivation of owners' workshop are an important means of gradually shifting the focus from 'informing' to 'motivating'.

The main topics for awareness-raising and basic consultations should be the following in the medium term:

- Estimating the consumption of your own building by comparing it with the consumption of a high-quality renovated building;
- Estimating and separating costs for otherwise necessary measures and additional costs for higher energy quality;
- Economic viability over the period of use with an emphasis on the long-term nature of decisions in the construction and renovation of buildings;
- Combining energy renovation with renovations otherwise taking place or modifications being made because of a change in ownership through purchase or inheritance;
- Non-energy benefits, such as protection from structural damage;
- Funding options;
- Energy renovation options in listed buildings;
- Motivation to combine several measures and to execute in line with high energy quality (deep renovation);
- Clarifying the regulations;
- Options for combining energy renovation with redensification measures (addition of another floor, extensions, dividing a property into several housing units) as a means of reducing costs;
- Reconciling energy efficiency and heritage protection.

As the TNS-ILRES surveys indicated, awareness of support programmes is relatively low. This highlights how important and urgent it is for information campaigns and better basic consultation services to be introduced and for the multiplier role of key players in the planning and construction sectors to be strengthened. In this respect, myenergy should also take on a more active facilitator role.

4.4 Measures to eliminate financial obstacles:

The financial obstacles identified in the fourth workshop primarily relate to high investment costs, a lack of capital, the financial viability of renovations for owners, the owner-user dilemma, decision-making procedures in homeowner associations and uncertainties with regard to support programmes.

The measures to eliminate the identified obstacles are as follows:

Measures to eliminate financial obstacles:			
No	Description of measure	Bodies preferably involved	Timescale
M6	See Point 4.2 (Table)		
M10	See Point 4.3 (Table)		
M15	Tax measures to increase profitability: <ul style="list-style-type: none"> • Reduced VAT rate for energy renovations (3 %) • Link land tax to energy efficiency class • Increase energy taxes on electricity and fossil fuels 	Ministère des Finances, MINECO	2019

M16	Myenergy consultation and communication focus: <ul style="list-style-type: none"> • 'The right time for energy renovations' (combining measures) • Options for redensification and increasing the number of housing units 	myenergy	2018
M17	Minimise the owner-user dilemma: <ul style="list-style-type: none"> • Verify the introduction of rent including heating costs (if necessary with practical testing in some sample projects) • Introduce terms for freezing rent into support programmes (e.g. ban on increasing rent for X years following an energy renovation) 	Ministère de la Justice	2019
M18	Support low-income households: <ul style="list-style-type: none"> • 'Climate allowance' to compensate for increase in rent • 'Climate bank; → 'Klimaprêt à taux zéro' • 'Projet d'assistance aux ménages en situation de précarité énergétique par myenergy' 	myenergy, MDDI, MLog, MINECO, Ministère de la Famille, Ministère des Finances	2020, partially in preparation

The TNS-ILRES surveys show that financial obstacles are a key reason behind the relatively low renovation rate and the fact that deep renovations are very rarely carried out.

The development of new funding instruments and the assessment of existing ones should be improved through increased inter-ministerial cooperation with the involvement of relevant construction sector stakeholders (see Chapter 2).

4.5 Measures to eliminate obstacles for the construction sector:

The obstacles for construction sector stakeholders identified in the fifth workshop primarily relate to the lack of information for owners about building renovation and for stakeholders from the construction sector about the support programmes. They also refer to the fact that the current support programmes are not attractive enough and that few stakeholders from the construction sector have the requisite qualifications.

The measures to eliminate the identified obstacles for construction sector stakeholders are as follows:

Measures to eliminate obstacles from the point of view of the construction sector			
No	Description of measure	Bodies preferably involved	Timescale
M19	Create a website ('Bauen und Energie' – <i>Construction and Energy</i>) with all the relevant information for tradespeople relating to energy policy regulations, training opportunities and the guidelines to be developed on energy renovations for listed buildings	myenergy, OAI, FdA, CdM, SSMN	2017 - 2019

M20	Organise regular meetings between construction sector representatives, myenergy and the ministries in order to share best practice	Myenergy, SSMN	In preparation
M21	Promote cross-sector cooperation between companies and networks of trades businesses (sharing of knowledge and best practice, discussion of partnerships for comprehensive solutions)	OAI, FdA, CdM	2018

The increased involvement of the relevant construction sector stakeholders in the implementation of the enhanced renovation strategy is key. The inclusion of relevant construction sector stakeholders in the drafting of the building renovation strategy has already proved successful. Further steps to implement it should therefore be expanded upon in a participatory process. With the increased involvement of construction sector stakeholders, myenergy should take on the key role of facilitator.

Myenergy should, by means of various activities such as workshops or round table discussions, give relevant stakeholders a platform to exchange ideas in a result-oriented way and on an equal footing. Furthermore, myenergy should consistently gather the ideas and experiences of the sector, summarise them and as a neutral partner forward them to the relevant ministries with the aim of finding practical solutions.

4.6 Measures to eliminate obstacles for municipalities:

The obstacles for municipalities identified in the additional workshop primarily relate to the legal and procedural framework, the motivation of owners and owners' lack of information.

The elimination of obstacles for municipalities is in the most part covered by measures to eliminate legal obstacles, financial obstacles and obstacles relating to the motivation of owners.

There are also the following additional measures to eliminate the identified obstacles:

Measures to eliminate obstacles for municipalities			
No	Description of measure	Bodies preferably involved	Timescale
M22	Develop and establish guidelines on the rules and requirements that can be incorporated into the PAG Develop best practice examples for PAPs, PAGs. Modify or adapt building regulations as part of the development of new PAGs.	Ministère de l'Intérieur, SYVICOL, municipalities	2017
M23	Harmonise municipal building regulations, especially with regard to exemptions from spacing requirements in the event of subsequent building insulation. Adapt the 'Règlement-type' of the Interior Ministry.	Municipalities, Ministère de l'Intérieur, SSMN	2018 - 2019

M24	Adapt the FPE procedure: <ul style="list-style-type: none"> Adapt assistance for making calculations in the context of FPE applications for renovation projects 	MDDI	In preparation
M25	Proactive communication on 'construction and energy' Information brochures on municipal regulations and Procedures	Municipalities, myenergy, SSMN	2017
M26	Improve the data in relation to energy consumption in municipalities through systematic analysis/collection of consumption data	Municipalities, energy providers	2018
M27	Implement and communicate more clearly building inspection responsibilities with regard to energy efficiency. Identify and communicate best practice examples in relation to building inspections.	Municipalities, MINECO, myenergy	2017

Some measures (M22 and M23) relate to the targeted use of municipal adjusting screws in building plans and the lack of flexibility in building regulations in the event of subsequent insulation. The solutions proposed to these problems should be dealt with as a priority, as not all municipal building plans have been developed and therefore there is still some room for manoeuvre at the current time. This also applies to building regulations being revised at the same time as the building plans.

5 Prospects for developing the building renovation strategy further

5.1 Scenario study

In order to assess long-term savings that can be achieved in Luxembourg's building stock, the Ministry of the Economy commissioned a scenario study. This study is still ongoing. It will show potential room for manoeuvre and will act as a basis for successfully monitoring the implementation of the building renovation strategy and the interim objectives.

The main focus of the study is on a detailed analysis of the building stock and a scenario-based illustration of several future development paths. The results should, in particular, allow quantitative objectives for the building renovation strategy and the renovation rate to be defined.

The timeframe of the scenario study covers the period up to 2070 in order to allow the typical renovation cycles of 30 to 50 years to be reviewed. This will enable energy renovation measures combined with necessary maintenance work to be taken into account. Studies and experience from renovated buildings show that this is when renovations are at their most economical.

The scenario study examines the influence of various factors, such as population development, rates of new construction, renovation and demolition, energy quality in new construction and renovations, change in the mix of energy sources based on energy requirements, and greenhouse gas emissions. These influencing factors are depicted in several scenarios which represent different developments.

In the first step the energy requirements for heating, hot water, auxiliary currents and domestic electricity of the current building stock are calculated for each building type and age group. In the second step the duration of the final energy demand for the different scenarios is identified. This will incorporate the findings from step one and take into account the anticipated efficiency improvements and the changing energy mix.

The scenario study should be structured in such a way as to allow future updates and therefore enable an improved and more precise illustration of the energy status of the building stock, for example by describing and quantifying renovation steps that have already been completed and the number of vacant properties, and by locating energy requirements in the buildings sector.

5.2 ‘Research & development’, implementation and analysis of pilot projects:

As the basis for the design of several measures, activities related to the ‘research and development’ of technical solutions and the implementation and analysis of pilot projects should be promoted more.

The measures are as follows:

Measures in ‘research and development’ and the implementation and analysis of pilot projects			
No	Description of measure	Bodies preferably involved	Timescale
M28	Economical renovation of a typical social housing AB in efficiency class A	SNHBM, Fonds du Logement	2018
M29	Economical renovation of a typical social housing AB combined with addition of (an) extra floor(s) and/or redensification	SNHBM, Fonds du Logement	2018
M30	Renovation with heritage protection	SSMN, myenergy, uni.lu, LIST, FNR	2019
M31	Renovation of a typical public building in class A	Municipality, CdM, OAI	2018
M32	Knowledge networking among tradespeople via best practice examples and exchange of experience	CdM, Centres de compétences	2018
M33	Support for research and development	FNR, uni.lu, LIST, SSMN	2019

Experience from several other regions indicates that in order to ensure the acceptability of buildings and building renovations of high energy quality it is important to demonstrate their technically and economically feasible savings potential through the example of supported pilot projects. It is less about the development and analysis of new complex concepts than about concepts that can feasibly be transferred to large market segments.

The main objective is to reduce misconceptions about deep, high energy quality renovations and to show that these renovations:

- reach the projected low energy benchmarks in practice,
- can be carried out at minimal additional cost and can be operated economically over the entire period of use
- guarantee more comfort than typical renovations,
- provide more protection from mould and moisture damage and allow high-quality designs to be executed in different building types.

Myenergy should play a supporting role in the implementation of pilot projects.

5.3 Impact on the construction sector

The construction sector in particular, as executor, can benefit from the building renovation strategy and its measures and/or effects. Above all, it is important to make effective use of the sector's multiplier role in order to exploit the available potential to the greatest possible extent. According to a status quo analysis carried out as part of the LuxBuild project [15], the economic potential of energy renovations amounts to over EUR 277 million per year, and for the whole construction sector around 8 000 new jobs could be created by 2020. The building renovation strategy should help to make use of this potential, particularly with regard to energy renovations.

The TNS-ILRES survey [7] gives the experts an insight into the direction in which the construction sector is heading:

- The experts indicated that companies in Luxembourg definitely possess the skills and capacities to meet increased demand in the area of energy renovation. However, there is a lack of training options and these should be expanded with regard to the implementation of the building renovation strategy, among other things.
- In addition, the experts believe that in the next ten years more ecological materials will be used. This will be promoted and highlighted by the fourth guiding principle and by developments in the support programmes.
- However, the experts also stated that companies need to become more competitive in comparison to foreign companies. More innovative solutions and materials are required in order to guarantee this.

Given these findings and the measures proposed in Chapter 4.5, the priority of the construction sector should be to extend and coordinate existing training provisions. This would be the foundation for reinforcing all the aforementioned trends and exploiting the huge economic potential which is available.

5.4 Reviewing implementation via a monitoring programme:

Monitoring the implementation of the renovation strategy and the interim objectives is of utmost importance in light of the buildings sector's share of the national total energy requirements and Luxembourg's total emissions as well as the substantial savings potential that exists.

The monitoring programme should significantly improve the current data situation by evaluating various sources (statistical evaluations of energy passes with consumption data, anonymised consumption data of energy suppliers and meter-reading services).

The surveyed consumption of the entire building stock should be regularly compared with the quantitative objectives and taken into consideration when implementing the guiding principles presented in Chapter 2.

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