VIOLET
Interreg Europe

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Policy Recommendations to Promote the Inclusion of Standards for Heritage Buildings in EU Regulations

Partners Consortium

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List of Abbreviations

CoP - Community of Practice

E/M - Electromechanical; i.e. E/M installations

EPDB - Energy Performance of Buildings Directive

ERDF - European Regional Development Fund

HVAC - Heating, ventilation and air conditioning

LCA - Life Cycle Assessment

LCC - Life-Cycle Cost

PTRE - Territorial Platforms for Energy Renovation (France)

RES - Renewable Energy Source

ROP - Regional Operational Programme

1.0 VIOLET Project's Key Message for Policy Makers

The cultural value we attribute to our historic buildings across the EU denotes our identity as communities and individuals. Therefore, heritage buildings play an important positive role in our urban and rural environments. However, as spaces for functional buildings, they often demand energy in excess if compared to modern building structures. As the reduction of carbon emissions becomes an essential requirement in our public policy, historic and traditional buildings will need to play a contributing role in climate mitigation across the EU.

The VIOLET project covers two different axes within the current Regional Operational Programme (ROP) of the European Regional Development Fund (ERDF) 2014-2020. Hence, it is difficult to tackle both subjects at once. However, this challenge should be approached positively and with confidence since the complexity of the heritage buildings sector is not linear. All VIOLET's partners are also aware of the complications of having cooperation across a wide range of professionals and vocations. Considering such challenges, policymakers should address these issues following the VIOLET EU policy recommendations.

2.0 Intention of the Interregional Analysis

VIOLET partners had contributed to the development of the interregional analysis with their individual reports where the facts and figures about their regional building stocks were gathered in addition to suggestions for policy recommendations. The primary intent of the interregional analysis is to review the current state of policies across the EU relating to renovation of traditional buildings, taking into consideration their energy consumption and energy efficiency measures. Based on this analysis and partners' reports, policy recommendations to promote the inclusion of standards for heritage buildings in EU regulations have been identified. These recommendations are to serve only as an illustration and partners will have to play their role in the development of final documentation (action plans) that they will submit to their national level policy representatives or national Members of European Parliament in a view of impacting EU policy and the 2021-2027 programming period.

While preparing the analysis, the following had to be taken in consideration:

1.1 Clarifying, illustrating and publicising renovation methods for heritage buildings reflecting the concerns of protected/monument structures. It should be noted that, while useful for knowledgeable building professionals, information is quite ambiguous for a layperson. Ideally, information requires to be incorporated in a plain English text that sets out standard and alternative routes of compliance for heritage buildings over the range of VIOLET partners, illustrated with drawings and case studies.

1.2 Partners needed to provide a "logical'' approach to improvements in energy performance of heritage buildings, emphasising that the performance of services and equipment should be the preferred position of improvement, particularly where renewable energy sources (RES) can be installed. This is said as many fabric measures are impossible due to the protection of the structure. Of course, a number of improvements can also be made to the fabric of the building without sacrificing its heritage value. For instance, roof insulation can be increased to optimal levels, while floor insulation can be installed in some cases. Step-by-step energy renovation plans for heritage buildings and guidance on the most advantageous order of works could be provided through Building Renovation Passports, such as that in Middleburg. Partners need to reference their own particular local/regional/national arrangements.

3.0 Existing Standards/Regulations

Much of the primary standards/regulations used to guide the energy efficient renovation of heritage buildings does not consider the application of heritage buildings and therefore makes no mention of methodologies to be used. Indeed, the Energy Performance of Buildings Directive (EPBD) (2018/844/EU), to be transposed into national legislation by early 2020, and the Energy Efficiency Directive (2012/27/EU) do not specifically categorise the type of buildings the VIOLET project is considering.

Much of the literature and guidance across the EU that VIOLET is aware of may not be appropriate for structures that the VIOLET project is considering. One reason for this is geographical variation. Protected structures and, indeed, proposed protected structures may be of architectural or cultural interest and that some heritage buildings perform and respond to environmental conditions differently from more modern structures. However, no further guidance is provided on how to approach the energy renovation of heritage buildings or where construction professionals can seek advice.

Advantages of working with an existing structure rather than a new building, particularly when considering embodied energy, need highlighting and understanding. The advantages that an existing fabric represents in terms of embodied energy reduction, and energy savings during the construction/refurbishment stages, should be acknowledged, especially when compared to the conservation of fuel and energy during the construction stage itself. These are simple measures that can be relatively easy to determine, but they provide serious energy reduction strategies in life-cycle terms. VIOLET is not aware of such policies that require the above to be conducted within the project partner regions.

Obligations to regulations across the EU provide standardised constructional details across EU Member States. These regulations are more applicable to new build structures and could possibly run the risk of exaggerating negative perceptions around older building stock as poorly performing or noncompliant. Recent research within the VIOLET project shows that in some cases, the original construction of an existing heritage building may outperform proposed interventions, so care must be taken and hasty assumptions should never be made. VIOLET partners are required to clarify classes of buildings where special considerations in making reasonable provision for the conservation of fuel or energy may apply.

4.0 VIOLET EU Policy Recommendations

The European building stock has a unique mix of historic and modern architecture, providing both significant opportunities and challenges.

Effective policies and incentive schemes to reduce the carbon footprint of buildings require a solid understanding about the current building stock, especially the special features of heritage buildings. VIOLET partners contributed to an improved understanding within this report culminating in policy recommendations. Each partner has gathered facts and figures about their regional building stock with EIfI-Tech providing meaningful analysis.

It could be suggested that current EU energy policy with respect to heritage structures is too simplistic and thus defective, leading to wasted money and potential harm to the buildings' occupants and ultimately their energy performance.

The Energy Performance of Buildings Directive (EPBD) (2018/844/EU) is a legal instrument designed to improve the energy performance of buildings across Europe through the implementation of binding targets, which European nations are required to transpose into their national laws and building regulations.

The technical body for the Conservation of Cultural Heritage within the European Committee for Standardization (CEN) has drafted international guidelines for improving the energy performance of architecturally and culturally significant heritage buildings through European Standard EN 16883:2017. This document applies to heritage buildings of all types and ages regardless of statutory heritage designation and presents a normative methodology for selecting measures to improve energy performance, based on an investigation, analysis and documentation of the building including its heritage significance and the impact of these measures on the character-defining elements of the building. The standard is designed to be used by building owners, authorities and professionals involved in the conservation and refurbishment of heritage buildings. The standard aims to facilitate the sustainable management of heritage buildings by presenting a methodical approach to aid building professionals in choosing the most appropriate solutions for each individual case, but does not presume that all heritage buildings need energy performance improvements.

The EN 16883:2017 standard outlines four aspects of sustainability to be taken into consideration when prescribing energy improvement works to heritage buildings:

- Environmental
- Economic
- Social
- Cultural

Much of the Member States regulations and standards are based on the 'EN 16883:2017 Conservation of Cultural Heritage Guidelines', even though it must be highlighted it is only a suite of guidelines. Partners are encouraged to reference this document whilst inquiring if some of the guidelines could possibly become policy.

5.0 VIOLET Consortium EU Policy Recommendations

5.1 South-East Regional Development Agency (Romania)

5.1.1. EU Legislation and Policy

The topic of energy renovation of heritage buildings must be included in the current EU legislation in a more elaborated manner than in the existing provisions. The current Energy Performance of Buildings Directive (EPBD) (2018/844/EU) introduced new elements, such as "research into, and the testing of, new solutions for improving the energy performance of historical buildings and sites should be encouraged, while also safeguarding and preserving cultural heritage". However, this provision is vague, with no deadlines and targets, and no reference to the complexity of the issue.

Currently, there are no explicit policies for the energetic rehabilitation of heritage buildings at national and regional level in Romania. The national legislation on energy efficiency in buildings does not require the implementation of measures or the provision of energy certificates in case of protected buildings/monuments and of protected neighbourhoods, as well as churches. This fact leads to lowest standards of energy efficiency. On the other hand, in Romania, there are national and local policies and regulations for the renovation of the current building stock and for a better valorisation of heritage buildings. Yet, not all of them refer clearly to energy efficiency measures. Hence, such policies/regulations could be improved by: introducing the topic of energetic rehabilitation; concretely assessing the energy efficiency of buildings; requiring the owners to follow the recommendations included in the audit certificate.

At the national level, the Strategy for the Mobilization of Investment in Residential and Commercial Building Renovation, in the context of the Energy Efficiency Directive (2012/27/EU), states that "minor and moderate renovation of existing historical buildings may be feasible, as measures for energy saving are always available even if the building doesn't undergo a total renovation", yet without indicating specific standards or objectives. This strategy, currently under revision, stimulates stakeholders' debates and encourages a more ambitious approach for preserving the current building stock. Further initiatives, such as the National Strategy on Protecting Historical Monuments (to be finalised by September 2021), the Romanian Sectoral Strategy for Culture and National Patrimony (2014-2020) and the 2035 Romanian Strategy for Territorial Development focus on the protection of cultural heritage in buildings. However, due to their large scope, there is no reference to energy efficiency measures.

At regional level, in the South-East Region, the local development strategy of the six major towns (Braila, Buzau, Constanta, Focsani, Galati and Tulcea) include two complementary objectives related to heritage buildings and energy efficiency measures (a similar approach is also adopted by smaller towns):

- Promoting urban refurbishment of heritage buildings, which are mostly public buildings hosting social activities and events. This includes the adoption of energy efficiency measures.
- Improving energy efficiency in public buildings, both by addressing a given building's structure and equipment.

By elaborating upon an adequate national policy capable of reducing the environmental burden of heritage buildings while preserving their cultural heritage, it would be necessary to consult the national list of heritage buildings. This list is managed by the National Institute for Patrimony and differentiates two categories of heritage: individual protected buildings and protected urban/rural areas consisting in neighbourhoods of cultural and social value, encompassing both heritage buildings and monuments. The National Programme for Implementing a Geographic Information System (GIS) for protecting the national cultural patrimony, also managed by the National Institute for Patrimony, includes a public searching engine with information on each building and an in-depth section for experts. To complement these information sources at the national level, it would be ideal to consult the local cultural directorates and chambers of architects. Cultural directorates represent the Ministry of Culture at local level and are responsible for ensuring the application of local regulation. Local municipalities should also be involved when elaborating this kind of policy.

5.1.2. Interventions for Energy Improvements in Heritage Buildings

In the context of energy rehabilitation of heritage buildings, the adoption of RES and/or improvements to the building's fabric depends upon the nature of the building. The following three scenarios can be distinguished.

In the first case of heritage buildings (independent) protected by law, RES solutions are limited since the surroundings are also protected, constituting one single monument. In this case, heat pumps (if surroundings allow both in size and topography), solar/PV panels (if the roof includes a hidden area) and renewable heating systems (only if equipment is not visible) may be applied. Depending on the building's age and local regulations, thermal glass and masonry (2/3 sheets) for windows and doors may be used, under the condition that this preserves the exterior aspect. Wood frames (massive or stratified) should be used, with metallic frames only if no other solution meets the fire regulations. Depending on the interior design, thermal insulation is available for roofs, walls and floors (preserving as much as possible the natural ventilation) as well as underfloor/wall heating. Technological equipment may not be visible and "camouflage" solutions are imposed by local regulation. As a rule, all of the above solutions are to be applied gradually. Ideally, first the roof, windows and doors; second, if the energy performance is still insufficient, the walls.

In the second case of heritage buildings (independent) not protected by law, the adoption of RES solutions and improvements to the building's fabric is the owner's decision since no legislation is limiting its rights to alter the building. However, in medium and large towns, local regulation may apply, rules as stated in the Urban Planning Permit.

In the third case of heritage buildings enclosed in protected urban/rural sites, the entire area is regulated in order to preserve and promote its cultural value. Usually, RES (solar/PV panels, thermal roof or heat pumps) and improvements to buildings' fabrics are allowed under the condition that they do not alter the external aspect of the building or of the neighbourhood.

In some circumstances, the original construction of an existing heritage building may outperform the proposed energy efficiency measures. Examples are those buildings with very thick walls (e.g. 40-50 cm thickness) or with natural ventilation (because of particular architectural design). Despite the acknowledged complexity when dealing with such restoration works, there is currently no official information/guidance or literature of reference at national level. South-East Regional Development Agency (SERDA) provided guidelines and good practices on the larger subject of preserving cultural and architectural heritage in South-East Romania.

5.1.3. Sustainability Aspects of Heritage Buildings Renovation

When implementing energy efficiency interventions in heritage buildings, environmental aspects must be taken into consideration. An initial energy efficiency audit report should evaluate the benefits and disadvantages for introducing such measures, proposing building-specific interventions. For this purpose, it is necessary to consider the mandatory level of primary energy consumption and CO_2 emissions reduction per year. In some cases, the rate of change in the land use and topography could be relevant. Introducing energy efficiency measures in heritage buildings is expected to yield positive outcomes in terms of economic sustainability, for example in terms of decreasing rate of energy-related bills.

With respect to social and cultural aspects of sustainability, when adopting energy efficiency measures, these should be in line with the building's identity (its historical and architectural nature) and with the collective memory-related features. Also, these interventions should be in line with the gender, age-related, health and social legal requirements of the social and human rights policy/legislation. All energy efficiency measures should consider the destination of the building and avoid hindering it.

5.2 Cyprus Energy Agency (Cyprus)

5.2.1 The Relevance of Heritage Buildings in the EU Legislation

Across the EU, national and regional Action Plans have been implemented to mobilize investments in the energy upgrading of the existing building stock. However, heritage buildings are often exempted from meeting the minimum energy performance standards because their compliance would substantially alter their character. If instead subjected to such standards, heritage buildings must often comply with too extensive and too strict criteria, which cause a deteriorating service to end users or even the inactivity of the building.

However, nowadays, improving the energy performance of heritage buildings by applying a set of less strict but targeted energy efficiency standards (hence reducing their often large environmental burden) does not have to mean a deteriorating service and comfort conditions for the users. The current standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines' helps in ensuring that the interventions for energy upgrades of heritage buildings will not damage their cultural value by altering the buildings or by increasing the risk of long-term deterioration.

The urgency to intervene in this sector is highlighted by the current Energy Performance of Buildings Directive (EPBD) (2018/844/EU), which encourages the "research into, and the testing of, new solutions for improving the energy performance of historical buildings and sites … while also safeguarding and preserving cultural heritage". There is still uncertainty on how this objective will be achieved at national level since the energy efficiency measures in heritage buildings are here encouraged, but not mandatory.

In Cyprus, proposals for a legislative amendment, based on the regional and interregional activities of the VIOLET project, have already been made for what concerns the "Categories of buildings exempted from the obligation to meet the minimum energy performance requirements and the issuance of a building energy performance certificate". By 2020 the amendment law will be made available.

5.2.2 Working Towards a National Policy

In Cyprus, there is currently no national policy connecting the restoration of heritage buildings with energy efficiency measures. However, some practices related to energy renovations of heritage buildings are in place. For such heritage buildings, when applying for restoration works or incentives, there are individual guidelines concerning energy efficiency interventions. In addition, a handbook is provided to building owners in order to give recommendations to those undertaking the restoration works concerning the protection of architectural heritage. These two instruments (guidelines and handbook) can be considered the foundation for the development of an integrated national policy on this topic.

Concerning the protection of architectural and cultural heritage in Cyprus, different policies are in place. Incentive schemes are provided to buildings' owners either on a continuous basis or on a periodic basis according to the nature and the needs of the building. Direct grants are complementary to other incentives, such as tax reductions and transfer of development

rights. However, such national funding programmes for the protection of architectural and cultural heritage are not linked to the implementation of any energy efficiency measures.

Effective policies and incentive schemes to reduce the carbon footprint of heritage buildings, while protecting their historical value, require a solid understanding of the existing building stock. Hence, it would be ideal to estimate the current number of heritage buildings at national level (as percentage of the whole building stock) and their geographical redistribution. This would entail the evaluation of whether their overall carbon footprint is actually significant and, if so, how to adequately address this issue.

However, as in the case of Cyprus, the development and implementation of such policies is often complicated because the responsibilities are redistributed across different authorities. Over the next few years, major progress in this area is expected which will follow the changes in the current legislation. Nowadays, for instance, this topic falls within two different axes of the EU Regional Operational Programm – reduction of CO_2 emissions versus sustainable urban development—thus creating a further fragmented space for an effective public intervention. This results in complicated management and cooperation systems, time-consuming processes, excessive bureaucracy, lack of double-expertise and new technical solutions, and the absence of coordinated actions and political commitment.

Nonetheless, the VIOLET project has promoted cooperation across competent authorities and professional associations, fostering knowledge-sharing in order to establish a new policy framework. Cyprus Energy Agency (CEA), based on the information and experience acquired through the VIOLET project, has organised two WISE events targeting relevant actors in order to raise awareness. Recognising this complexity and after a key-stakeholders' analysis, CEA invited more than 20 members from various backgrounds "under the same roof'' in order to contribute to the local Community of Practice (CoP). CEA has also provided consulting in various occasions when heritage buildings were applying for energy renovations, including energy audits.

5.2.3 Interventions for Energy Improvements in Heritage Buildings

The performance of services and equipment is of major importance as the form and the construction of heritage buildings cannot change radically. The proposed steps (hierarchy) for achieving an energy efficient building usually consist of the following: i) considering the siting, orientation and design to minimise the demand for energy, materials, water or other resources; ii) selecting suitable materials to ensure low embodied energy; iii) designing, managing and controlling the services and systems to ensure they operate as efficiently as possible; iv) supplying of RES and other sustainable resources.

When considering the installation of RES (and HVAC systems) it is important to acknowledge the current legislative framework at the national and local levels. For Cyprus, the installation of RES on the roof of (declared) heritage buildings is not allowed. Nonetheless, RES can be installed on the roof of building extensions (newly constructed or not declared sections of the original building). In most cases, solar thermal panels for hot water are installed and in few occasions, there are examples of PV installation. The installation of HVAC systems in heritage

buildings must be minimal. Their external units should be hidden from the main view and ensure that they will not affect the microclimate of the building. To avoid the installation of big systems, which usually demand large spaces for maintenance works, fans are usually preferred for cooling purposes and eco-friendly fireplaces for heating purposes. In the case of lighting systems, the installation of energy efficient lights is usually easier and have no major implications for the building's fabric. Overall, outside of E/M installations, interventions that can be made without compromising the original building's fabric are: installation of double glazing or internal glazing, roof insulation, reconstruction or maintenance of windows/doors/shutters/shades, and the placement of thermal plaster or internal insulation under specific considerations.

In some cases, the original construction of a heritage building may outperform the proposed interventions in terms of energy performance. Indeed, these buildings are inherent in solar and bioclimatic architecture, entailing passive strategies to compensate for hot/cold weather. Heritage buildings are usually characterised by high thermal mass, which means that they can store energy (heat) in their elements, providing "inertia" against temperature fluctuations. However, particular attention to heritage buildings is needed as in winter they need to be heated up or else they will be significantly colder on the inside; whereas in the summer, a non-ventilated building can be overheated due to its high thermal mass, and therefore night cooling is essential. High thermal conductivity of materials might need additional insulation (usually internal). This might cause degradation of the masonry due to humidity (the materials are usually very prone to moisture); therefore, extra attention should be given to the combination of the materials for insulating purposes. The HVAC systems also need to be taken into account as not all heritage buildings can compensate using these installations. Policymakers in cooperation with research actors, such as universities, are running projects to establish the thermal properties of traditional materials and their behaviours in present climate conditions in order for heritage buildings to meet the modern standards. However, the marketplace is often not yet equipped with new solutions or adequate materials.

Consequently, energy efficiency measures should be addressed for each individual building, as there is no situation of one-solution-fits-all. Also, the need for protecting and preserving cultural heritage sets its own limitations in terms of measures to be implemented. An example is the 168 "Areas of Special Character" in Cyprus, which require an ad-hoc approach. As an overall guideline, prioritisation needs to be given to the preservation of cultural heritage and to the comfort of end users. Hence, it would be ideal to conduct a preliminary analysis by classifying the existing building stock according to its heritage value and its energy performance. For example, differentiating between those buildings whose heritage value is so important that it must prevail over the energy performance and those buildings that need to achieve the highest energy standards as their heritage value is deemed low.

5.2.4 Sustainability Aspects of Heritage Buildings Renovation

Heritage buildings play a role in the three main pillars of sustainability – environmental, economic and social. Focusing on the environmental pillar, improvements in the energy performance of this building stock have the potential to reduce building operational energy

and its associated impact on the environment. The adoption of passive strategies and bioclimatic design, the use of natural-physical materials and the installation of RES (when possible) are the essential steps.

When considering the economic sustainability of restoration works, one of the most important result of the VIOLET project was the mobilisation of financial opportunities. Without external funding (both public and private), the initial investment can seem unaffordable. In the case of listed buildings or ancient monuments, for example, the price for restoration is already extremely high due to specific construction works and materials. If additional criteria for energy efficiency are set, a techno-economic analysis based on Life Cost Cycle (LCC) assessments is essential to decide whether to proceed or not. Direct grant aids should, however, not be considered as a "panacea". Other actions must be promoted. For example, the Energy Performance of Buildings Directive (EPBD) (2018/844/EU) will open up market opportunities, making such interventions increasingly economically viable.

Recently, there has been a growing movement towards including a "fourth pillar" in the sustainability model, considering culture as essential in shaping sustainable societies. In Cyprus, the majority of heritage buildings that are currently in use are located in rural areas. Here, social inclusion should be enhanced to avoid rural communities becoming deserted. The restoration of (residential) heritage buildings can contribute to the revitalisation of rural area and to the preservation of cultural heritage. In urban areas, instead, gentrification should be avoided, especially in historic urban centres.

5.3 Junta de Andalusia (Spain)

5.3.1. EU Legislation and Policy

Heritage buildings should have a particular relevance in the EU legislation. However, because of the inherent difficulty of introducing technical specifications in the Energy Performance of Buildings Directive (EPBD) (2018/844/EU), national and regional policies should first enhance the implementation of the recommendations of the standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines' in the rehabilitation of heritage buildings. By doing so, the extensive execution of specific cases would generate the necessary knowledge to face the changes in the EPBD. This mechanism refers to the "learning by doing" philosophy.

In Andalusia, renovation works in heritage buildings are regulated at the regional and local levels. All Andalusian cities and towns have a protection catalogue, where designated heritage assets are protected by law under Municipal Planning. The interventions on this category of buildings are restricted by specific ordinances. A higher level of protection is guaranteed to some buildings catalogued at regional level. The interventions on this latter category of buildings must be approved by Provincial Heritage Commissions, which is made up of specialists in the field of cultural heritage (architects, historians and archaeologists). If improvements would be possible in this context, the following indications should be followed. First, the decision-making bodies should incorporate specialists in energy retrofitting of heritage buildings. Second, financial incentives for energy retrofitting should be provided,

with extra budgets for the necessary analysis and evaluations. Third, as stated in the standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines', a systematic procedure should be compulsory followed in rehabilitation projects.

When considering policies specifically designed for the implementation of energy efficiency measures in heritage buildings, local policies are still lacking in terms of ad hoc instruments. On the contrary, regional policies appear to be more adequate (despite the needs of further improvements), considering this topic as a strategical point.

In Andalusia, local policies adopted by city councils are not always well fit to address the unicity of energy interventions in heritage buildings. For example, some city councils provide a municipal-tax advantage for listed buildings' owners in case of renovation works, without paying attention to their energy retrofitting. In other cities, such as Seville, tax incentives promote the installation of solar energy facilities, but without considering the nature of heritage buildings. The legal problem of visual pollution has not been addressed.

At the regional level, the energy retrofitting of heritage buildings is considered as strategic within the "Integral Plan for the Promotion of the Construction Sector and the Sustainable Rehabilitation in Andalusia Horizon 2020" (PICSA), aligned with the "Energy Strategy in Andalusia 2020". The PICSA includes specific measures for heritage buildings in its lines 8 and 9. However, energy interventions in Andalusia are almost non-existent, due to various difficulties and barriers. One of the rare cases is the energy rehabilitation of the listed building that holds the public body headquarters of "Defensor del Pueblo Andaluz", in Seville. It was conducted thanks to the 2008 agreement between this institution and the Andalusian Energy Agency (AEE), together with REDEJA (Energy Net of Andalusian Public Administration), a management tool of AEE.

These objectives, axes and lines of the PICSA are taken into consideration, among others, in two regional instruments, none of which includes energy efficiency interventions in heritage buildings. The first one is the "Housing and Rehabilitation Plan for Andalusia 2016-2020", which gives financial support to five initiatives for the rehabilitation of residential buildings and dwellings. One of these initiatives, the Regional Building Rehabilitation Programme, considers the category of heritage buildings. This programme is dedicated to private owners of buildings, who can apply for grants/subsidies for the improvement of their buildings (including energy efficiency) on a competitive basis. It provides for an additional grant of €1,000 per dwelling, to be added to the maximum subsidy, when the building is declared an Asset of Cultural Interest—the highest protection grade existing in Spain, named BIC—catalogued or integrally protected in the corresponding urban planning. This category of buildings also receives four additional points in the evaluation of proposals. Nevertheless, very few listed buildings have been refurbished under this programme and the general energy efficiency standards (based on the current Spanish energy code) have not been applied either, given the exception treatment granted by the Energy Performance of Buildings Directive (EPBD) (2018/844/EU). No follow-up plan has been implemented either. The second instrument, "Andalucía Es Más": Programme for the Sustainable Energy Development in

Andalusia (2017-2020)", is managed by the Andalusian Energy Agency (AEE). Under one of its incentive lines, called "Sustainable Construction", 6,419 interventions were carried out, 75% of which were to improve the energy performance of buildings. Although it does include specific measures for heritage buildings, this kind of intervention is scarce.

To conclude, the two regional instruments described above do not exclude energy retrofitting of heritage buildings. However, they often do not have the required budget for their execution. In addition, none of the two instruments considers neither the potential impact on the protected values of the buildings nor a specific methodology for analysis, intervention and evaluation.

Since 2013, AVRA has been developing its own line in energy retrofitting of buildings. AVRA has been using various funding sources supported by Axis OT4, the above mentioned "Plan Andaluz de Vivienda y Rehabilitación 2016-2020" and "Andalucía Es Más": Programme for the Sustainable Energy Development in Andalusia (2017-2020)", but also by the "Sustainable Construction Programme" emerged in 2014 and funded by the former OP 2007-2013. Its main target has been the residential public stock.

In the period 2014-2017, 116 residential complexes (housing blocks and/or groups of housing blocks) and 7,282 dwellings were rehabilitated, implementing innovative solutions, such as eco-materials, ventilated facades and highly efficient hot water equipment. The line did not include cases of heritage buildings, although their number remains small. No historic building has been energy retrofitted by AVRA due to the presumed difficulty of meeting the efficiency requirements established in tenders. This line from AVRA was selected as good practice by Interreg Europe within the BUIL2LC project.

To conclude, considering all of the above, in order to develop effective policies and incentive schemes in the field of energy retrofitting of heritage buildings, it is of primary importance to estimate the volume of the existing building stock differentiating between two categories: residential and non-residential buildings. Both stocks should be classified, at least, by listing grade, climate zones and typology. Residential buildings are the most abundant and should be on the focus of any ambitious strategy. The second stock is more heterogeneous in terms of end usage and energy parameters, from a big museum to a little town hall. Both stocks should be characterised in order to design specific strategies, a complex task that requires precise planning. Cadastre databases, which provide very detailed information, could serve as a basis. This would be a similar task to the one done within the EU projects TABULA and EPISCOPE, but specifically designed for heritage buildings at the regional level[1].

5.3.2 Interventions for Energy Improvements in Heritage Buildings

The energy performance of services and equipment in heritage buildings can be improved in several ways, but with technical and legislative constraints. The performance of downgraded technical equipment can usually be improved when renovating a historic building. However, restrictions related to lack of space, archaeological and architectural protection and visual

[1] *See: www.episcope.eu/building-typology/country/es/*

pollution frequently arise. In addition, the need to avoid risks (hygrothermal, structural, chemical, biological, etc.) that endanger the conservation of the architectural components or of the movables assets is another restriction. These constraints, which are specific to heritage buildings, may lead to lower energy efficiency and a reduction in CO_2 emissions.

Concerning the installation of RES, regional legislation on heritage conservation, enacted in 2007, makes it difficult to install such technologies or some other highly efficient systems, which are often voluminous, in historic centres. It compels the municipalities with heritage assets registered in the General Catalogue of Andalusian Historic Heritage to include in their urban planning or municipal regulations control measures regarding "permanent or temporary installations whose high volume or distance may disturb the perception of the asset" and specifically "installations related to the energy supply, generation and consumption". Thus, although it is not explicitly prohibited, such installations are discouraged for the vast majority of the 778 Andalusian municipalities.

Concerning passive strategies to be applied to the original fabric of the building (such as control systems, changes in the user habits, solar protection of windows), these can reduce the energy demand of the building. Improving the efficiency of the active systems (HVAC, HW, etc.) can usually be achieved without putting at risk the preservation of the assets. However, if the expectations are too ambitious (A or B rates), these strategies may be insufficient due to the difficulties and legal barriers in integrating RES in this context.

The recent Spanish Royal Decree 244/2019, regulating the administrative, technical and economic conditions for self-consumption of electricity, allows any energy production facility to supply one or more consumers when both generation and consumption are connected at low voltage and at a distance of less than 500 metres. This collective self-consumption system could enable a heritage building to be supplied by a nearby renewable energy production facility in those cases when the installation of RES in the building is not viable. In addition, this option may solve the problem of visual pollution.

When undertaking energy renovation works, some classes of heritage buildings require special considerations. For example, in a traditional building that has a low energy demand due to its inherent physical characteristics (i.e. high inertia or compactness), the introduction of RES could transform it into a near-zero energy balance building, without modifying its walls, windows, etc., because likely no extra-insulation nor window enhancement would be needed. The advantage of this situation is that the CO_2 emissions during the operational life of the building could be minimised, without carrying out an intrusive intervention to its physical structure. On the other hand, the disadvantage is that the installation of RES may produce visual pollution and conflict with local legislation. Overall, each single case should be analysed separately. However, in the Andalusian region there is currently no official guidance for approaching energy renovation of heritage buildings. Professionals usually make decisions based on their knowledge and expertise.

5.3.3 Sustainability Aspects of Heritage Buildings Renovation

The environmental sustainability aspects to be considered when prescribing energy upgrading works to heritage buildings are many and diverse. It may be not feasible to carry out such a comprehensive evaluation for each case. Each region can decide which aspects to evaluate and which not to evaluate, as well as which methodologies to use.

Heritage buildings have certain features that make them sustainable from an environmental point of view. First, the building fabric (structure, walls, roof, etc.) has a large amount of embodied energy, making its reuse, recycling and recovery particularly favourable. Second, since they cannot be demolished, their use stage is supposedly endless. Hence, all the processes and impacts considered in the end-of-life stage are not applicable in the evaluation. This makes the use-stage analysis especially important, covering, among other aspects, use, maintenance, repair, replacement, refurbishment, operational energy and water use. Third, the Life Cycle Assessment (LCA) considers the substitution (or addition) of materials in order to guarantee the proper functioning of the building. For these materials, the end-of-life stage should be also considered.

Energy retrofitting in buildings has an impact on both the indoor air quality and the external environment. Both impacts should be evaluated in order to guarantee the sustainability of the process. The general standards to evaluate the indoor air quality (IAQ) are EN 15251, EN ISO 7730 and ASHRAE 62-2001, which are all referenced in the standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines'. Also, the technical body CEN/TC 346 Conservation of Cultural Heritage of the European Committee for Standardization has developed a set of specific standards (EN 15757:2010, EN 15759-1:2011, EN 15759-2:2018). These standards give support to the evaluations of the fifth category established in the standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines', among which four criteria are included: 5.1. indoor environmental conditions suitable for building content preservation; 5.2. indoor environmental conditions suitable for building fabric preservation; 5.3. indoor environmental conditions suitable for achieving good occupant comfort levels; 5.4. emission of other harmful substances.

On the other hand, the impact assessment of energy retrofitting works on the external environment is part of a set of EU standards from CEN TC 350, based on Life Cycle Assessment (LCA) methodology. One of them (EN 15643-1) provides the general principles and requirements to the threefold sustainability assessment of a building: social, economic and environmental. Also, the ISO 15978:2013 "Sustainability of Construction Works, Evaluation of the Environmental Performance of Buildings, Calculation Method" uses the Life Cycle Analysis (LCA) methodology to measure the environmental impact of a construction work (new or refurbishment). It divides the total life cycle into 4 stages, also applicable to the case of energy retrofitting of heritage buildings: i) product stage (A1-A3 EN 15978); ii) construction process stage (A4-A5 EN 15978); iii) use stage (B1-B7 EN 15978); iv) end-of-life stage (C1-C4 EN 15978).

The result of applying the LCA methodology will be to obtain a series of categories of impacts produced as a result of the intervention throughout its entire life cycle, from the extraction

of raw materials to their final disposal. In the case of building assessment, these impact categories are usually the following (UNE EN 15804:2012+A1:2013): global warming potential (GWP); acidification potential of soil and water (AP); stratospheric ozone depletion potential (OPD); photochemical oxidant formation potential of tropospheric ozone (POCP); potential toxicity in humans (HTTP); potential toxicide in ecosystems (ETP); abiotic resource depletion potential (ADP); incorporated non-renewable primary energy (EEN); incorporated renewable primary energy (EER). The last two "energy-related" categories, EEN and EER, have been included among the evaluation categories within the standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines'.

From an economic point of view, the operating costs of a heritage building should permit its long-term functioning, since its use stage is considered endless. While costs of construction and of end-of-life stages are set to be zero, operational and maintenance costs represent the most important part of the total life cycle costs. Refurbishment works are considered as costs involved at the use stage, which could lead to savings in the medium and long term. For this reason, it is important to plan and execute such refurbishment works of a heritage building under a sustainable construction approach. First, the system and its elements must be designed to have a long-term functioning, to be flexible and adaptable to possible changes. Second, measures for energy and resource efficiency, such as passive strategies (for instance, correct window shading) and efficient lighting system, must lower energy demand.

In the case of public buildings, the payback period from initial investments could be large. This issue has been considered in the procurement strategy for construction/renovation works carried out by Östersundshem (the municipal housing company of Östersund, in Sweden). According to this strategy, included as good practice in the Interreg project BUILD2LC[2], the payback periods of energy efficiency measures are calculated by the tenders, which should assure their profitability in a time span of 50 years. In the case of private owners, accurate economic assessments are needed. The lack of expertise in this field makes difficult to predict a reasonable payback period and to evaluate the economic sustainability of the works. LCCA (Life-Cycle Cost Analysis) is the most common methodology used for carrying out this type of economic analysis. This evaluation system is regulated in ISO 15686-5:2017[3] and in UNE-EN 60300-3-3:2017[4].

Concerning the social aspects of sustainability, heritage buildings play a role in local communities. Such buildings must be comfortable and energy efficient (according to modern standards), in order to not condemn them to obsolescence, deterioration and neglect. These buildings should host intensive programmes, related to day-to-day activities: residence, work, public services, etc. Touristic uses should be constrained to special cases. This is challenging, but it ensures the social sustainability of the rehabilitation investments and promotes the sustainable preservation of cultural and historic urban areas. Local policies should favour the rehabilitation of heritage buildings over the construction of new ones, especially in the case

[2] *See: www.interregeurope.eu/policylearning/good-practices/item/2000/smart-procurement/*
[3] *Buildings and constructed assets. Service life planning. Part 5: Life cycle costing.*
[4] *Dependability management. Part 3-3: Application guide. Life cycle costing.*

of tertiary sector and public services. Local policies should also raise awareness and teach how to better use a building to lower its energy demand. This should be included in the training of professionals (architects, builders, public administration technicians, etc.).

5.4 Municipality of Middelburg (Netherlands)

5.4.1. EU Legislation and Policy

Heritage buildings should have a particular relevance in the EU legislation, particularly in the Energy Performance of Buildings Directive (EPBD) (2018/844/EU) and in the Energy Efficiency Directive (2012/27/EU), for both environmental reasons and conservation of cultural heritage. The EU legislation should take into the account their unique nature, allowing for the adoption of a flexible approach. In the opposite case, at some point it will become prohibitive to live or work in this category of buildings.

The Netherlands has decided to achieve an energy neutral building stock by 2050. Municipalities in the region and in the province of Middelburg signed an energy agreement, which includes renovating private houses to be energy neutral by 2045. In the Municipality of Middelburg, the local policy promotes the adoption of solar panels, sun-screens and insulating glass for heritage buildings. An improvement to this policy would be to include further interventions, such as insulation for roofs, walls, floors and cellars. Also, it might be helpful not to focus at individual building but at the city centre as a whole. For example, there might be buildings with excess heat that can be used by other buildings. Another option would be to place solar panels on "regular" buildings in order to share this energy with heritage buildings nearby.

In the Netherlands, each municipality has its own policy in this regard. It would be desirable to have a single national policy on this complex subject. Nowadays, there is a national loan provided at a low interest rate in order to implement energy efficiency measures in heritage buildings[5], which are generally more expensive than for other buildings. However, owners tend to prefer subsidies. When considering the development of an integrated national policy in this field, the following information about the existing building stock is necessary to consider: property vs renting, type of buildings (listed or not listed, offices, monuments, churches, etc.), construction year and energy measures already in place.

When seeking advice on this subject in the Netherlands, the national foundation, Stichting ERM, designs guidelines for the implementation of energy efficiency interventions in heritage buildings. Companies who want to be registered as a qualified heritage companies are obliged to adopt these guidelines. Also, the Municipality of Middelburg, together with its stakeholders, has developed a Sustainable Monument Passport. Experts visit the building and make an online report (passport) with recommendations to make the building more energy efficient, highlighting costs and benefits. In parallel, the Municipality of Middelburg developed the so-called Sustainable Monument Coach. This coach is a delegated experts who helps owners with the complete process of energy renovation—from receiving advice and offers from contractors to permit and quality checks when the work is finished.

[5] *See: www.restauratiefonds.nl/monumenteigenaren/financieringen/duurzame-monumenten-lening*

5.4.2. Interventions for Energy Improvements in Heritage Buildings

In the Netherlands, when approaching interventions for heritage buildings, the “restoration ladder” is often applied to make the decision easier. The ‘’ladder’’ consists of three hierarchical steps. First, to maintain the building through its conservation. Second, to repair the building if it is damaged. Third, to renew it if its repairs are not viable. If you proceed with renewing the building, the following actions should be considered: first, to copy the original parts; second, to imitate if copying is not possible; third, to improve it if necessary. This “restoration ladder” complies with the principle of "as much as necessary and as little as possible."

In the Municipality of Middelburg, the energy performance of heritage buildings can be improved by the installation of RES. Solar panels can be installed on the roofs when they are not visible from public spaces, hence solar panels not visible to the public would be a solution. Solar panels can also be placed in a nearby building/area (for example, a nearby factory with a large roof) in order to consume this energy in heritage buildings/monuments. RES cannot be installed on top of monuments and on roofs covered with slates.

With respect to the fabric of the building, energy efficiency interventions must not damage its cultural and architectural heritage. The building can be insulated on the outside of the construction (open for vapour, but waterproof on the outside), if this is invisible (for instance, beneath the roof tiles, depending on the connections with other building components). Insulating glass is allowed when it is thin enough and the wood is thick enough (the horizontal part of the wood next to the glass should be at least 5 mm wood). There are new types of insulating glass that are very thin; i.e. vacuum glass is allowed for insulation purposes. If the window frame is thick enough, one can replace the single glass (reusing the single glass elsewhere) with thin double (vacuum) glass. A good solution is to make insulated compartments in a building, for instance insulating the floor of the attic instead of insulating the entire roof. Better and thinner insulating materials can play a role, even beneath the stucco layer/plaster on the outside of the wall—depending on the connections with other building components. Eventually, insulating and reflecting paint, given the walls are already painted, as well as sunscreens—if placed on the window frame, using covered colours and a simple frame—are additional options.

Overall, there are quick a few solutions to implementing energy efficient measures in heritage buildings, but there is no one-fit-all solution. In the Municipality of Middelburg, there is a list of top monuments, for which the standard solutions for “normal” heritage buildings are not possible with a free and fast permit procedure. Because of the value and delicacy of such monuments, special considerations may apply. Indeed, in each case, the importance of preserving heritage value must be weighed against the environmental benefit. The preservation of historical and architectural value is of top priority and energy efficiency measures must conform to this.

Moreover, when implementing energy efficiency measures for heritage buildings it is necessary to account for the varying architectural styles. This is an important issue when

conducting a cross-countries comparative analysis as of this VIOLET paper. Indeed, buildings of a certain style can be compared across countries; on the other hand, it is not possible to compare, for instance, a 17th century building in the Netherlands with a 17th century building in Spain because of different architectural styles.

5.4.3. Sustainability Aspects of Heritage Buildings Renovation

In considering energy renovation works in heritage buildings, environmental aspects must be taken into account. The objective is to reduce CO_2 emissions and to adopt a circular approach by consuming RES, using renewable materials and applying energy efficient equipment. For instance, in Middelburg's city centre the soil is polluted, because in the past lead was used for waterproofing roof connections. Nowadays lead substitutes are used. The Municipality recommends natural and breathable insulation materials, which have the advantage of being renewable.

Concerning the economic sustainability of energy efficiency measures applied to heritage buildings, these interventions are generally more expensive than for other buildings. Since the national Dutch government has decided to achieve an energy neutral housing stock by 2050, private owners expect future subsidies and wait to adopt these measures. However, the Municipality of Middelburg wants these private owners to act now. In this regard, research shows that the restoration of heritage buildings has a good impact on the economy: it creates jobs and sets an impactful example for other owners also wanting to restore.

Energy retrofitting of heritage buildings can also have cultural and social impacts. For example, without these interventions, living in such buildings would become less attractive, with the risk of losing cultural heritage. The adoption of energy efficiency measures can foster the sharing of further environmentally friendly ideas within communities.

5.5 Local Energy and Climate Agency (France)

5.5.1. EU Legislation and Policy

Heritage buildings should definitely have a particular space in the EU legislative framework, such as in the Energy Performance of Buildings Directive (EPBD) (2018/844/EU) and in the Energy Efficiency Directive (2012/27/EU). In France, for example, heritage buildings (as reference, those built before the mid-20th century) constitute a significant share of the existing building stock—around 33%. Heritage buildings already receive special attention in the current legislation, but the common solution is to exclude them from the application of energy performance standards, which is nowadays not the optimal solution. Regulation should be adapted to the special nature and needs of these buildings. Moreover, as heritage buildings are mainly placed in city centres (rural or urban areas), non-compliance with modern energy standards might damage their perennity, hence decreasing their attractiveness and leading to negative social and economic impacts on city districts.

In accordance with the Energy Performance of Buildings Directive (EPBD) (2018/844/EU), France has adopted regulations for the construction sector (i.e. new buildings), as well as for renovation interventions (i.e. existing buildings). For existing buildings, the regulatory measures differ according to the importance of the work undertaken. For major building renovations—for example, a cost of "thermal" renovation exceeding 25% of the building's value, excluding land—of more than 1,000 m², completed after 1948, the regulations define an overall performance objective for the renovated building. This first section of the Thermal Regulation (RT) is applicable to building permits submitted from the 1st of April 2008. For all the other renovation interventions, the regulations define a minimum performance for the replaced or installed element. This second section of the RT, known as "RT element by element", is applicable from the 1st of November 2007.

The 2015 Law for Energy Transition and Green Growth (LTECV) reinforced the objectives related to the renovation of the existing building stock. The aims are to renovate the energy supply for up to 500,000 homes per year, to increase the skills among professionals and to improve the quality of the energy rehabilitation works. These goals are an integrated pillar of the national Action Plan for the Quality of Construction and Energy Transition (PACTE). Among the dwellings that make up the existing building stock, about 33% (more than 10 million) are defined as "old buildings". These are constructed before the middle of the 20th century using traditional techniques, know-how and materials (i.e. stone, wood panelling, raw earth, etc.).

In the Nouvelle Aquitaine Region, following the VIOLET project's impact, local authorities have decided to include bonuses for energy efficiency improvements in three calls for tenders on different categories of heritage buildings. Beside this instrument, or bonus, in the upcoming period, the Local Energy and Climate Agency (ALEC) will advocate for the adoption of further financial aid in this context. However, interventions for energy retrofitting are sometimes refused by local authorities because of high cultural value of heritage buildings; for example, when situated inside the UNESCO context.

To develop effective policies capable of applying energy efficiency standards to heritage buildings, it is recommended to estimate the size of the existing heritage building stock. It would be ideal to account for the original materials used in a building's construction and the current level of the its deterioration. Social enquiry among the population living in the area could also assist by receiving valuable feedback. However, a public policy aimed at the rehabilitation of heritage buildings cannot be limited to the objective of energy efficiency. Throughout the adoption of a more holistic diagnosis, the solutions must be based on a multi-criteria evaluation, accounting for environmental dimensions, heritage preservation dimensions and technical/economic dimensions (e.g. durability of components and health standards).

5.5.2. Interventions for Energy Improvements in Heritage Buildings

In general, in France, the overriding principle is that energy efficiency interventions do not cause damages to the overall functioning of the building. In terms of RES, it is almost impossible to install solar panels on the roofs if those are visible due to low acceptability. Nowadays, energy efficiency performance of heritage buildings can be improved by the application of roof insulation, double-glazing or double windows.

In the Nouvelle Aquitaine Region of France, there is a large share of heritage buildings originally built with stones. Such buildings have particular constructive features and a hygrothermal behaviour that is very different from modern buildings. In particular, it is necessary to proceed carefully with insulation interventions and materials because they may lead to high humidity that can induce risks of discomfort and diseases.

An initial diagnosis should make it possible to determine the opportunities and constraints specific to each building. In this context, energy retrofitting interventions must consider solutions that respect the rules of art; i.e. rules that are compatible with the building's original construction type, fabric, technical systems and materials, and local climatic conditions. Also, rehabilitation projects must take into the account the preservation of cultural heritage by respecting the authenticity of the building. Hence, it is necessary to: emphasise repair, restoration and reuse; restore the original provisions by using identical and compatible materials; and apply contemporary architectural solutions in a reasoned and justified manner.

5.5.3. Actors Providing Guidance in France

In France, there exists a well-structured network of actors involved, in various ways, in supporting, informing, consulting and facilitating the preservation of cultural value in heritage buildings and the adoption of energy efficiency measures in these buildings.

The Local Energy and Climate Agency (ALEC) was established with the support of the local authorities (Metropolis, Département, Region) and of the French Ministry for the Environment & Energy (ADEME) in order to sustain the green transition at the local level. Among other tasks, ALEC works alongside a team of professionals to provide technical expertise to public authorities on the energy performance of public buildings and related interventions, from preliminary inspections and renovation works to constant follow-ups.

ALEC, together with the Urban Planning Agency, has already developed factsheets on building typologies to facilitate the uptake of energy efficiency measures.

The Council for Architecture, Urbanism and Environment (CAUEs) was founded with the goal to improve the quality of the living environment, as objective of public interest. At CAUEs, independent professionals offer technical consulting to public policy and educational training in order to promote the highest quality standards in architecture, energy efficiency and sustainable living environment. A specific activity of CAUEs is the energy management of heritage buildings through energy renovation interventions.

The Territorial Platforms for Energy Renovation (PTREs) are shared structures, managed by local authorities with the support of ALEC, that provide public services to promote the energy renovation of buildings. PTREs provide support (technical, legal and financial) to private individuals throughout the energy renovation projects. PTREs mobilise professionals and contribute to the training of companies that are recognised as environmental guarantors (RGE). PTREs carry out financial arrangements, combining the banking sectors, public subsidies and market mechanisms such as the Energy Savings Certificate.

The National Association for the Protection of Rural Heritage Buildings (Maisons Paysannes de France) promotes the maintenance and restoration of rural heritage buildings in order to protect the cultural and social identity of each region while applying modern environmental standards. The main objectives of the association are raising awareness to promote adequate legislation and public policy and fostering knowledge-sharing among building professionals.

The Resource Centre for Responsible Rehabilitation of Ancient Buildings (CREBA) is a portal intended for building professionals involved in renovation works. It put a strong emphasis on the preservation of cultural heritage and on energy efficiency interventions. CREBA offers a historic record of operations and related technical feedback, which is a precious tool for the adoption of a comprehensive and adequate approach during the rehabilitation of heritage buildings.

5.5.4. Sustainability Aspects of Heritage Buildings Renovation

In France, due to their average level of energy consumption as well as the sheer amount of them (33% of the existing building stock), heritage buildings must contribute to the achievement of the national climate and environmental objectives. Following an initial diagnosis, the energy rehabilitation of heritage buildings must be modified according to the building's requirements in terms of energy consumption, CO_2 emissions, energy loss/energy efficiency, internal comfort according to building’s use. The energy rehabilitation can be achieved in stages, or partial rehabilitation. For instance, the insulation of the building’s envelope is to be preferred over installing new equipment. Consideration should be given to the treatment of interfaces and interactions between stages of rehabilitation. The use of the "Guidance Wheel" tool allows one to identify such interfaces and interactions (e.g. installation of a ventilation system in the event of a change of joinery).

5.6 Conclusive Recommendations and Questions for Decision Makers

Thanks to the experience gained by the VIOLET project's international consortium and the partners' valuable contributions, this paper has collected various recommendations and questions to be posed to policymakers across Europe. The report has gathered opportunities for energy renovations of heritage buildings from different perspectives, highlighting challenges and opportunities per partner region. From the insights provided by the VIOLET project's partners, it is clear how the major purpose of decision makers should be to push for a rapid implementation of a comprehensive EU legislative framework capable of considering the nature and needs of heritage buildings in the area of energy efficiency—heritage buildings that constitute a large portion of the European building stock and are undoubtably responsible for unwanted greenhouse emissions. The VIOLET project's partners would also like to receive feedback on critical issues, such as the optimal governance model in this multidisciplinary field, operational framework and incentives schemes, accounting for the preservation of the cultural heritage across the EU.

Highlighted within this paper was the need:

- **To establish a single competent and responsible authority/department in each region**. How to decide which actor is in the best position to act effectively remains a major concern.
- For a more **efficient coordination between cultural heritage preservation and energy efficiency measures**.
- For a **complementary strategy**, which is necessary to inform about and facilitate energy renovation in heritage buildings, for several reasons outlined but primarily in the reduction of CO_2 emanating from the built environment.
- **For an introduction of specific instruments**, such as a mandatory evaluation tool, which refers to the obligation to carry out energy audits for all types of buildings, including heritage buildings.
- For an EU legislation to take into the account the **unique nature** of traditional and heritage buildings, allowing for the adoption of a **flexible approach**. In the opposite case, at some point, it will become prohibited to live or work in this category of buildings.
- To include the topic of energy renovation of heritage buildings in the current EU legislation in a **more elaborated manner**. The current Energy Performance of Buildings Directive (EPBD) (2018/844/EU) introduced new elements, such as "research into, and the testing of, new solutions for improving the energy performance of historical buildings and sites should be encouraged, while also safeguarding and preserving cultural heritage". However, this provision is vague, with no deadlines and targets, and no reference to the complexity of the issue of the heritage building stock.
- For a **particular relevance** of heritage buildings in the EU legislation. However, because of the inherent difficulty of introducing technical specifications in the Energy Performance of Buildings Directive (EPBD) (2018/844/EU), national and regional

policies should first enhance the implementation of the recommendations of the standard 'EN 16883:2017 Conservation of Cultural Heritage Guidelines' in the rehabilitation of heritage buildings. By doing so, the extensive execution of specific cases would generate the necessary knowledge to face the changes in the EPBD. This mechanism refers to the **"learning by doing"** philosophy.

The VIOLET project's partners have inquired how it would be possible to integrate energy efficiency interventions in heritage buildings with other issues that need to be addressed currently, such as circular economy, energy transition or even with local policies on a micro-level (e.g. households). Effective and consistent mobilisation of financial opportunities and implementation of incentives—for example, a bonus in the call for tender for refurbishment works—capable to link both energy efficiency measures and preservation of cultural heritage have proved to be challenging.

It has been interesting to realise how the preservation of cultural heritage does not play a secondary role in the policy scenario. Partners are very interested to know which cultural aspects should be prioritised in heritage buildings when making decisions. Also, in order to contribute to the preservation of such buildings, it was discussed whether it would be ideal for regions and cities to adopt an ad hoc taxation; for instance, a tourist tax. Indeed, regions and cities benefit much from a well-maintained traditional building stock, as tourism represents a significant source of income for regions. However, whether tourists are willing to accept a new low-carbon aesthetic in heritage buildings in order to preserve them remains a major concern. It is also important to maintain adequate health and comfort conditions for end users when energy retrofitting heritage buildings. It is apparent through the work of VIOLET, if there is not the necessary investment into energy efficiency measures, as with aesthetic maintenance, then these value assets may fall into neglect, possibly being lost forever.

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