FuturHist

Barrier analysis: Identifying views on hindrances to the retrofitting of historic buildings

Project Overview



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Executive Summary



As part of the "Drawing the baseline" FuturHist work package, this report presents the results of Task 1.1 focused on the identification of barriers. A survey was conducted to assess the main barriers to energy efficiency in historic buildings. Feedback was gathered from various types of stakeholders engaged with energy retrofitting of historic buildings: practitioners, building owners, and public authorities. Almost 150 survey responses were collected from 25 different countries across Europe. Analysis of the data shows several trends within different stakeholder sectors and regions.

Additional in-depth feedback was received through a structured interview process and “practitioner form” targeting key individuals from the demo case countries. Twenty-five respondents from Spain, Sweden, Poland, and the United Kingdom were interviewed, while six individuals were selected to complete the “practitioner form.”

A major barrier identified by most respondents to the survey and interviews was the current state of policies and legislation. In particular, current policies and legislation regarding energy efficiency are created with new construction in mind and significantly disadvantage historic buildings. Building performance targets are not always applicable for historic buildings, yet they are still largely obligated to adhere to them. Shortcomings in funding, awareness, traditional skills, and a lack of best-practice examples are also identified as significant barriers.

The “practitioner forms” showed that while there are clear national and international guidelines and standards for practitioners to perform heritage value assessments and energy value assessments, these require some refinement to address issues with applicability and complexity.

Of primary importance in addressing these barriers is a more nuanced approach in policy and legislation that better takes into account the unique conditions and requirements of historic buildings as well as the local contexts of the countries they are found. This could either mean a new set of policies specifically designed for - and only applicable to - historic buildings; or a reworking of existing legislation to better accommodate their realities.

The best solutions would take a holistic approach and address as much as possible all notable concerns voiced by the stakeholder respondents; improving resources for training, funding, and awareness raising to improve public opinion around the inherent sustainability and energy efficiency of historic buildings. By making progress across these areas, the overall situation for energy retrofits of historic buildings would be greatly improved.

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Disclaimer

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Abbreviations and definitions

Barriers	Refers to any obstacle or challenge that inhibits the implementation or widespread adoption of energy-efficient technologies, practices, or policies in practice
Energy retrofit	A general concept for all types of renovations where reduced energy consumption is the main goal for the renovation. It is used for the entire renovation process, from planning to evaluation, and is closely related to sustainable renovation (Thuvander et al., 2012). Sustainable renovation of existing buildings is a way of extending the lifespan of a building and improving its living and working conditions, which includes lowering the energy used for those purposes (Asdrubali and Desideri, 2018, chapter 9)
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
Historic building or **Building of heritage significance**	Includes also buildings that are not statutorily designated as cultural heritage ("i.e. listed buildings").
HIBERatlas	Historic Building Energy Retrofit Atlas
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
Likert scale	A rating scale used to measure survey participants' opinions and attitudes. Respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale
Planning process	The process of identifying the need for energy performance improvements and defining appropriate improvement measures that match the requirements for the building in question. It would cover all the steps of the proposal procedure of EN 16883 (from the client's intentions to the final decision), but not the implementation, monitoring or maintenance of the intervention afterwards.
Step	Most important technical/practical aspects or considerations associated with the energy retrofit process of historic buildings (pre-design, design and post construction phases). Steps are not necessary implemented sequentially; some can be implemented in parallel during the retrofit process.
WP	Work Package

Introduction

FuturHist aims to develop replicable retrofit solutions for historic buildings of the future. Before any guidelines or solutions can be presented, it is first necessary to develop a better understanding of the challenges and obstacles faced by the different stakeholders involved in the retrofit of historic buildings. Recent research has shown that while there are many resources, recommendations, and options available relating to energy retrofits, building owners especially are hindered by a surplus of information and the gaps present between national initiatives and local realities. Understanding barriers as identified by stakeholder groups is a vital step in addressing a meaningful way forward. To that end, practitioners, heritage specialists, architects, researchers, engineers, building managers, owners, and others were invited to participate in the FuturHist Barriers Survey, with the aim of answering the main question "What do you think are the main barriers to making historic buildings more energy efficient?" Interviews were carried out in parallel with representatives of each target group along with a "practitioner form" for professionals involved in the design of retrofit projects to capture additional information.

The approach was adjusted to cover all target groups with a single survey as opposed to numerous specific surveys aimed at numerous specific groups. Not only is this adjustment less labour intensive, but it also provides more certainty in terms of the number of respondents and general outreach. Data collection was thus aided, and a general overview was obtained alongside targeted specific data-points. The parallel interview process targeted key individuals from four groups: Practitioners, Public Authorities, Professional Owners, and Private Owners. An additional "practitioner form" was created to collect further data on standards, guidelines and tool usage at different stages of the retrofit process, specifically by practitioners. Doing so refined the project's understanding of the needs and challenges of practitioners, providing direct assistance to Work Package 4 "Development of an integrated planning toolkit" and Work Package 6 "Scale-up" and its Task 6.2 "Policy-making: Heritage authorities knowledge transfer".

The results presented in this report are useful for successive stages of the FuturHist project. The identification of different types of barriers is crucial for:

1. The design of the FuturHist Toolkit (Work Package 4). Ensuring that the Toolkit is designed to address the main identified barriers for different potential user groups.
2. Informing the selection of Key Performance Indicators (Task 1.6). Ensuring that the selection of KPI:s is based on what is considered relevant by stakeholders, and that the indicators and assessment methods have the right level of complexity.
3. Facilitating the upscaling of the FuturHist methodology (Work Package 5). By focusing on main, transnational, barriers the FuturHist methodology will be well prepared for upscaling across borders in Europe.
4. The identification of policy proposals to address some of these barriers (Work Package 6

and its Task 6.2) that will be then disseminated amongst heritage authorities from European countries.

This document presents the results of the survey, interviews and the “practitioner forms”, interpreting and categorizing the data for better clarity and understanding.

The document is structured as follows:

1. Methodology
2. Data Analysis - Key Findings
3. Conclusions and Outlook
4. References
5. Annexes

1. Methodology

1.1.Survey

1.1.1. Structure of the Survey

The survey was divided into three sections (See *Annex 1*). The first section established the demographics of respondents, their professional background and expertise, their affiliation and membership of the International Council on Monuments and Sites (ICOMOS) and FuturHist, as well as where they are based. The second part, the survey's core, consisted of a series of questions to establish the current situation for professionals involved in the management and maintenance of historic buildings. Respondents were asked several open-ended questions along with a series of Likert-type scale questions in order to understand their perspective on the current state of retrofitting of historic buildings.

Within the context of the survey, the term "historic buildings" is used to include all buildings with heritage values, both listed and non-listed; while retrofit or retrofitting refers to energy retrofitting and similar interventions focusing on improved energy efficiency and sustainability. Other types of retrofit are not within the scope of this project.

1.1.2. Survey Distribution

The survey was intended to reach the three main target groups (stakeholder groups) defined by the FuturHist consortium:

- Practitioners
- Building owners
- Public authorities (including managers of public buildings, planning officers and heritage authorities)

These target groups should make it possible to obtain as differentiated a picture as possible of the current problems, especially as it can be assumed that there are different focal points depending on the group. This should be analysed in the survey.

The survey was distributed internally within the FuturHist consortium so that the extensive networks of the participants could be utilised to increase the reach. At the same time, ICOMOS utilised its wide membership list by sending the survey to the individual European National Committees and all members via the existing newsletter. Relevant ICOMOS working groups (e.g., the Energy Performance of Buildings Directive working group) were also directly informed about the survey. In addition, the survey was shared on social media and in the FuturHist project newsletter. In a second step, invitations to take part in the survey were resent to countries that were not represented in the responses after 10 days.

The survey received 148 answers from 25 countries, with respondents expressing their mainly professional opinions regarding the barriers to energy efficiency and retrofitting of historic buildings.

1.1.3. Limitations of the Survey

Given the limited number of survey responses compared to the actual number of professionals working in energy efficiency and retrofitting of European historic buildings, there are a few noticeable gaps in responses. Like any survey, it is important to acknowledge these limitations and keep them in mind when reviewing the data. Shortcomings are most noticeable in geographical terms. A few respondents' answers from outside Europe were disregarded in the data, but chiefly there are only a limited number of responses from eastern European countries. Furthermore, because only one or two responses were received from some countries, it is difficult to reach any firm conclusions about the situation there with such limited data points. It is also important to acknowledge that answers from respondents may not all be factual, but instead represent their perceptions and opinions. Nevertheless, the data is valuable for establishing an overall view of the broader situation, with clearly identifiable trends among different cohorts.

Since the structure of the survey questions primarily focused on the professional background and experience of respondents, building owners were not represented as a clear discreet grouping. However, the opinions and perspectives of owners of historic buildings were presented in two different ways. Firstly, the survey heard from numerous professionals working for municipal and regional governments who are the public owners of large collections of historic buildings. As representatives of these institutions, their professional work and experience relate directly to the realities of historic building ownership. This is especially relevant in the European context where public ownership of historic buildings is common. Secondly, professionals whose clients are owners of historic buildings (i.e. architects, engineers, etc.) reported opinions and concerns expressed to them by their clients throughout their careers. This latter information represents a valuable expression of public opinion, being as it is distilled by professional expertise. Furthermore, barriers that cannot be addressed solely by professionals working for their client-owners are precisely the most relevant to be addressed by any solutions proposed in the future.

1.2. Structured Interviews Methodology

1.2.1. Selection of Interview Respondents

Shortcomings in the survey data were supplemented by in-depth structured interviews carried out in parallel. The approach was adjusted from the original plan of conducting interviews as a follow-up to the survey, to carrying out the interviews in parallel with the survey process. The structured interview approach gathered insights from stakeholders involved in the planning

process of retrofitting historic buildings. Interview participants were recruited based on two criteria: their involvement in the project's demo cases and the project partners' knowledge of individuals likely to provide valuable insights. This purposive sampling method ensured that the interviewees were well-positioned to provide meaningful information related to the study's objectives.

The interviews were conducted either face-to-face or online, depending on logistical constraints and the preferences of interviewees. Each participant provided standard consent to allow the use of the data collected during the interviews. The interview process began with an introduction to the FuturHist project and an explanation of the interview's purpose, alongside a clarification of key terms to ensure consistency in understanding.

1.2.2. Structure of Interviews

A structured set of questions was prepared for each stakeholder group, with some overlap across groups to enable comparison (see *Annex 3* for a list of all the interview questions). All interviews in WP1 were made with the same interview template containing questions from different tasks, see deliverable D1.3. The questions were designed to elicit specific insights from each target group's perspective while maintaining the flexibility to explore broader themes. The interviewer was encouraged to use prompts such as "interesting, tell me more", “how do you mean?”, “explain further”, “please elaborate” when appropriate to capture more in-depth responses. Interviews lasted between 30-90 minutes, depending on the interviewee’s availability and the depth of discussion.

The interviews were conducted in the local language, recorded, and later transcribed for analysis. Transcriptions were translated into English, with minor edits to improve clarity without altering meaning. All transcripts were anonymised. This structured and methodical approach allowed for comprehensive data collection, ensuring that the perspectives of different stakeholder groups were systematically documented for subsequent analysis.

1.2.3. Overview of Respondents

In total, 25 respondents from Spain, Sweden, Poland and the United Kingdom were interviewed.

No	ID	Stakeholder group	Country	Role
1	PRAPL1	Practitioner	Poland	Designer (architect)
2	PRAPL2	Practitioner	Poland	Architect
3	PRAES1	Practitioner	Spain	Engineer
4	PRAES2	Practitioner	Spain	Architect
5	PRAES3	Practitioner	Spain	Architect
6	PRAES4	Practitioner	Spain	Researcher (architect)

7	PRASE1	Practitioner	Sweden	Heritage expert at architectural firm
8	PRASE2	Practitioner	Sweden	Heritage expert at architectural firm
9	PRAUK1	Practitioner	UK	Designer (architect)
10	PUBPL1	Public Authority	Poland	Planner at heritage authority (architect)
11	PUBPL2	Public Authority	Poland	Administrative official at heritage authority
12	PUBPL3	Public Authority	Poland	Regional conservator at heritage authority
13	PUBPL4	Public Authority	Poland	Regional conservator at heritage authority
14	PUBES1	Public Authority	Spain	Heritage expert
15	PUBES2	Public Authority	Spain	Planner
16	PUBES3	Public Authority	Spain	Officer at heritage authority
17	PUBES1	Public Authority	Sweden	Heritage expert at national heritage authority body
18	PUBUK1	Public Authority	UK	Policy and Strategy Manager
19	PROPL1	Professional Owner	Poland	Property manager
20	PROPL2	Professional Owner	Poland	Deputy head of real estate company
21	PROUK1	Professional Owner	UK	CEO of social housing organisation
22	PRIPL1	Private Owner	Poland	Building owner
23	PRISE1	Private Owner	Sweden	Building owner
24	PRIUK1	Private Owner	UK	Owning a flat in a listed building
25	PRIUK2	Private Owner	UK	Owning a flat in a listed building

Table 1. Overview of interviewees located in the four demo countries

1.3.Practitioner Forms Methodology

Practitioners, those construction professionals directly involved in retrofit projects of historic buildings (e.g. architects), were asked to fill a specific ‘practitioner form’ in when they took part in the in-depth structured interviews.

The form aimed to list the guidelines/standards and tools (e.g. software) used by practitioners for each of the main “steps” of any retrofit project – considering the pre-design, design and post construction phases. 7 “steps” were identified before the interview process by project partners involved in Work Package 1 based on the “assessment categories” from the European guidelines for improving the energy performance of historic buildings EN 16883. These 7 “steps” represent the most important technical/practical aspects or considerations associated with the energy retrofit of historic buildings:

- Heritage value assessment
- Assessment of the use of the building

- Condition survey and technical documentation
- Energy performance assessment
- Indoor environmental assessment
- Economic viability (e.g. Life cycle costing)
- Environmental impact (e.g. Life cycle assessment, waste)

It is important to note that the "steps" are not necessary implemented sequentially; some can be implemented in parallel during the retrofit process.

Respondents were also asked to indicate when these guidelines/standards and tools were used in the retrofit process - when the "step" was meant to take place - and what the related advantages and disadvantages ("pros and cons") were when using them.

The template of the practitioner form can be found in *Annex 4*. The table below indicates the number of interviews with/forms filled in by practitioners across the four demonstration site countries:

	Spain	Poland	Sweden	UK	Total
No. interviews	4	2	1	1	8
No. forms filled in	3	1	1	1	6

Table 2. Number of interviews of practitioners and forms filled in per country

Data from all the forms was compiled in one Excel spreadsheet to form a dataset. This enabled the proper analysis of this data: comparing responses, identifying and compiling similarities and divergences and identifying main trends. Key findings were produced as a result of this analysis, for each "step" and the overall retrofit process – to understand more generally what works or does not work for practitioners in terms of guidelines/standards and tools used to support the retrofit process for historic buildings. Data collected will provide inputs to WP4 and help inform the development of FuturHist's approach to retrofitting historic and the associated toolkit.

2. Data Analysis – Key Findings

2.1. Survey and Interviews

The results provide a clear picture of the barriers and challenges faced by European professionals in energy retrofitting of historic buildings. Survey responses and perspectives were wide and varied, with 148 respondents from 25 countries, but noticeably, several concerns and frustrations were repeatedly recorded across the results.

2.1.1. Demographics

Regional Demographics

Survey responses were received from individuals from 25 European countries [see *Figure 1*]. While significant gaps still remain, the survey results represent a broad geographical spectrum across the continent. The wide variety of countries represented enables the identification of trends based not only on individual countries of origin, but across wider regions. A few responses were also received from outside Europe; three from the United States of America, two from Canada, one from Argentina, and one respondent in South Africa but working in Ireland. As the scope of the project is limited to Europe, these responses, with the exception of the respondent working in Ireland, were not taken into consideration in the final data analysis.



Figure 1 Countries represented in the survey

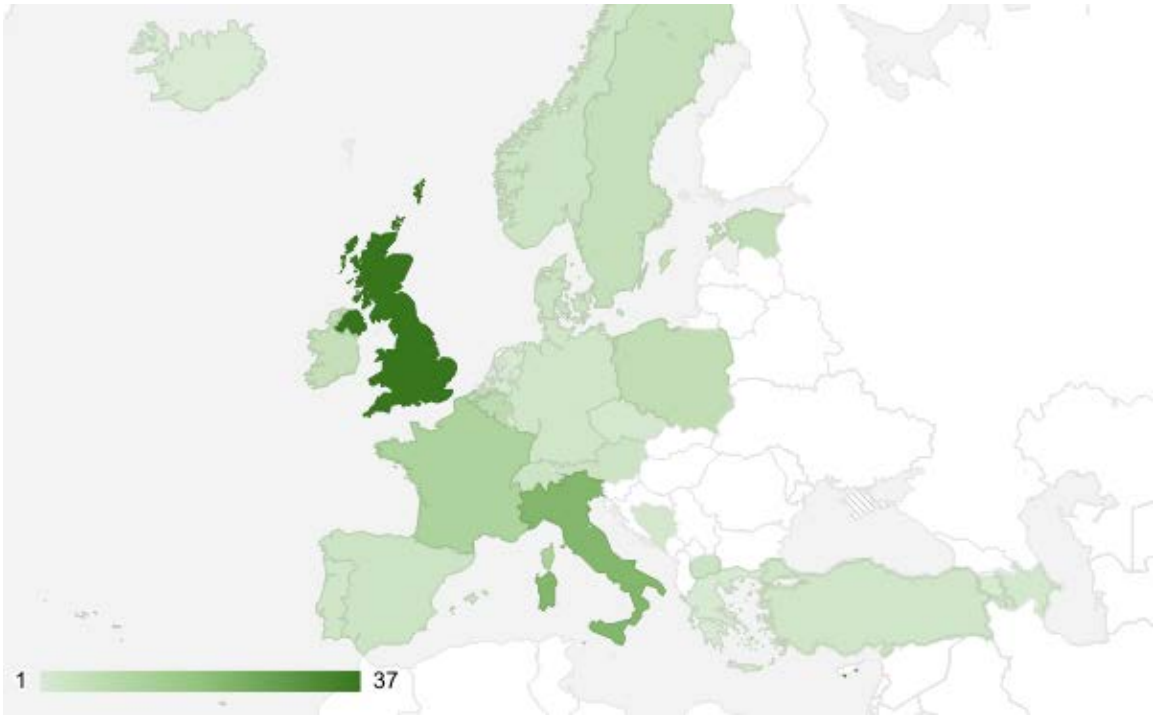


Figure 2 Location of respondents

A significant percentage of respondents are from a small number of countries; the United Kingdom is the most represented country with 37 respondents, followed by Italy with 22 [see *Figure 2*]. However, the majority of countries listed have responses from multiple individuals, while a small number of countries are represented by only 1 or 2 respondents each. In most cases, responses are dispersed evenly across the majority of countries. [see *Figure 2a*].

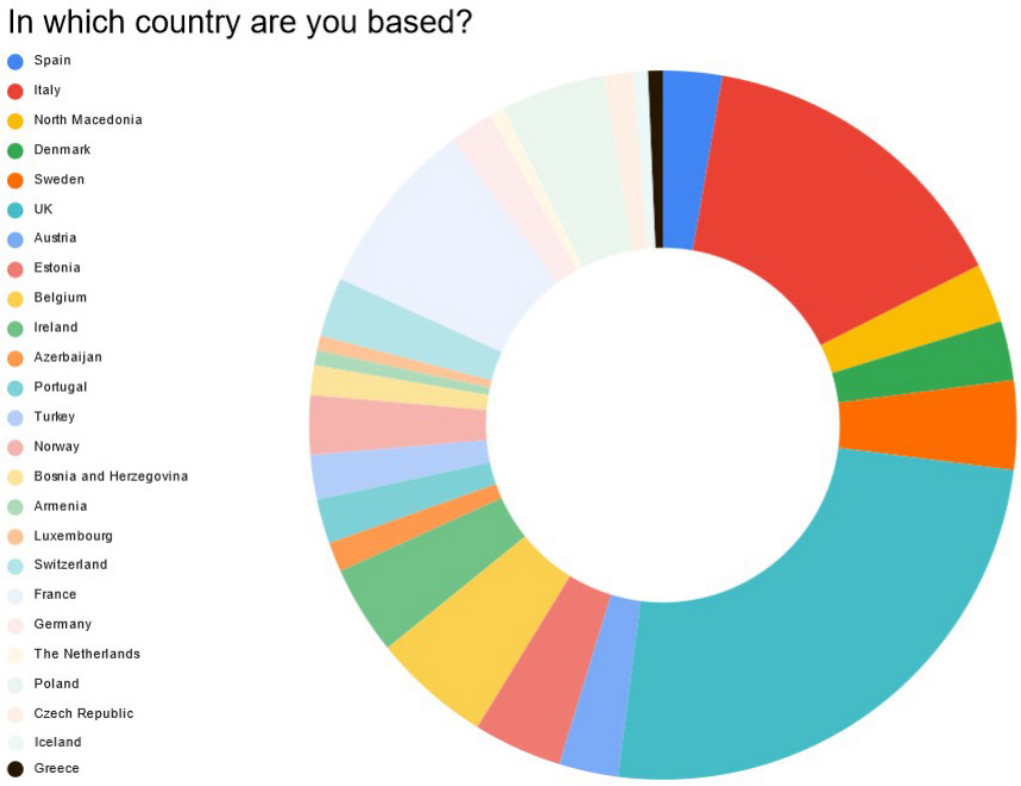


Figure 2a Respondents by country

Taking into account the number of responses and their geographical distribution, it is possible to categorize responses by region or sub-region. For the purpose of this document, three regional categories are established: Northern Europe (64 respondents), Central Europe (42 respondents), and Southern Europe (42 respondents) [see *Figure 3*]. While these three groupings may seem to incorporate countries with very different cultural or historical contexts, the primary focus is on shared climactic conditions, typologies, and needs in retrofitting buildings for improved energy efficiency. From the demo case countries, there were 37 respondents from the UK, seven from Poland, six from Sweden, and four from Spain. Together, these results represent roughly 36% of total respondents, thus it is clear that respondents were not limited to the case study countries alone, but in fact the majority are from other countries, offering a much wider view of the current situation across the continent.

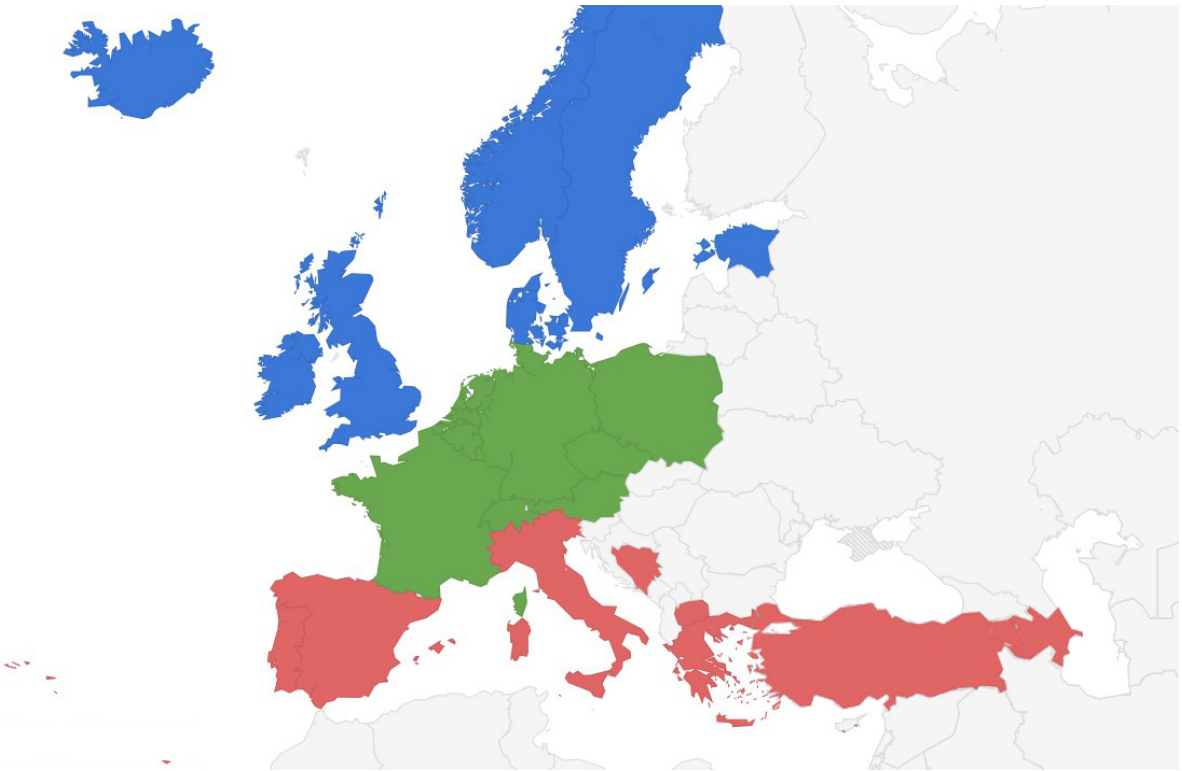


Figure 3 Geographical regions

Greater specificity and more distinct regional groupings can potentially be made at a later stage with increased inputs. However, due to the limited number of responses from certain countries, a higher number of groups with fewer countries in each would not be practical at this stage, nor would it assist in visualizing or understanding the data collected.

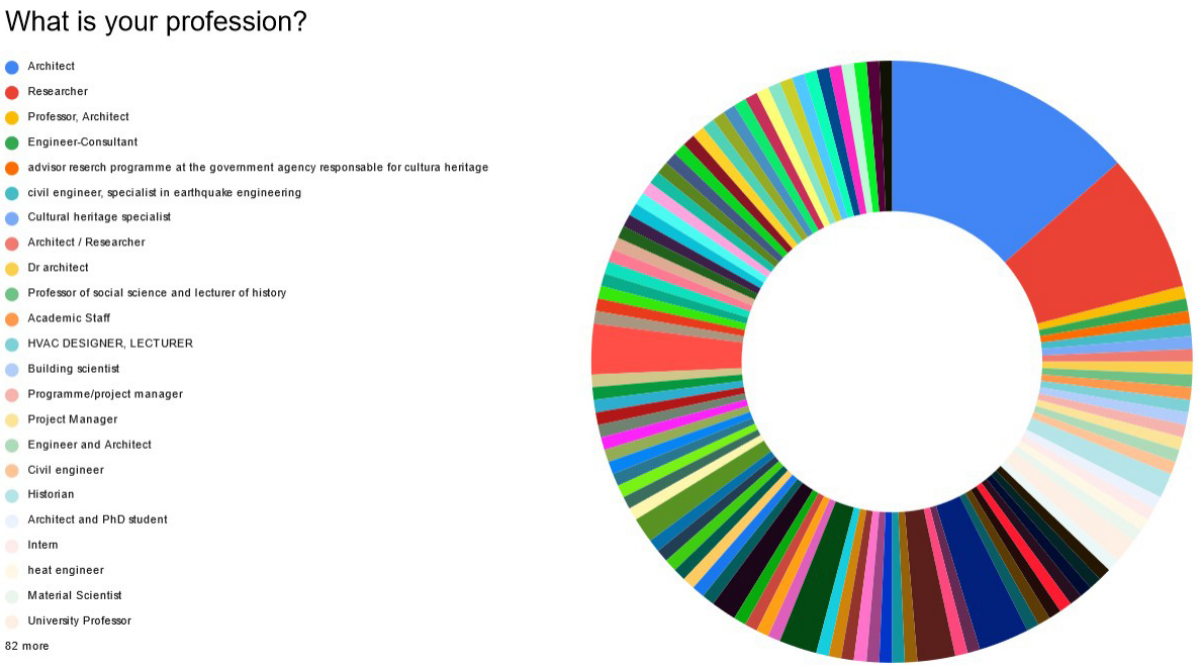


Figure 4 A breakdown of every profession recorded.

The graphic is intended for illustrative purposes only, showing the diversity of professions among respondents. For the complete list of careers, please consult the accompanying anonymised survey [Annex 2].

Professional Demographics

Survey respondents were asked to state their profession. By its open-ended nature, the question "What is your profession?" unsurprisingly resulted in a wide variety of answers, with only a few given answers having been repeated [see *figure 4*]. The most notable examples of this are "architect", "researcher", and "engineer." Using these answers, survey respondents were grouped into six professional profiles: Architecture and Design; Academia and Research; Engineering, Construction, and Field Practitioners; Site or Project Management; and Other. The professional profiles of survey respondents are wide and varied. The results are reflective of the diverse careers involved in the complexities of energy retrofitting of historic buildings. Survey respondents have experience in theoretical research, hands-on site construction, policy and decision making, ownership of historic buildings, and many other things.

	Survey	Interviews
Practitioners	71	9
Owners	8	7
Public Authorities	19	9
Academia	46	0
N/A	4	0

Table 3. Number of respondents from each stakeholder group for the survey and for the interviews

The respondents were also categorised into three major stakeholder groups: Practitioners, Owners and Public Authorities. As there were also a substantial number of respondents from academic backgrounds, a fourth group of "academia" was added. It is important to bear in

mind that it is frequently possible for professionals working in the sector to be categorised as belonging to multiple stakeholder groups. For example, a university professor that has a professional practice as an architect, and is simultaneously the owner of an historic building.

Professional Memberships

The overwhelming majority of survey respondents are not currently members of FuturHist [see *Table 4*]. This suggests that the survey reached professionals not previously engaged with FuturHist research efforts and projects. It also suggests that the responses are from a broader range of professionals than have been previously contacted in FuturHist efforts. Membership of ICOMOS was better represented in responses when compared to FuturHist memberships [see *Table 4*]. Nevertheless, a significant majority (roughly 69%) of survey respondents are not current members of ICOMOS either. Taken together, these two facts suggest that the survey reached new audiences and the opinions expressed by respondents are representative of a wide range of professionals. Even if the professional networks of the two organisations were used in distribution, the majority of respondents come from outside the membership body of each.

	Yes	No
Are you a member of FuturHist?	16 (10.8%)	132 (89.2%)
Are you a member of ICOMOS?	46 (31.1%)	102 (68.9%)

Table 4. FuturHist and ICOMOS memberships

2.1.2. Identification of Main Barriers

There is no well-established taxonomy of barriers for energy retrofit of historic buildings. Instead of eliciting opinions about a predetermined set of barrier categories, the study has used an inductive approach with the aim to establish the most important barriers and categories. Using predetermined categories (e.g. economic barriers, regulatory barriers etc) could point respondents in a certain direction, leading to biased results. Therefore, we used the open question "What do you think are the main barriers to making historic buildings more energy efficient?" This question was used both in the survey and the interviews, generating a rich dataset. Follow-up questions based on predetermined categories were used in the interviews in order to get comprehensive answers.

The main question of the survey *"What do you think are the main barriers to making historic buildings more energy efficient?"* allowed respondents to voice their professional opinions regarding the current state of affairs regarding retrofit of historic buildings. The question was intentionally broad in order to not introduce bias (e.g. by presenting a predetermined categorisation of barriers). The same question was also used for all the interviews and the interview answers have complemented the survey results.

There was a possibility for respondents to answer with multiple barriers. One can assume that those answering with more than one barrier would put them in descending order of priority, but this has not been analyzed. All mentioned barriers have been assigned equal weight. The

answers were labelled and put into categories. Categorisation was made with an inductive approach based on the content of the individual barrier labels. In total there were 260 single barriers grouped into six categories. Seven additional answers were not included in the categorization as they were assessed as non-applicable.

Overall barrier categorization

Across all stakeholder groups, professional profiles and regions there was a general consensus that a number of elements or conditions are lacking. Respondents frequently mentioned the lack of public support, awareness, funding, understanding and experience, time, adequate materials and products, and skilled and trained craftspeople. The financial and regulatory barriers are dominating, but the variety of identified barriers is quite large. It is also the case that many barriers, also across categories, are intertwined. This shows the complexity of the task and the many facets of the renovation process.

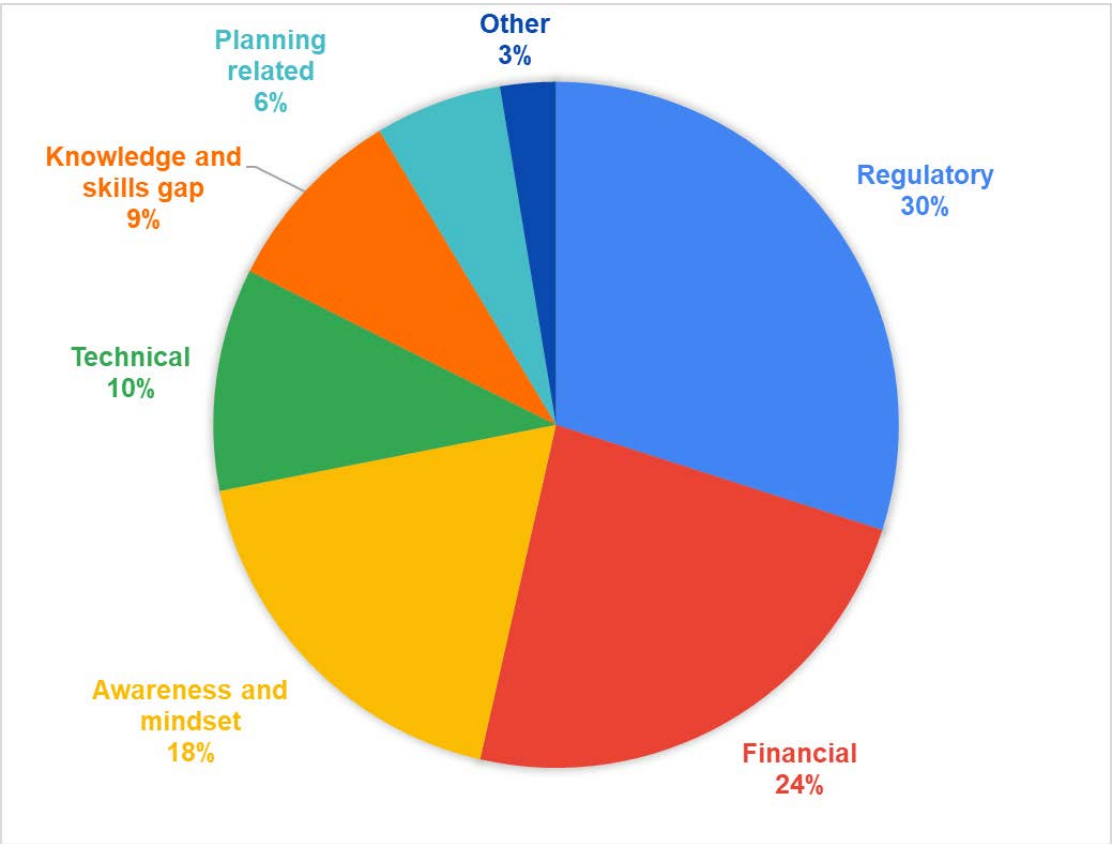


Figure 5. Overall barrier categorization, 260 answers to the question "What do you think are the main barriers to making historic buildings more energy efficient?" were categorised into six barrier categories.

Figure 5 shows the six barrier categories that were identified based on a total of 260 answers to the question "What do you think are the main barriers to making historic buildings more energy efficient?" There is an overlap between barrier categories and it is not always easy to identify if a barrier belongs to a certain category or not.

Financial and regulatory barriers were the most frequent ones, followed by awareness and mindset, technical barriers, knowledge and skills gap, and finally planning related barriers. 3 %

of the barriers could not be categorized.

A Scottish architect working as a retrofit designer (PRAUK1) gives some insight in how barriers can be connected. This architect suggests that conservation restrictions on most listed buildings prohibits external façade insulation and goes on to discuss how internal insulation is a viable alternative (mentioning that technical pitfalls have to be considered). Furthermore, the added insulation takes up valuable dwelling space. Another option discussed to decarbonise buildings is the installation of heat pumps, but here there are challenges related to the heating infrastructure and the process of transitioning to a communal heating system. Clients, according to the experience of this practitioner, prefer individual heating systems, and it is difficult to coordinate when there are many owners. Also, less affluent groups can have difficulties accommodating the cost of a heat pump. This practitioner's experience shows that it is difficult to point out a single barrier as most important, but there is a mix of factors depending not only on the building construction or conservation protection, but also on ownership and communal infrastructure.

"It's slightly trickier thing with social housing, where I think that it all [installing heat pumps] works quite nicely for people who can afford to pay for their heat. But we work a lot with social housing. That's a kind of different landscape where you've got people who are choosing between heating and eating /.../ But we can't push the fabric too hard, because otherwise we're encroaching people's dwelling space. But also the client doesn't want communal heating system. They want individual heating systems" (PRAUK1)

Regulatory barriers

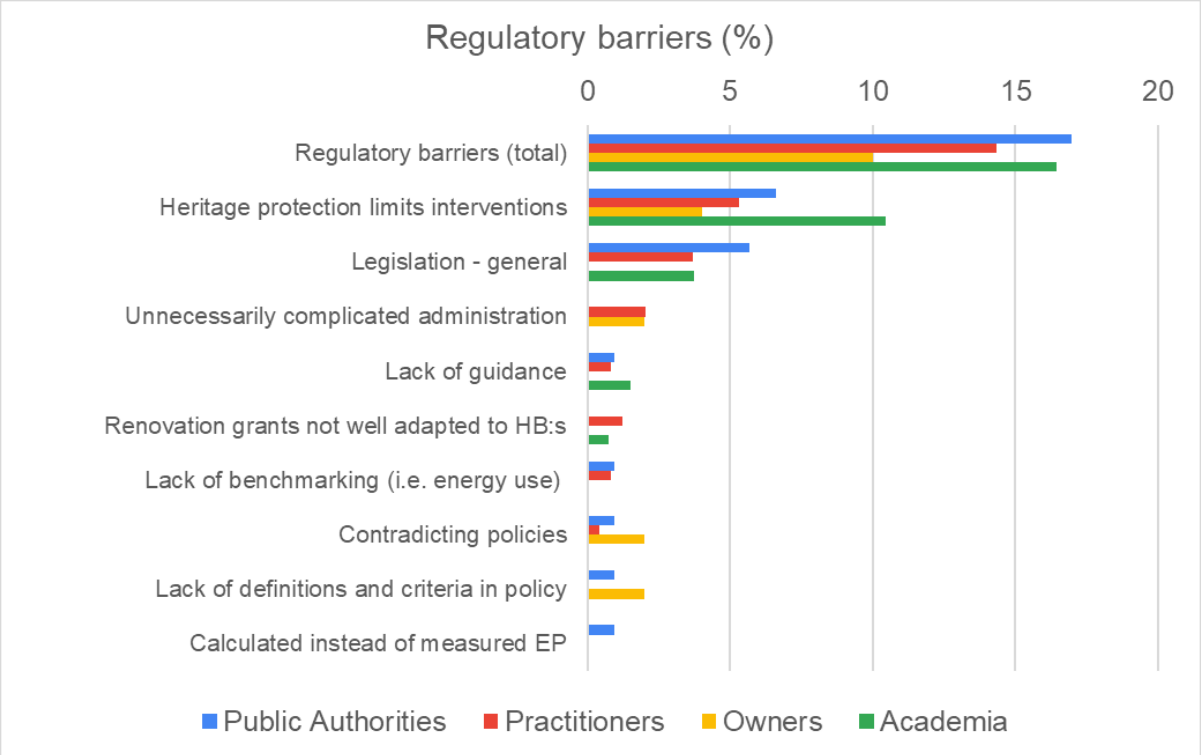


Figure 6. Regulatory barriers vs. Stakeholder group

Policy and regulatory barriers are the most frequently referenced, see figure 6. The most

common one is that heritage protection limits intervention. One could ask if this should be considered a barrier at all, as it is a legal condition. However, other barriers mentioned give hints: “Unnecessarily complicated administrative processes”, “Contradicting policies”, “Lack of definition and criteria in policy”, “Too strict enforcing of heritage protection”, “Hesitation of conservation professionals.” These all point to there being something problematic with policies and their application which is not a criticism of heritage protection policy per se, but of its design and application.

Some interviewees were frustrated with the ambiguity related to planning permission, the slow process to get permission, and the dissonance from policymakers:

“what you can and can't do with these properties and what I guess you do need planning permission for and what you don't need planning permission for it. It it's not immediately transparent. And sometimes you've got to go through an engagement process with local authorities to unpick what's going to be acceptable. Which takes time. We're trying to accelerate everything. How do we shortcut that? I think that's an interesting question. Good guidance, clear guidance. If it's already there, it just needs to be put out there a bit more.” (PRAUK1)

“dissonance between the government saying there is a climate emergency and you've got to do something about it, and the constraints of planning regulation.” (PROUK1)

A more detailed discussion of policies in relation to energy retrofit of historic buildings can be found in deliverable 1.3 from the FuturHist project.

Another common concern voiced across regions and professional sectors is that current policy and regulations do not adequately take into consideration the unique nature and characteristics of historic buildings. Legislation was frequently cited as a barrier rather than an aid to initiatives. To date, building legislation and regulations in individual European nation-states have focused on the construction of new structures and buildings. Historical building stock or conversions are not considered, leading to an objective that can often only be realised through major interventions in the substance. Historic building structures and their qualities are ignored.

Rather, there are separate laws or guidelines for the area of historic buildings, which refer to target values (energy-efficient refurbishment or corresponding specifications for U-values), but these are structured in such a way that they take into account the special qualifications and possibilities of a historic building typology.

While the current situation of legislation and policy is more directly covered and analysed in task 1.3, the main value presented in the survey results in regard to policy is the opportunity to build a picture of public opinion on the subject. While the answers respondents gave may not be factual, with misunderstandings, misinterpretations, and even ignorance of the actual policies in place, they do represent the professional opinions of those working in the field. Responses It is important to recognize this distinction; respondents’ answers offer insight into commonly held opinions relating to policy and legislation that can often differ greatly from the actual policies themselves.

Financial barriers

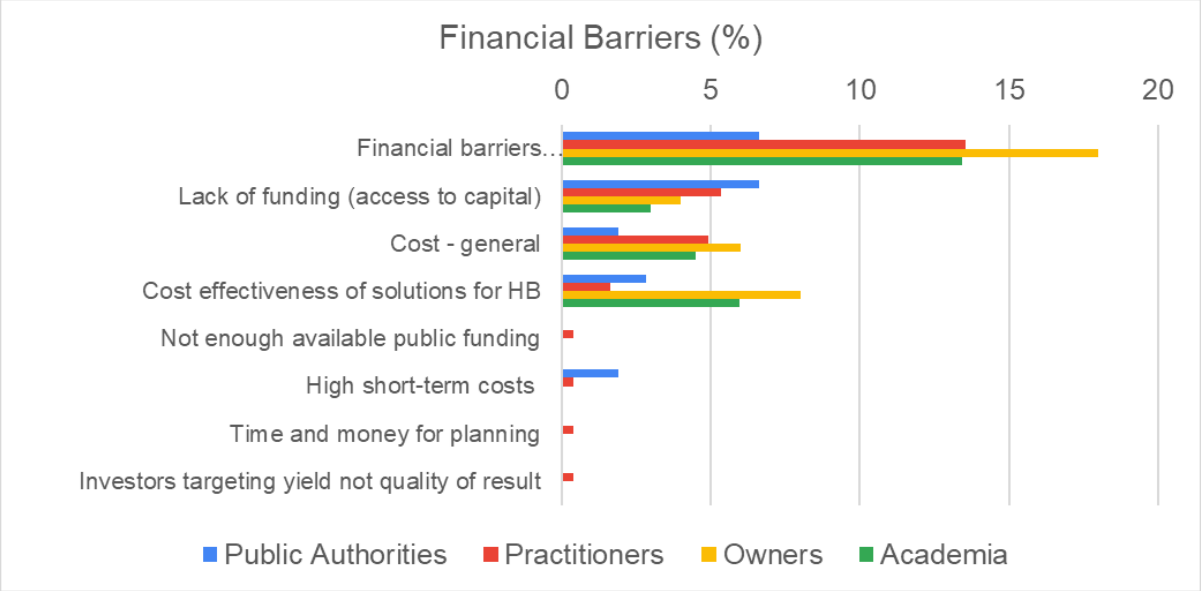


Figure 7. Financial barriers vs. Stakeholder group

Financial barriers are the second most frequently referenced category [see *Figure 7*]. Concern was repeatedly stated in both the survey and interviews that a focus on short term investment costs of energy retrofits along with renovations was acting as a serious deterrent to building owners to take action, even if the retrofits would result in long term savings further down the line.

Respondents were asked a series of questions related to funding; whether funding was available for listed buildings, non-listed buildings, whether funding was available for maintenance and for repairs. When interpreting the responses, it is important to note that while respondents may state no funding is available, it is possible that individual respondents are simply not aware of available funding options and initiatives in their areas. If this is the case, this situation itself raises another concern: if funding is available, but the relevant professionals and building owners are not made aware of it properly, efficient use of funding could be severely hindered. In short, not only should funding be made available, but distributors of this funding (whether public or private) should make efforts to ensure the relevant potential recipients of funding are aware of their options.

With this in mind, a review of respondents' answers shows that funding options and awareness of these options varies by profession and region. In Northern Europe, architects, engineers and field practitioners were more aware of funding options than other professional profiles in the region. In Central Europe, there were far more respondents aware of funding options and describing them in some detail. It is likely that in this region funding options are more numerous, or awareness of options is greater or a combination of the two. Significantly, in Southern Europe, there is less awareness of funding options. There were far more responses along the lines of "I don't know" or "I am not aware" than a more emphatic "no." This level of uncertainty suggests that whatever funding options are available are not being communicated properly to professionals in the region. Respondents' answers are more representative of

public opinion than the actual situation. An expression of ignorance of funding availability does not mean the funding does not exist.

In the interviews it is stated that cost effective, standard solutions are impossible to use either because of heritage protection or because of technical compatibility (or both). A private owner in Scotland rates high costs as the biggest barrier, giving the example of replacing windows with replicas as a very costly option – but the only one that would be allowed by the conservation authorities.

"There are technical solutions within the regulations, but they are just very expensive." (PRIUK1)

Interview answers from a practitioner respondent and a public authority respondent shed light on what can be hidden behind the barrier "cost" that was a frequent answer in the survey. Their answers show that there is an interplay between a lack of economies of scale, lack of access to capital, and grant schemes that don't take into account the renovations of historic buildings:

"And at the moment, we're sort of in the early adopter stage. It's quite additionally expensive. So there's a premium. You know, if you were to go and do this, there would be there's a premium on your expenditure. Because these things tend to be not necessarily bespoke, but there aren't the economies of scale yet that drives down the cost of these innovative solutions. And so I think that is prohibiting or at least limiting organisations, institutions and individuals from attempting retrofit of their buildings." (PROUK1)

"...current grant funding is also potentially a bit of a straitjacket for certain property owners. You can get a grant for doing a suite of measures, but if you're wanting to take a whole building approach and you can't do the windows as part of that suite of measures, that's a blocker. /.../ I just can't help but feel like if there's going to be money made available for a project, it should just be made available for a project to do all of the stuff that needs to be done on that project. /.../ it should be flexible based on the onus of the design team and the client and what's right for the project." (PRAUK1)

The cost-effectiveness of energy retrofit measures was discussed by several of the Polish respondents. One practitioner had concerns that there are weak incentives for home owners and that they think it is too costly.

"People are reluctant to retrofit HBs because they think it is very costly. Retrofits themselves are perceived as something positive, but the costs, especially shock costs, are a major barrier." (PRAPL2)

The answer from one professional owner shows that interpreting cost as a barrier can be misleading, as he/she specifically refers to a lack of cost-effective solutions and that thermal retrofits are economically sound from the outset:

"Technology is a major obstacle, as in HBs it is not possible to use standard, cheap solutions. The lack of cost-effective, proven solutions that would be acceptable to conservation services is a major obstacle. /.../ I do not think there are any economic barriers as thermal retrofits are economically sound. /.../ There are not enough funds to sufficiently retrofit buildings." (PROPL2)

Also adding to the ambiguity in how answers could be interpreted is the answer from a Spanish interviewee:

"My experience is that we have funding available, but we are not able to manage it because we lack staff or we lack training in the field. For instance, there is a kind of caution not to get involved in a project with European funding. So I honestly believe that right now the problem is not one of financial availability." (PUBES1)

Awareness and mindset

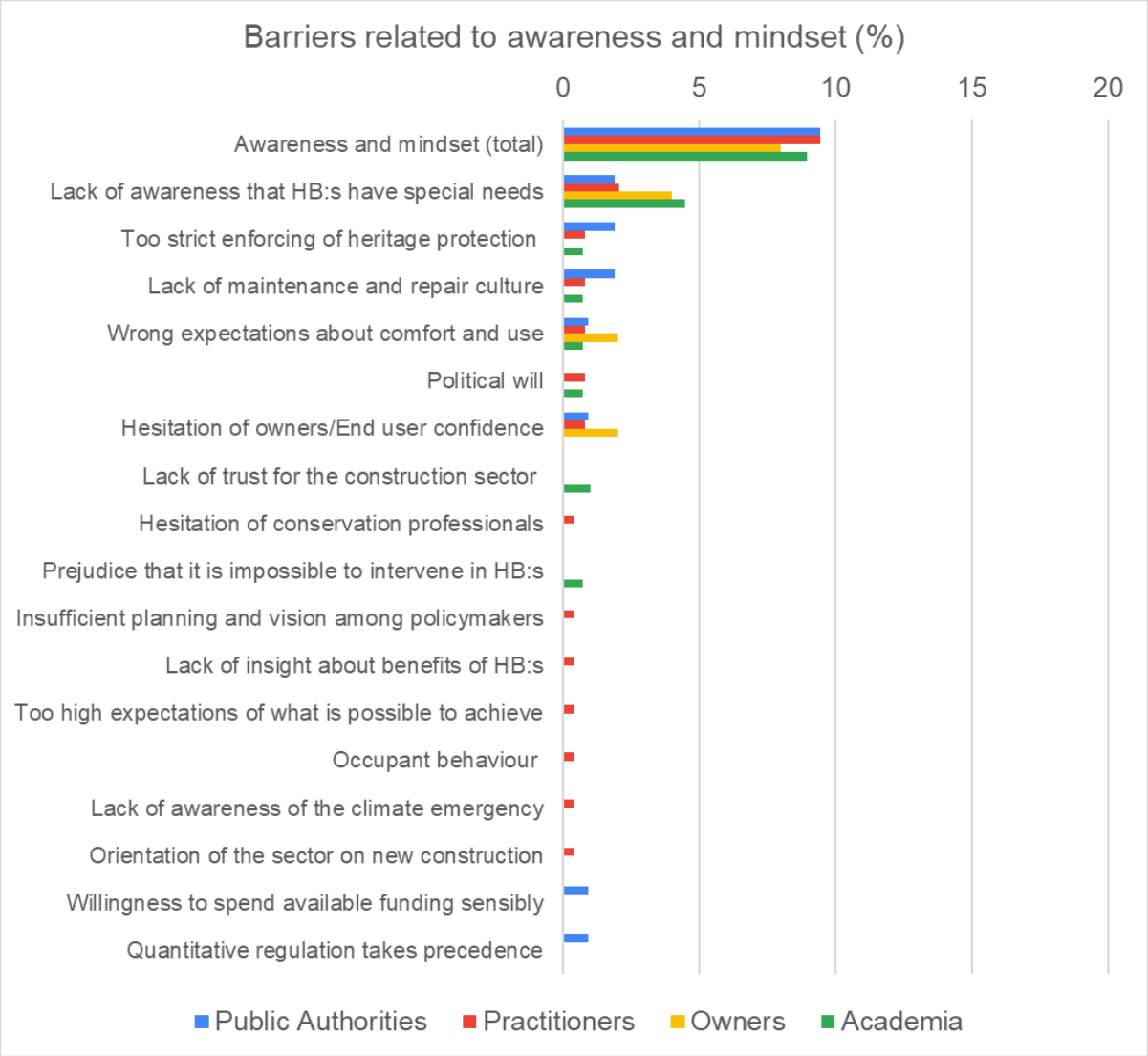


Figure 8. Barriers related to awareness and mindset vs. Stakeholder group

Figure 8 shows the different barriers categorized as "awareness and mindset". This category includes barriers originating in the lack of awareness of both individuals and organisations. The most common one, across stakeholder groups, is the lack of awareness about the special needs of historic buildings, i.e. that both professionals and owners are unaware that historic buildings need special treatment because of their technical construction and/or heritage significance. The category covers barriers related to awareness and mindset of different stakeholder groups, but also more overarching ones such as "orientation of sector on new construction".

Technical barriers

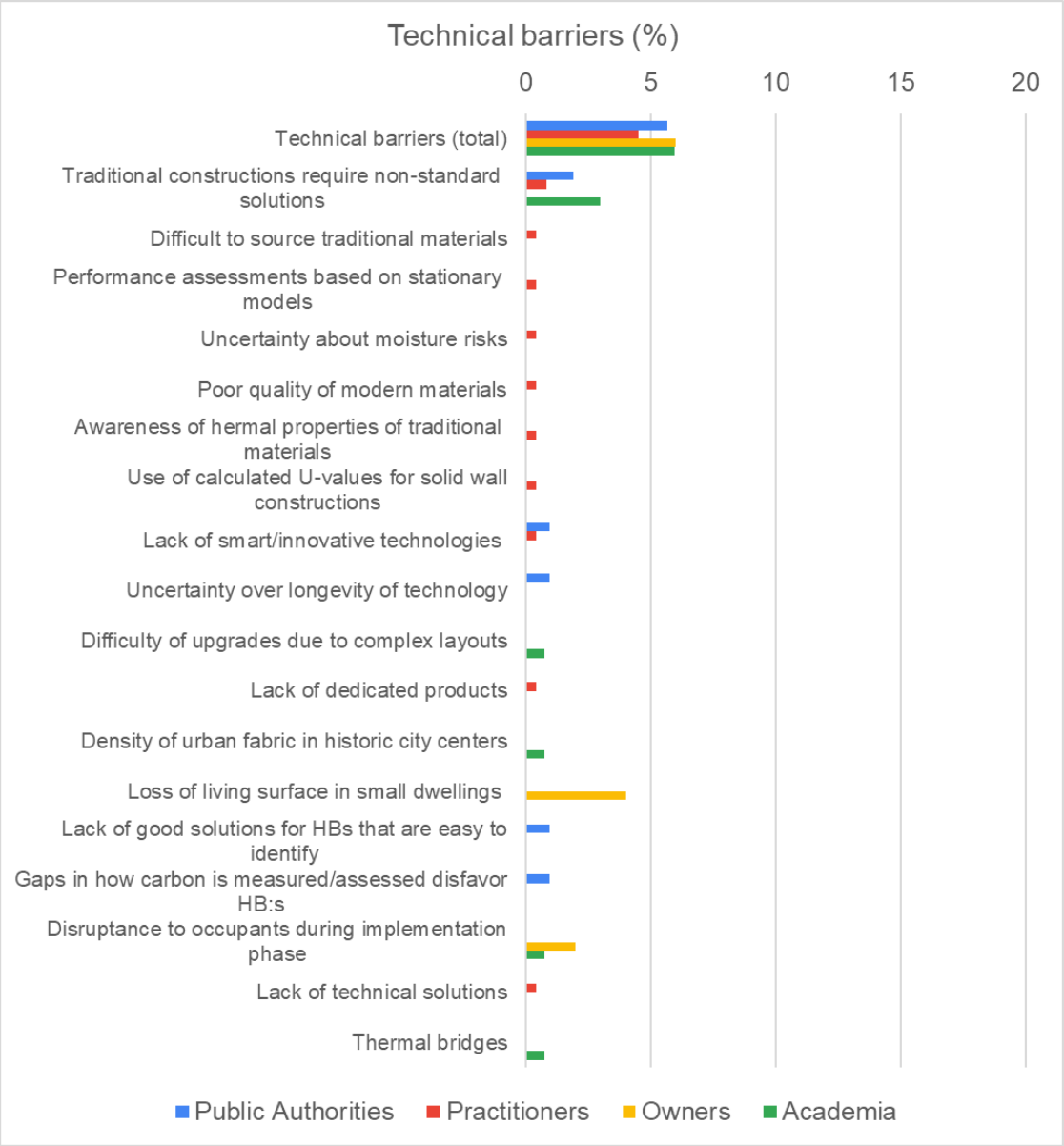


Figure 9. Technical barriers vs. Stakeholder group

The technical barriers are shown in figure 9. The most common technical barrier for all stakeholder groups except owners is "Traditional constructions require non-standard solutions". This might not be a barrier by itself; more a matter of fact. However, interview answers hint that there is a perceived potential for the development of innovative, robust and cost-effective solutions also for traditional constructions, but that this potential is not realised due to a focus of the construction sector on new construction, and a lack of expertise of the building physics of traditional buildings:

"I do not see any technical barriers arising from technology itself. There are certain barriers that stem from a historical building's specificity in terms of building physics. For instance, a 19th century fort, which is damp and cold and has immense thermal mass that makes it difficult to heat and thus difficult to retrofit. Current technologies are at their core designed with new buildings in mind, and historical buildings are sometimes too different from them. From this standpoint, I believe building physics expertise is a key obstacle." (PRAPL2)

Two technical barriers were emphasized by building owners: "Loss of living surface in small dwellings" (due to insulation, boiler space etc), and "Disruptance to occupants during the implementation phase". These barriers can be quite important from a building owner's perspective but are likely rarely in focus for other professional groups.

Knowledge and skills gap



Figure 10. Barriers related to knowledge and skills gap vs. Stakeholder group

The Swedish National heritage board conducted a study in 2010 with practitioners in the heritage sector to map the need for knowledge about energy efficiency in historic buildings. Not surprisingly, all respondents called for more knowledge. However when exemplifying this, they all pointed to a lack of availability of existing knowledge. They asked for streamlined accessible information, knowledge repositories, forums, independent consultants, handbooks, good examples, seminars etc. (Altahr-Cederberg et al. 2010). A recent UK study came to a similar result that the problem (of making historic buildings more energy efficient) was not a lack of knowledge, but a lack of knowledge utilization: "the main hurdle seemed to be disseminating this [expertise] more widely." (Marie Stuart 2014, p. 190).

Respondents were asked if they were aware of a "best practice database for energy retrofit of historic buildings." Apart from individual highly localized or regional examples like DuMo-Prestatiekaart in the Netherlands, or Historic Scotland within the UK, respondents typically gave one of two answers: either that they were not aware of any, or they gave the example of the Historic Building Energy Retrofit Atlas (HiBERatlas). Apart from this example, there was no other single centralized database referenced. A few respondents referenced databases that are no longer current, active, or even accessible, like Periscope. Interestingly, judging by the survey responses, the HiBERatlas is proportionally better known in Central and Southern Europe compared to Northern Europe.

Planning related

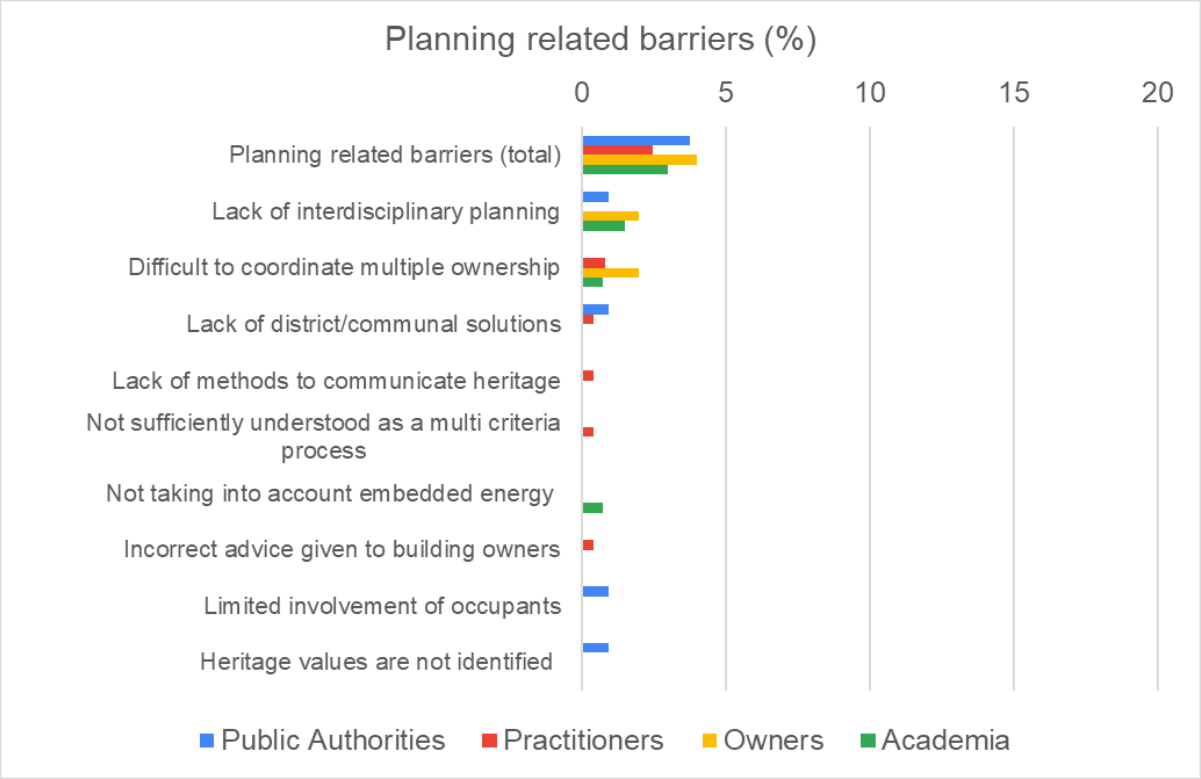


Figure 11. Planning related barriers Observations by Stakeholder Group

Planning related barriers are shown in figure 11. Also in this category there is a rather wide spread of barriers, some related to the process (e.g. "Lack of interdisciplinary planning"), and some related to the lack of focus on specific aspects (e.g. "Heritage values are not identified", "Not taking into account embedded energy"). Notably, the owner group identified "Difficult to coordinate multiple ownership" as a common barrier.

2.1.3. Observations by Region

While concerns about the shortcomings of policy and legislation were universally voiced in some form, this particular concern was especially emphasized by respondents in Northern Europe in the open form text questions of the survey. They were far more likely to identify policy and legislation as a principal barrier to retrofitting of historic buildings. Policies designed

for new construction being poorly adapted to historic buildings, and a lack of knowledge and understanding of the specific needs of historic buildings were frequently referenced. However, for the Likert-scale question “Do policies regarding renovation of historic buildings support the planning of energy retrofits in an effective way?” negative responses (answers of 1 or 2 on the 1-5 scale) across the regions were more evenly distributed. 51.6% of respondents in Northern Europe answered in the negative, compared to 57.1% in Central Europe and 66.7% in Southern Europe. This shows a discrepancy between the qualitative and quantitative format answers that was further explored in the structured interviews.

Conversely, in Southern Europe, especially in Italy, there was a noticeable focus on issues of aesthetics and a perceived reluctance and fear from policy and decision makers to allow for retrofits that might jeopardize the aesthetic qualities of a historic building. These frustrations were not voiced by the public authorities themselves, but rather by those in the architectural, engineering and field practitioner sectors. In their statements, respondents suggested that these concerns stem from a misunderstanding among policymakers that retrofitting threatens the historic and cultural value of building and that all retrofits inherently lessen the authenticity of historic buildings. Respondents also suggested that greater awareness and understanding was required to correct these misconceptions.

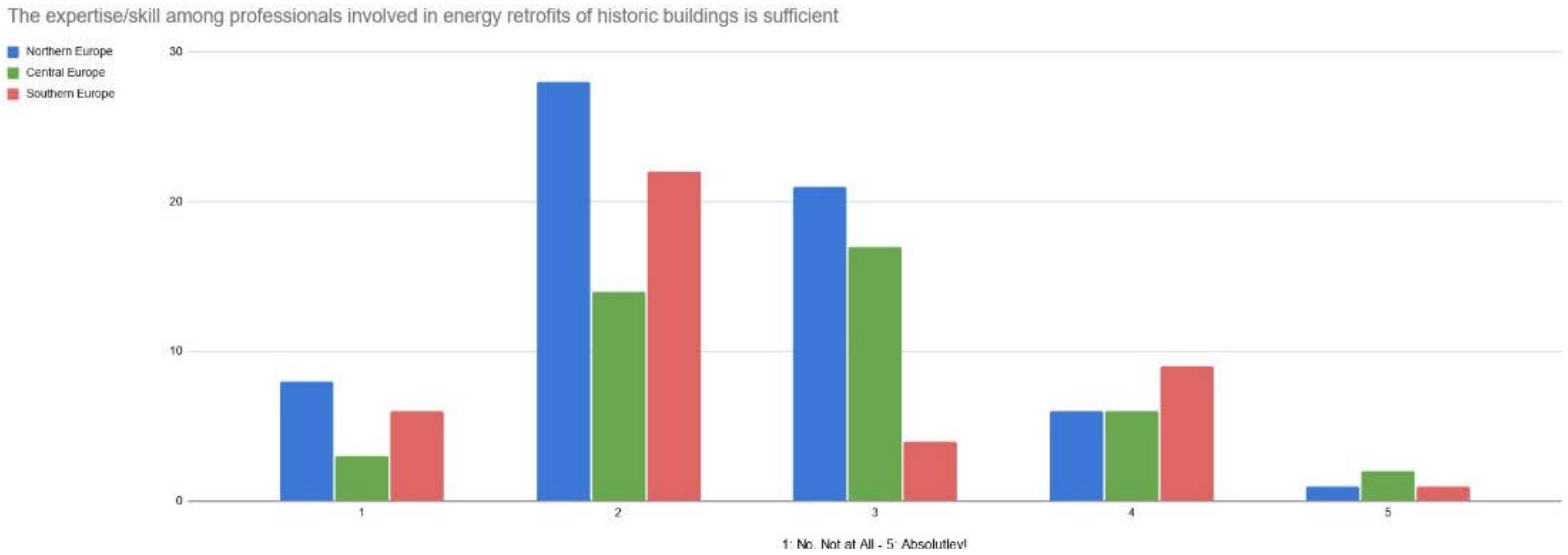


Figure 12. Expertise/skill among professionals per region

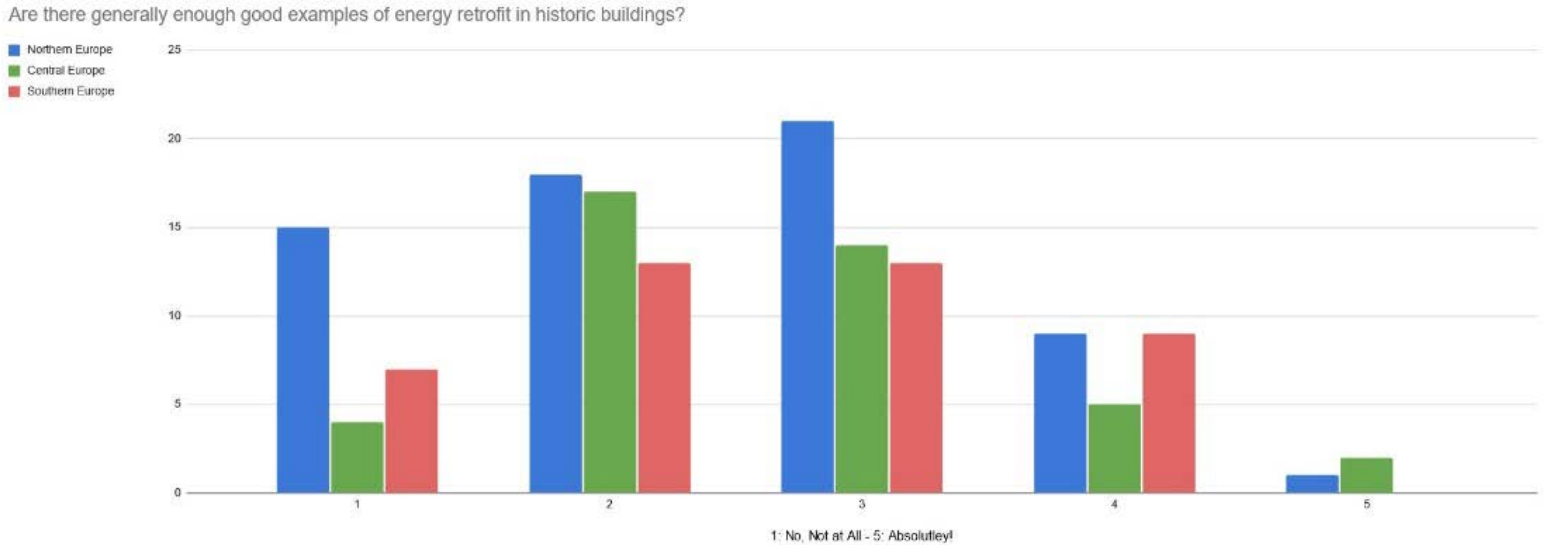


Figure 13. Access to enough good examples per region

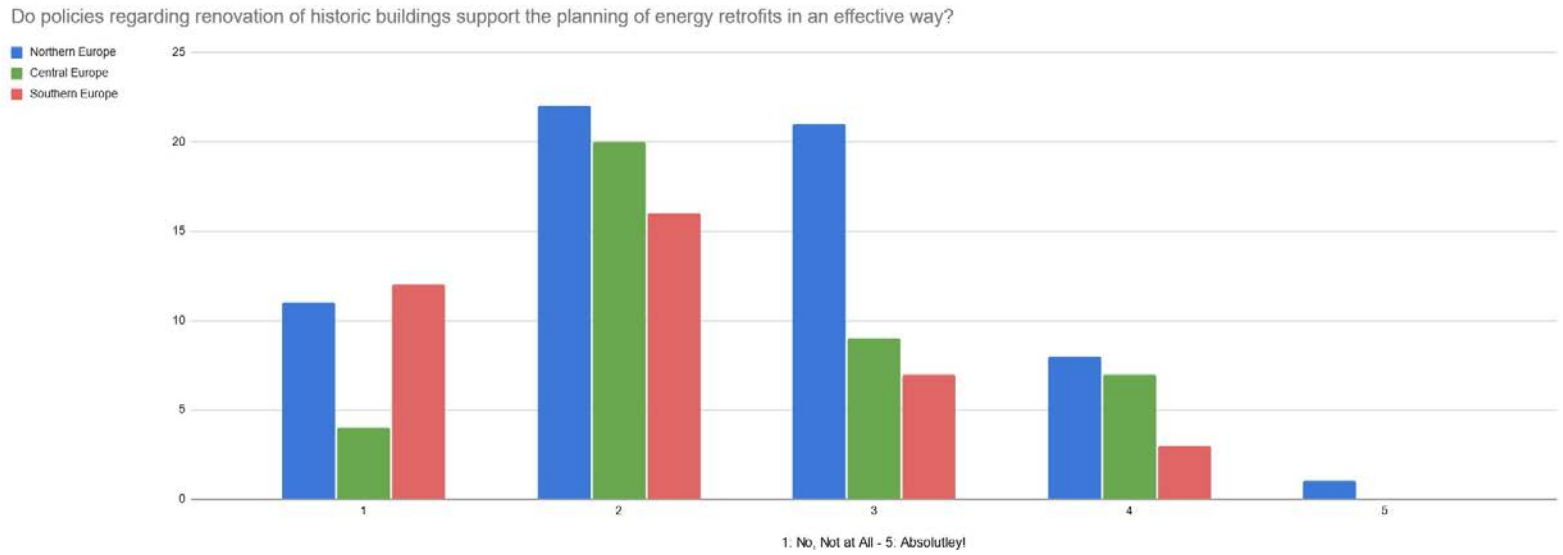


Figure 14. supporting policies per region

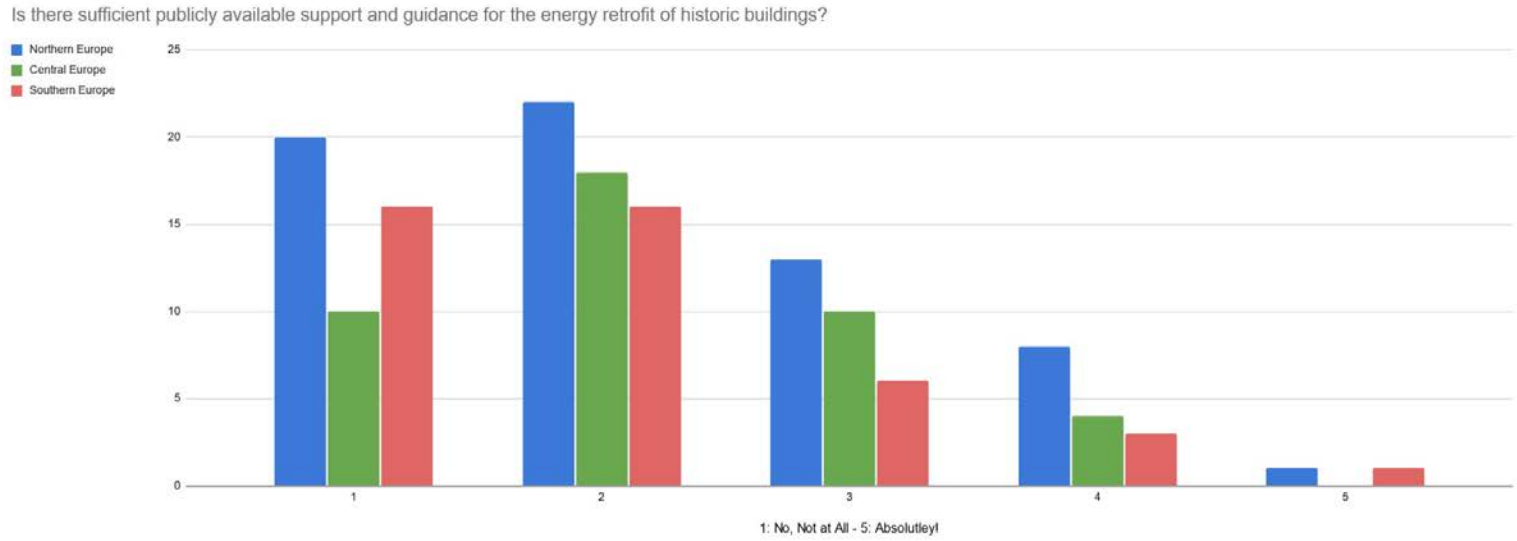


Figure 15. Access to publicly available support and guidance per region

2.1.4. Observations by Professional Profile

What is very clear when reviewing answers from respondents with different professional backgrounds is that each respondent approaches the subject differently based on their profession. As it may be expected, respondents working in academia and research were more likely to focus on theoretical issues, policy decisions, and overall approaches to retrofitting historic buildings. Engineers and field practitioners focused more on details such as thermal barriers, thermal bridges, suitable window and door replacements, and specific issues directly relating to individual building projects. Professionals working in academia and to a lesser degree architecture are more aware of good examples and precedents of energy retrofits in historic buildings. Architecture professionals especially, and to a lesser extent engineers and field practitioners voiced concerns that policy and legislation can act as a barrier. Public authorities however are more divided on this matter. These differences also highlight the multidisciplinarity and the great variety of professional profiles engaged in energy retrofits and management of historic buildings.

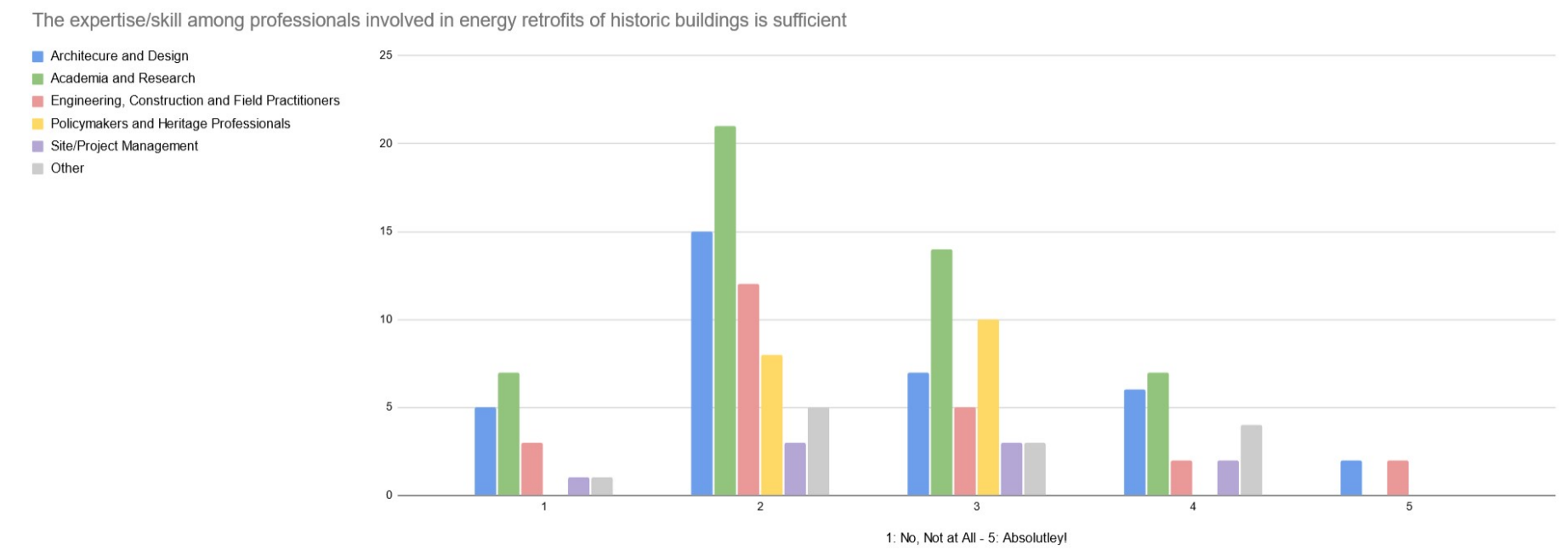


Figure 16. Expertise/skill among professionals

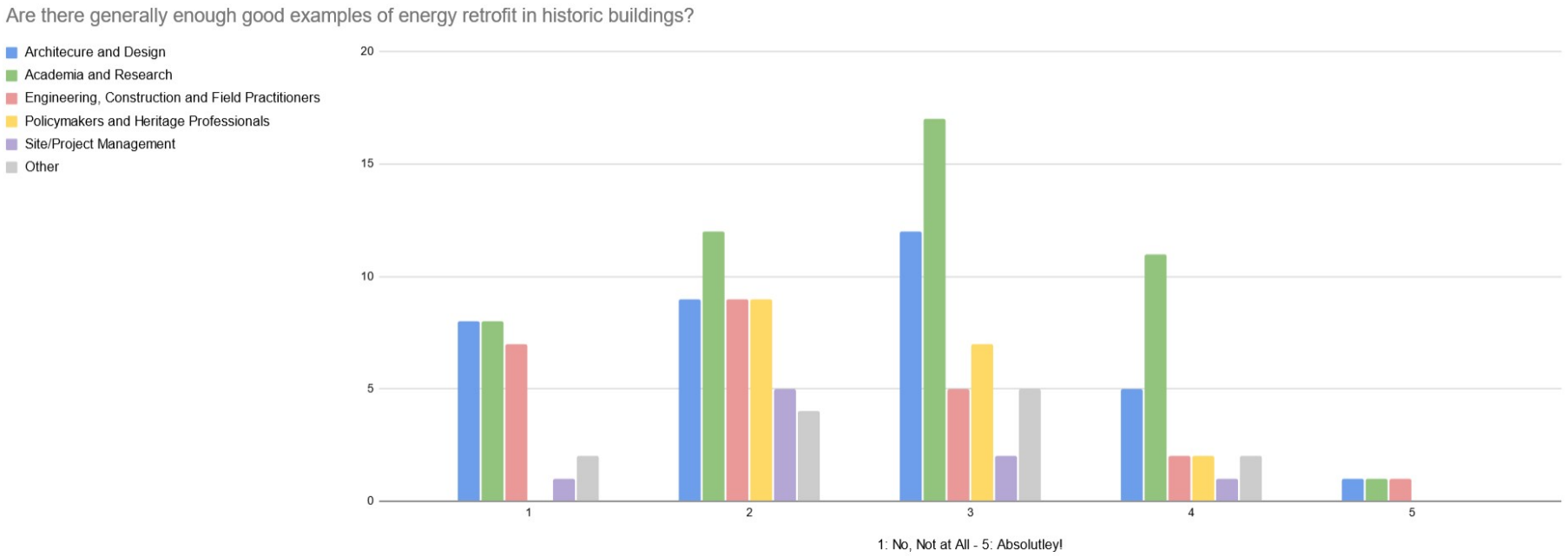


Figure 17. Access to enough good examples per profession

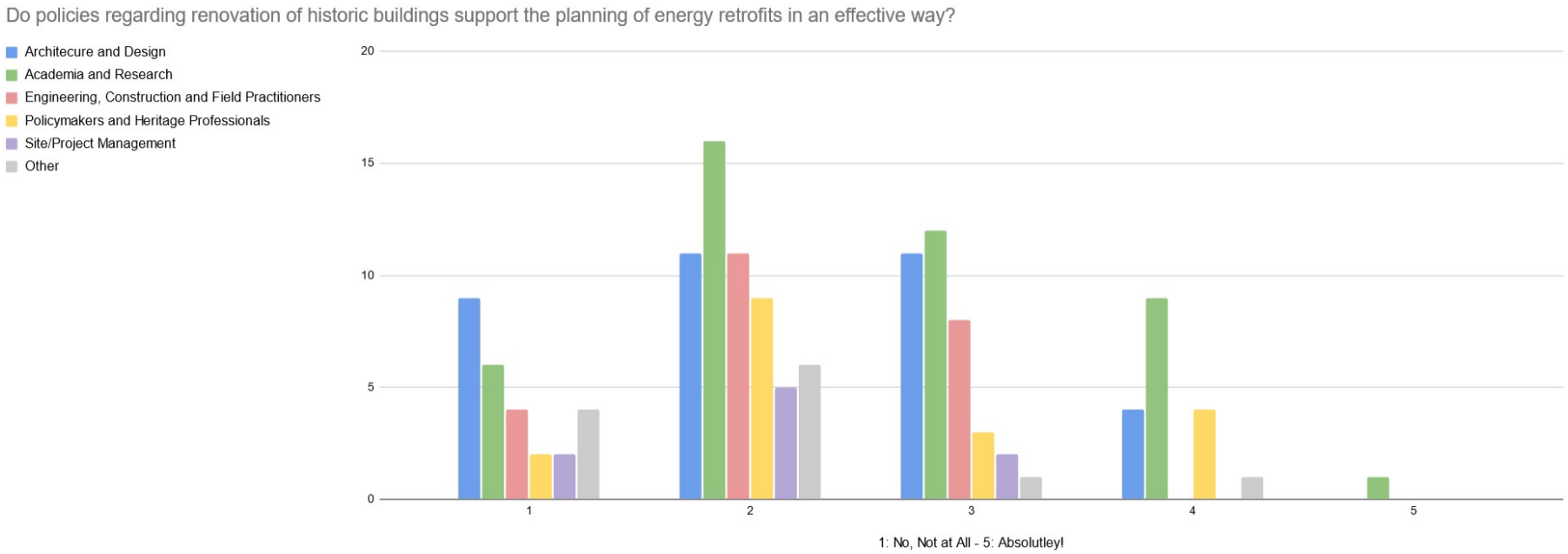


Figure 18. supporting policies per profession

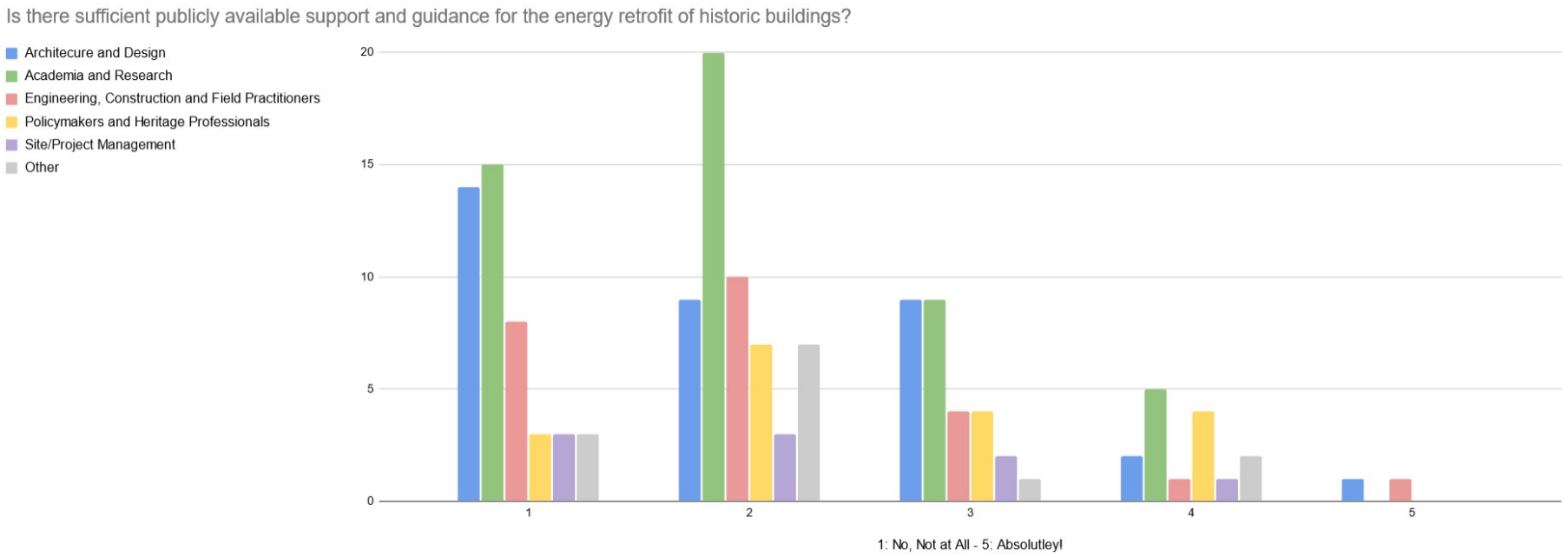


Figure 19. Access to publicly available support and guidance per profession

2.2.Practitioner Forms

2.2.1. Detailed analysis per “step”

This subsection details the findings drawn from the analysis of the practitioner’s form data compiled in the dataset for each of the 7 “steps” of energy retrofit projects of historic buildings. It covers both general trends and specific qualitative data that were extracted from the dataset. The number of respondents is indicated for each “step”.

More detailed data resulting from the analysis of the dataset, and presented using tables based on the practitioner form template, can be found in Annex 5 – including examples of tools.

Heritage value assessment (6 respondents)

There was a strong consensus amongst respondents that the step to perform a heritage value assessment is guided predominantly by national, and by international heritage conservation legislation/standards. Professional practice/processes/methods at national level to analyse historic significance were also mentioned. Their main advantages, as mentioned by respondents, were the accessibility of heritage conservation legislation/standards, the fact they form a well-integrated system, the fact there are international standards, and the clear legal framework. One respondent specifically mentioned, as an advantage, the fact that they ensure the protection of the character, appearance and aesthetic of heritage assets. The difficulty to adapt these heritage conservation legislation/standards to individual buildings was seen as a disadvantage, and it was mentioned by one respondent that they limit or prevent retrofit interventions, and that the documentation process is time-consuming.

When it comes to tools used to support the process, the respondents mentioned tasks to be performed rather than proper tools to be used – e.g. studying the history of the building and its context, carrying out a site visit and analysing the significance of the building. There was one exception regarding the tools used to create drawings (e.g. Polycam, Autocad). One respondent mentioned he did not use any tool. One respondent mentioned that there is no other way to fully understand a building and what it represents than using/performing the aforementioned tools and tasks.

There was clear feedback that this step should take place at the beginning of the retrofit process (either at pre-design stage or at the start of the design phase) and potentially at another point in time too, during the building permit stage (when a planning permission/listed building consent is sought from a city council or local authority).

Assessment of the use of the building (6 respondents)

There was potentially a problem with the wording of the question with regards to the meaning of “use of the building”, as one respondent said he was unsure if he understood the question. However, the analysis of the answers tends to provide reassurances that most respondents

understood the question – some adopting a holistic approach to answering the assessment of use by considering structural survey to probably define what type of loads (applied to the building structure) and activities can be acceptable in a given historic building.

For respondents, the step to assess the use of historic buildings is guided predominantly by construction and planning legislation/standards at national level, and to a lesser extent by heritage conservation standards at international and national level. It was felt that structural requirements are very well defined with a comprehensive approach. However, respondents highlighted the fact that there is uncertainty about the structural condition of historic buildings and limited flexibility to adapt them. Another issue regarding existing guidelines/standards was that existing legislation/standards are not very focused on use and space planning.

The tools mentioned by respondents to perform this step only focused on engagement with users – to understand users' needs/challenges and current use of the building and collect feedback. Respondents mentioned various tasks to be performed, without indicating the tools to do so – e.g. structural tests, site visit, gathering/analysing historical documentation on the building, and consultation, engagement events outside the building, door to door with to residents, and resident meetings.

There was clear feedback that this step should take place at the beginning of the retrofit process (either at pre-design stage or at the start of the design phase).

Condition survey and technical documentation (4 respondents)

For respondents, the step to undertake a condition survey and gather technical documentation is guided by construction legislation/standards at national level and heritage conservation standards at international and national level. It was felt that there were detailed criteria provided by existing guidelines/standards (presumably heritage conservation standards at the national/international level). Additionally, it was also felt that legislation/standards do not provide specific guidance for any type of building – implying it is too general, which is seen as a problem. Furthermore, it was mentioned that up-to-date technical documentation of the buildings is often not available.

The tools mentioned by respondents to perform this step covered the collection of 2D/3D technical information and the processing/creation of 2D/3D technical information. It was mentioned that whilst these tools provide precise documentation on the current condition of the building, they are expensive. It was also felt that there was a lack of information about internal structure in the case of building pathology surveys. One respondent was not aware of any condition survey tool.

Respondents mentioned various tasks to be performed without indicating the tools to do so – carrying out a building pathology analysis (i.e. understanding damage to masonry, wooden elements, etc.), analysing the resistance of the building's structural elements (bearing walls, domes, etc.) and carrying out a historic analysis of the building.

There was clear feedback that this step should take place at the beginning of the retrofit process but diverging views on the specific point in time (either at the pre-design stage or at

the start of the design phase or during the stage when a light touch design is being developed). It was also mentioned that the process should potentially take place at another point in time too, during the building permit stage (when a planning permission/listed building consent is sought from a city council or local authority).

Energy performance assessment (5 respondents)

There was a strong consensus amongst respondents that the step to assess the energy performance of historic buildings is guided by energy performance legislation for buildings at the European level (EPBD), energy performance legislation/standards for buildings at the national level and energy performance standards (non-governmental) for buildings at the national level. This is complemented by energy performance standards (non-governmental) for buildings at the international level and construction legislation/standards at the national level. The feedback received was very positive in that these guidelines/standards are very well-defined, detailed, provide clear targets, and there is some flexibility in how some standards can be used (i.e. following the steps but not necessary the specific targets). However, complexity was pinpointed as the main issue: complexity of the standards/legislations themselves, an increasing complexity due to the large numbers of standards/legislation that can generate contradictions between each other (a suggestion was made to group them in one single standard/guideline), the fact that different procedures are required depending on the standards/tools being used, and the difficulty in applying the standards to historic buildings.

A lot of tools were mentioned to perform this step, and they can be split between those being compulsory or recognised by national governments to produce EPCs or required for energy modelling calculations, those who are not compulsory but are widely used and in-house tools. These tools include software programs for energy modelling that are compulsory at national level or recognised by governments, including Dynamic Simulation Modelling (software), and those that are non-obligatory. Other tools cover hygrothermal risk assessment (i.e. risk of condensation in walls, roofs, ground floors), thermal bridges, modelling heat fluxes through buildings components, thermal load and temperature and relative humidity evolution, U-value calculations – some of which can be covered by an energy modelling software. The combination of tools (software) to generate 3D model and to assign energy performance values to the walls, roof, floor, and an in-house tool to report on current energy performance of a given building were also mentioned. The feedback was extremely diverse and tended to be specific to the various tools used – see data from the relevant table in *Annex 5* for more detailed information. However, some general conclusions can be made: easiness to use the tool (e.g. when based on Excel like Passive House Planning Package) and provide results quickly are strong advantages, whilst the fact that a tool is very time consuming, requires skills and is slow to operate is problematic. Precision is very important and so is the ability to generate a lot of data that can be reused during the design process - whilst some tools can provide results that are not precise or are more focused on compliance with regulations (mandatory as part of national legislations) and there may be the need to use different tools. The possibility to use data from one tool to another is paramount, and so is the need for flexibility. The tool should allow comparisons between different retrofit scenarios to test them and facilitate data interpretation, as this part

of the design phase is an iterative process required before defining the most appropriate technical solutions that will be implemented during the works. As such, the tools should facilitate this part of the design process and accelerate it – as it is, in essence, a rather time-consuming process. It was mentioned that whilst these tools are indispensable, they have their limitations. A well-designed monitoring campaign is absolutely necessary to calibrate and validate the energy models; otherwise, their results may not be reliable.

There was clear feedback that this step should take place at a more developed design stage or building permit stage. It was also mentioned that this step should happen at several design stages, to check the performance of the design, and that this step should also happen after completion of the project.

Indoor environmental assessment (5 respondents)

For respondents, the step to assess the indoor environment of historic buildings is guided by energy performance of buildings legislation/standards at national level, indoor air quality in buildings standards (non-governmental) at national level and construction legislation/standards at national level. Ad hoc approaches/outsourced services to specialists and conservation guidelines were also mentioned. It was felt that the standards/guidelines were clear and that they provide a comprehensive approach. However, there was a consensus that the main challenge is complexity: complexity of the standards/legislations themselves, increasing complexity due to the large numbers of standards/legislation that can generate contradictions between each other, and difficulty in achieving a compromise between comfort and protection of historic buildings.

To perform this step, the same tools (software programs) as for energy performance assessment were mentioned – some of which are integrated energy modelling software programs. The need for tools to perform microclimate measurements/building performance monitoring (temperature, humidity and carbon dioxide), multi-criteria certification and comfort levels assessment/thermal survey (thermal camera) was indicated by respondents. It was mentioned that these tools provide data for other assessments (e.g. Wufi for hygrothermal risk). But it was mentioned that there is always uncertainty in the results of these parameters associated with indoor environmental assessment due to the actual use/occupancy of the building once it is retrofitted.

Respondents mentioned tasks to be performed rather than proper tools to be used – carry out post occupancy evaluation, ask data from clients on operational parameters (e.g. energy use, temperature settings) and visit the property and interview residents or building owners.

There were various divergences in the feedback received as to when this step should take place - at the beginning of the retrofit process (at the start of the design phase), at a more developed design stage or building permit stage, or after completion of the works. It was also mentioned that this step could happen at several design stages - at the beginning of the retrofit process and after completion of the works.

Economic viability (e.g. Life cycle costing) - (5 respondents)

For respondents, the step to assess economic viability is guided by professional guidelines on economic viability, as well as standards (non-governmental) at national/international level and National Grant Program Guidelines. However, 3 respondents mentioned they do not use or do not know the guidelines/standards for economic viability. It was felt that existing guidelines/standards can be helpful to obtain a general preview of the economic balance, get clear cost structure, enable comparisons, include full building life cycle and provide a basis for long-term decision making. Two categories of challenges were identified - either related to historic buildings/conservation works (difficulty in estimating conservation works and complexity of calculations for heritage buildings) or issues about the difficulty to estimate/anticipate construction costs in general (market price volatility, uncertainty of long-term economic forecasts and the fact that guidelines/standards do not reflect the current status of the construction market).

The tools mentioned by respondents to perform this step could be split between three categories: dedicated commercial software programs, using an in-house tool (e.g. custom LCC Excel formulas) or analysing basic data on running costs. There are various cost management software programs, and these may have variations - they can or cannot be integrated with BIM and can or cannot include LCC calculations. One respondent made the general comment that he is not using LCC because there is too much uncertainty about future costs and construction materials or products lifespan. It was also mentioned, as an issue, that a software program was not officially required by any institution at the national level.

There were various divergences in the feedback received as to when this step should take place – during the stage when a light-touch design is being informed, at a more developed design stage and at the tender stage or at each stage when a cost is presented to the client.

Environmental impact (e.g. Life cycle assessment, waste) - (4 respondents)

There was no consensus among the respondents on the guidelines/standards to assess the environmental impact of retrofit projects. Guidelines/standards for environmental impact that were mentioned by respondents were diverse and included construction legislation/standards at national level, energy performance of buildings legislation/standards at national level, environmental legislation at national level, environmental standards (non-governmental) at national level and internal procedures. One respondent mentioned he did not use any guidelines/standards. Feedback included advantages and inconveniences, although this was not requested in the practitioner form used. Existing guidelines/standards can be helpful to grow environmental awareness but there is a high cost associated when conducting these analyses, and a lack of specific guidelines for heritage buildings.

The feedback on tools mentioned by respondents to perform this step was diverse due to the diversity of environmental impact aspects tools could help with. Different tools/approaches were mentioned: software programs for environmental impact, Life Cycle Assessment (LCA) software programs, and carbon footprint calculators (either inhouse or commercial tools) sometimes primarily focused on operational energy rather than embodied carbon. One respondent said they do not do pre-demolition audits whilst another respondent said they do

not use these tools. It was highlighted that tools were available. However, one respondent said that there is a lack of reliable databases of materials and products, and that this is a big issue with LCA evaluations. One respondent said they are currently upskilling in whole life carbon assessment (being more focused on the cradle to gate, i.e. the A modules of whole life assessment, and on operational energy).

There was clear feedback that this step should take place at a more developed design stage or building permit stage.

2.2.2. Overall analysis across all "steps" and proposals to address identified issues

The table below summarises the key findings from the respondents' feedback for each of the "steps," i.e. the most important technical/practical aspects or considerations associated with the energy retrofit of historic buildings.

Step	Guideline/standard	Tool (software, …)	When
Heritage value assessment	Clear guidelines and standards at a high level. *Proposal: Develop guidelines/standards to help adapt the high-level heritage value assessment process to individual buildings (facilitating and mainstreaming the process)*	No tool mentioned, rather tasks to be performed. *Proposal: Create simple tool for heritage significance analysis (facilitating and mainstreaming the process)*	At the beginning of the retrofit process.
Assessment of the use of the building	Clear guidelines and standards for structural requirements but not enough for assessing use and space planning. *Proposal: Develop high-level guidelines/standards for assessing use and space planning in historic buildings*	Some tools mentioned as well as tasks to be performed. *Proposal: Create a tool for understanding users' use of the building and requirements*	At the beginning of the retrofit process.
Condition survey and technical documentation	Guidelines and standards available. *Proposal: To be developed further*	Some tools mentioned. *Proposal: Create a tool for building pathology survey and for surveying structural capacity of internal structures*	Beginning of the retrofit process. Could also happen at a later point in the project too - during the building permit stage.

Energy performance assessment	Many overlapping and sometimes contradictory guidelines and standards. *Proposal: Create a unified document (at a high level) to provide a clear process and to signpost to relevant guidelines/standards?*	A lot of tools are available - either integrated or very specific. Sometimes very complex and time consuming. *Proposal: Can these tools be optimised for easier use and efficiency? Can some of them be more high-level to support a solution appraisal exercise (comparing possible technical solutions) at an early stage in the project and in a holistic way?*	During developed design stage or building permit stage. Potentially at several design stages.
Indoor environmental assessment	A lot of guidelines and standards but this leads to some contradictions, and they are intrinsically complex. *Proposal: Create a unified document (at a high level) to provide a clear process and to signpost to relevant guidelines/standards?*	Some tools mentioned as well as tasks to be performed. *Proposal: Create a tool for post occupancy evaluation and interviewing users?*	No clear consensus – could potentially happen at any time in the project depending on objectives.
Economic viability	Few guidelines and standards (and/or no knowledge of them, not in use). *Proposal: Develop guidance on a process to assess economic viability and specifically on the use of LCC for historic buildings?*	Tools available. *Proposal: Develop additional tools at two levels – easy to use (e.g. running cost analysis) or at a more detailed (e.g. LCC)?*	No clear consensus – could potentially happen at any time in the project depending on objectives.
Environmental impact	Guidelines and standards are diverse – not clear "go-to" documents. *Proposal: Develop guidelines covering all aspects of environmental impact for historic buildings?*	Tools available but are numerous and sometimes very specialised. *Proposal: Develop simple tools on LCA based on reliable databases and on waste?*	At a more developed design stage or building permit stage.

Table 5. Overall analysis across all "steps" of the respondents to the practitioner form

2.3.Interpretation of results

2.3.1. Survey and Interviews

Taking all responses into account, there are several conclusions and potential next steps to be undertaken.

Improvements in public opinion or awareness raising, better understanding of the inherent energy efficiency of historic buildings, and increased training and skills development for traditional craftsmanship were all suggested or referenced by respondents and would certainly be welcome advances and improve the efforts to retrofit historic buildings, but of primary concern for most respondents is the need to improve policy and legislation. Historic buildings are placed at a disadvantage wherever energy efficiency building policy is created primarily with new construction in mind. Respondents were not in agreement whether existing legislation and policy should be adjusted to better reflect the needs of historic buildings or entirely separate policies should be put in place specifically for historic buildings, and this is a question that will no doubt require further study. It is also important to recognize that these concerns are interlinked, and a holistic approach taking all of these concerns into consideration is most likely to succeed going forward.

Sorrell et al (2000) divided barriers into three different overarching categories: economic, behavioural and organizational, while emphasizing that the main barriers to energy efficiency can vary significantly depending on the sector or organization, and that it is unlikely that a single policy approach will work universally across sectors. Instead, they argue that a diverse range of strategies will be needed, designed to address the distinct characteristics of each situation. As a result, effective policy solutions should be tailored to the circumstances of each energy-using sector, based on an analysis of barriers for that sector.

Energy retrofits in historic buildings is fundamentally different from standard energy retrofits as it is posited in the intersection of two different policy objectives: 1) improving buildings from a technical point of view to make them more resource efficient, improve the indoor climate, reduce emissions etc, and 2) preserve the heritage significance of individual buildings and heritage values in the built environment at large. This specific position calls for a customized analysis of barriers across the multiple stakeholder groups involved in retrofit. It also makes the barrier analysis more complex, as the barriers could be defined in relation to the two different policy objectives. In essence, is the identified barrier a barrier to improved energy efficiency or a barrier to improved heritage preservation (or both)?

2.3.2. Practitioner Forms

Whilst the respondent sample used to collect data was small with six respondents covering the four demonstration site countries, some general trends could still be drawn from the data analysis.

For instance, there was clarity amongst respondents regarding the guidelines and standards practitioners should use for heritage value assessment and energy performance assessment, and those guidelines and standards are national and international. The feedback collected indicated these guidelines and standards need to be refined to address some issues such as their applicability to individual buildings for heritage value assessment and their complexity for energy performance assessment. However, the feedback collected for tools led to the conclusion that different approaches are needed: new tools are required to support the

heritage value assessment process whilst existing tools for energy performance assessment need simplifying and optimising. It is clear that simpler/more guidance is needed for indoor environmental assessment, economic viability and environmental impact, and tools may need to be created or simplified to become easier to use.

In some cases, there is no clear trend that emerges from the results. This is the case for the guidelines and standards related to environmental impact; there is no "go-to" document that compiles all the required information. As a result, respondents mentioned a large number of distinctive documents. Similarly, it is not clear in respondents' feedback when indoor environmental assessment activities should be performed – guidelines could be created to address this gap.

Frequently, respondents mentioned tasks to be performed as part of the retrofit process but not tools required to perform them. Tools may not always be necessary, but this should prompt some reflection as to whether there is a gap to be addressed – e.g. for the heritage value assessment "step", the tasks mentioned by respondents included studying the history of the building and its context, carrying out a site visit and analysing the significance of the building. This phenomenon was quite recurrent for the "steps" heritage value assessment, assessment of the use of the building, condition survey and technical documentation. An explanation could be that the work related to these tasks is mostly performed by practitioners through her/his analysis of the data that is collected and own skills/knowledge, rather than the use of dedicated tools.

Sometimes respondents mentioned that they did not use or are not aware of any guidelines/standards and tools for specific "steps" of the retrofit project. There can be several explanations for this.

One is the size of the architectural practice and their specialisation (heritage, energy retrofit, public/commercial or residential buildings, etc.). Bigger practices will tend to use more complex tools (either commercial tools or developing in-house tools) whilst smaller practices may not use specific tools or would develop simple in-house tools. Specialised practices in energy retrofit will use more tools in that area than practices specialised in heritage – the latter could instead subcontract energy retrofit specialists on specific projects if required. As a consequence, if practitioners do not know the tools for a specific task to be performed, this does not mean there are no tools available. It is also important to mention that given the small size of the sample, some conclusions may need further confirmation from additional practitioners. For instance, respondents are not mentioning specific tools relating to structural surveys of historic buildings because this is not their area of expertise, if there are architects; this does not mean there are no tools available. As such, a careful analysis of the trends should be performed to avoid a misinterpretation of the data collected.

Therefore, the approach and the toolkit developed in Work Package 4 and other related Work Packages should take into account the targeted audience in their full diversity, when it comes to practitioners (e.g. small and size architectural practices, their specialisation), and should seek to fully understand and address their requirements – for the retrofit approach and toolkit to be widely used.

Another explanation in terms of different habits when using tools could be linked to national legislations or mandatory standards that may impose the use of specific tools. Overall and whilst there are many commonalities between each country in the respondents' feedback, it is important to keep in mind that some aspects of the process of retrofitting historic buildings are influenced by the local context, i.e. where the project is being implemented, prompting the use of specific tools or guidelines.

As such, the approach and the toolkit developed in Work Package 4 and other related work packages should take into account, to some extent (i.e. at a high level), the local context of the countries in which the tools will be applied – or at least include caveats/checklists for users so they can adapt this toolkit/approach to their own local context/requirements.

3. Conclusions and Outlook

The FuturHist Barrier Survey, together with the interviews, provided detailed information on the identification of barriers to the energy retrofitting of historic buildings, while data collected amongst practitioners from the four demonstration site countries using “practitioner forms” highlighted general trends observable across the continent on the guidelines/standards and tools used by practitioners for each of the main “steps” of any retrofit project.

Principle findings from the survey show that barriers of a regulatory nature are the most significant faced by stakeholders, with 30% of respondents citing individual barriers in that category, followed by references to financial barriers made by 24% of respondents. Yet the fact that barriers identified by respondents fell across all six barrier categories (regulatory, financial, awareness and mindset, technical, knowledge and skills gap, and planning related) without any one overwhelming majority shows the interconnected nature of these barriers.

The structured interviews gave more detailed insight into how these barriers and barrier categories are often intertwined. Interviewees gave concrete examples from their own experiences to illustrate this. The Scottish architect working as a retrofit designer (PRAUK1) gave the example of how conservation restrictions prevent installing external insulation of a facade (regulatory barrier), with internal insulation mentioned as a viable alternative. However, this option reduces the overall available living space (technical barriers) and impacts on the property value (financial barrier) and technical pitfalls have to be considered (technical barriers).

Analysing the practitioner forms, key findings show that while there is clarity on guidelines and standards that practitioners use for some of the 7 identified “steps” of the retrofit process, others are notably lacking, along with tools. In some instances, there are multiple tools being used by practitioners and no clear consensus on “go-to” guidelines/standards. Practitioners frequently mentioned necessary tasks to be performed, but less frequently the tools required to do so. However, this does not necessarily mean that there are no tools existing; in some cases, it may instead mean that no tools are required for certain activities. It is also important to mention that given the small size of the sample of practitioners and their profiles, some conclusions need to be dealt with carefully and further confirmation from additional practitioners may be required.

Furthermore, there is a correlation between the key findings from the survey, interviews and practitioner forms, especially in references to regulatory and financial barriers. Respondents to all activities expressed concerns in some way regarding the costs associated with the energy retrofitting of historic buildings and the costs of necessary tools for practitioners. Along with the Scottish architect (PRAUK1), other respondents like the deputy head of a real estate company in Poland (PROPL2), pointed to the lack of cost-effective solutions specifically acceptable to conservation authorities.

It is also important to acknowledge the influence of local contexts to any barrier identified in these activities. Identical barriers referenced by stakeholders operating in different local contexts are not necessarily addressed and resolved in identical ways. One example is the Spanish heritage expert working for a public authority (PUBES1) who witnessed caution in working on projects with European funding, something that was not referenced by respondents from northern Europe. Local contexts of culture, climate, and laws and regulations must be accounted for going forward. If properly understood, local contexts can offer as much hindrance as assistance to the process of addressing identified barriers. Local knowledge especially can be a significant form of assistance; adapting strategies to local necessities. However, local knowledge is often built up and developed over time, and it can be difficult to challenge deeply held notions when they prove to be counterproductive to the retrofit process. This is especially the case within the professional-client relationship.

The lack of direct input from private owners of historic buildings is a major challenge. It remains difficult to effectively communicate en-masse with private owners in the same way as with professional practitioners or representatives of public authorities and, as such, the stakeholder group remains somewhat underrepresented in the feedback collected.

Moving forward, the key findings from this work package should considerably help in the proper understanding of the target audience for the approach and toolkit developed in Work Package 4 (“Development of an integrated planning toolkit”), and Work Package 6 (“Scale-up”). Practitioners will be specifically targeted for the toolkit and methodologies, with the key findings from this work package directly assisting these developments. The survey, interviews, and practitioner forms will provide a better understanding of the diversity of practitioners, their local contexts, and their specific requirements. This data will also support the creation of specific policy proposals to address some of these barriers in Work Package 6 and its Task 6.2, which will be then disseminated amongst heritage authorities from European countries.

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5. Annexes

Annex 1 - WP1 FuturHist Barrier Survey – Original Survey Form

Futur*Hist* Barrier Survey

FuturHist aims to develop replicable retrofit solutions for historic buildings of the future. See more about the project at https://futurhist.eu/

The aim of this survey is to identify barriers to energy retrofit of historic buildings. The term "historic buildings" is here used to include all buildings with heritage values, both listed and non-listed.

The survey is short and should take around 10 minutes to fill in.

If you have any questions about the survey, please contact us.

Data management/consent

The personal data you provide to ICOMOS/ FuturHist with this survey will be treated in accordance with the ICOMOS' Privacy Policy, and in compliance with the European General Data Protection Regulation (GDPR). ICOMOS does not store personal data longer than it is reasonably useful or required by law. By sharing all other data in this survey, you consent that ICOMOS and the consortium partners within the FuturHist project may use them for analytical and research purposes, and publish them as part of the project deliverables.

* Spørgsmålet er obligatorisk

FuturHist

1. Name

2. In which country are you based? *

3. What is your profession? *

4. Are you a member of FuturHist? *

Markér alle, du er enig i.

- [ ] Yes
- [ ] No

5. Are you a member of ICOMOS *

Markér kun ét felt.

- ◯ Yes, I'm a member of Icomos
- ◯ No, I'm not a member of Icomos

6. If you are a member of Icomos, please let us know which National committee or Internation scientific committee

7. Which e-mail address shall we use to contact you?

Barriers

8. What do you think are the main barriers to making historic buildings more energy efficient?

9. The expertise/skill among professionals involved in energy retrofits of historic buildings is sufficient

Markér kun ét felt.

	1	2	3	4	5	
No,	◯	◯	◯	◯	◯	Absolutely!

10. Please specify what kind of expertise/skills that are lacking (if you think that is the case)

11. Are there generally enough good examples of energy retrofit in historic buildings? *

Markér kun ét felt.

	1	2	3	4	5	
No,	◯	◯	◯	◯	◯	Absolutely!

12. What kind of good examples would you like to have more of?

13. Do policies regarding renovation of historic buildings support the planning of energy retrofi in an effective way? With policies we refer to national, regional and local planning policies.

Markér kun ét felt.

	1	2	3	4	5	
No,	◯	◯	◯	◯	◯	Absolutely

14. If you can, please give examples of how policies can be a barrier in the planning process

15. Is there sufficient publicly available support and guidance for the energy retrofit of historic buildings?

Markér kun ét felt.

	1	2	3	4	5	
No,	◯	◯	◯	◯	◯	Absolutely

16. What kind of support/guidance is missing?

17. Are you aware of a best practice database for energy retrofit of historic buildings? If so, please share any link or sources.

18. Is it possible to get public funding for the energy retrofit of listed buildings? If yes, for what kind of measures?

19. Is it possible to get public funding for the energy retrofit of non-listed buildings? If yes, for what kind of measures?

20. Is there funding for maintenance (accompanying measures or follow-up costs beyond the main measure)

21. Is there funding to subsidise the repair of existing buildings, or is only a new measure considered eligible for funding?

22. Is there anything more that you would like to add regarding barriers to energy retrofit in historic buildings?

Step 2 - structured interview

In a second phase we would like to do follow-up interviews. The interviews will be made online and don't require any preparation.

23. Can we contact you for a follow-up interview? *

Markér kun ét felt.

- Yes
- No

24. Are there other individuals that you think that we should contact for an interview? Please also provide contact information if you have.

Dette indhold er hverken oprettet eller godkendt af Google.

Google Analyse

Annex 2 - WP1 Survey – Anonymised Raw Survey Data

Number	In which country are you based?	Region	Stakeholdergroup	What is your profession?	Professional Sector	Are you a member of FuturHist?	Are you a member of ICOMOS	If you are a member of Icomos, please let us know which National committee or	What do you think are the main barriers to making historic buildings more energy...	The expertise/ skill among professionals involved in energy retrofits of historic	Please specify what kind of expertise/skills that are lacking (if you think that is the case)	Are there generally enough good examples of energy retrofit in historic	What kind of good examples would you like to have more of?	Do policies regarding renovation of historic buildings support the	If you can, please give examples of how policies can be a barrier in the planning	Is there sufficient publicly available support and guidance for	What kind of support/ guidance is missing?	Are you aware of a best practice database for energy retrofit of historic buildings? If so, please share any link or sources.	Is it possible to get public funding for the energy retrofit of listed buildings? If	Is it possible to get public funding for the energy retrofit of non-listed buildings? If yes, for what kind of measures?	Is there funding for maintenance (accompanying measures or follow-up costs beyond the main measure)	Is there funding to subsidise the repair of existing buildings, or is only a new measure considered eligible for funding?	Is there anything more that you would like to add regarding barriers to energy retrofit in historic buildings?
	1 Spain	Southern Europe	practitioners	Architect	Architecture and Design	Yes	No, I'm not a member of Icomos	N/A	Urban legislation, lack of knowledge, professional	2	A broaden profesional profile having a combination of	3	Cost-effective cases, taking into account that, usually	1	1) performance indicators for energy retrofits in Spanish	1	- First of all, bringing the energy and heritage on an	Yes. In Netherlands: https://www.dumoprestatie.nl/; In France: https://www.observatoirebbc.org/batiments/patrimoine	Yes, but they do not considered	Yes, there are many funding programs. Usually they require and improvement of the %EPC of two separate	nON FOR MAINTENANCE, BUT MONITORING DEVISES CAN BE FUNDED IF JUSTIFIED	There are minor funding or subsidies for repairing, specially for public tenants, but the majority are linked with energy	Need to mention the risk of: 1) generation of a social gap and a situation of social inequality due to the unequal
	2 Italy	Southern Europe	academia	Researcher	Academia and Research	Yes	Yes, I'm a member of Icomos	ISCES	Cost effectiveness (Cost of intervention vs	4	There are few very well trained profesionals	3	www.hiberatlas. com of course :) (but with more	1	Policies seem to go in opposite directions	1	international level yes, but discersed and	www.hiberatlas.com of course ;)	Yes, but they do not considered	In Italy, Superbonus with 110% return on the energy related measures (soon to be cancelled)	only conservation of listed buildings and changes greatly form region to region	Yes, it exists. and there are different programs at national and regional level (but changes greatly form region to region)	
	3 North Macedonia	Southern Europe	academia	Researcher	Academia and Research	No	Yes, I'm a member of Icomos	North Macedonia	Gap in the knowledge needed for making historic buildings more energy efficient. Also, one of the main barrier is the finance and money needed.	1	Expertise in sustainable materials and energy efficiency of the architecture for historic buildings are lacking in North Macedonia	4	We don't have good examples in North Msacedonia, but however in Europe can be seen many good examples.	2	/	1	A support from the Government for a historic buildings as provate properties is highly needed in North Macedonia.	No	No	No	In North Macedonia there existed a small fund for funding historic buildings, no existed any funding for maintenance of historic buildings which are private properties.	There is no funding to subside the repair of existing buildings in North Macedonia and usually there exists small funds as measure rom the Government.	/
	4 Denmark	Northern Europe	practitioners	Professor, Architect	Academia and Research	No	Yes, I'm a member of Icomos	Denmark	The building Industry and the legislation	1	Knowledge on All levels from craftsmen, ingeniørs to architect. And the building industry	1	Examples that desaminates Scientific knowledge to the users	1	Building new is cheaper than retrofitting Retrofitting is not supported.	1	In Danmark a Broad campain would be helpfull	No	No. There is support but it focusses on the architectonical value	Only for retrofitting og windows	There is an in-direct support through the taxsystem, but no direct support	A new measure is needed	You are doping an important job
	5 Sweden	Northern Europe	academia	Researcher	Academia and Research	Yes	Yes, I'm a member of Icomos	Sweden	Lack of knowledge about the values of historic buildings. Both as resources for the future such as embedded energy but also about the meanings and values attached to buildings.	2	There are expertise and skills at different stages in the process. During the planning stage knowledge and skills in historic structures, materials as well as historic and heritage expertise should be more involved. During the operation stage know-how about existing buildings from different periods are often missing.	1	A good example does not necessary need to be an example of a complete energy renovation but should rather be focusing on different measures.	2		2	From a national discussion the needs of guidance about historic buildings should be integrated with already existing guidelines.	https://www.hiberatlas.com/en/welcome-1.html	Yes but not a general subsidy. You need to apply and the assessment of the application and the suggested measure could be different in different parts of the country.	Below there is a quotation from the authority in Sweden dealing with Housing, building and planning issues. "If you own and permanently live in a small house that is heated by electricity or gas, you can receive a grant for the material costs of certain energy efficiency measures on the heating system of the house. If you have received a grant for measures on the house's heating system, you can also receive a grant for measures on the house's climate screen (the outer shell of the house). You apply for the grant in the Swedish National Board of Housing, Building and Planning's e-service, but your case is processed by the county administrative board in your county." - www.boverket.se/sv/bidrag---garantier/bidrag-for-energieffektivisering-i-smahus/	Not what I know of.		
	6 UK	Northern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	NC-, ICOMOS Nigeria, ISC-, ISCES, ICORP and ICIP	(1) Inadequate skill capacity especially amidst emerging professionals (2) Hesitation on the part of building owners (3) Inadequate financial capacity	1	Energy assessment and digital documentation of historic buildings	1	Case studies to showcase best practices	4	Local county policies need to be clearer about how energy efficiency of historic buildings can be improved.	2	Technical guidance, toolkit, assessment know-how	NA	Yes, funding from British Council	No	No		
	7 Austria	Central Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	Austria	Besides insufficiently precise ways to demonstrate the health and quality of living in a historic building in an energy performance certificate, the low number of professionals ready and able to work out of the box solutions and with sustainable materials, is a big problem.	2	working with historic materials	3	Examples that are not fancy and expensive, but useful to a regular owner showing that a decent retrofit does not mean the disfigurement of this historic structure or come with enormous costs.	3	If policies only look at the improvement of the installed energy consumption without looking at the quality of the planning, we will see more and more "simple" solutions made by the cheapest bidder and not experts.	3	holistic, i.e. not only technically focused, support and guidance	Yes, there are several possibilities with different agencies and ministries: - through the ministry of infrastructure - some states have their own schemes - throught the Federal Monuments' Authority	Yes, there are several possibilities with different agencies and ministries: - through the ministry of infrastructure - some states have their own schemes	no	Repair and maintenance are not supported on a regular basis.	In the discussion on the retrofitting of historic buildings it is usually not mentioned that the energy used in replacing the old building would allow the old building to be heated and run for several decades without any retrofit action, i.e. there should be some slack for historic buildings, especially if they are of historic value. Receive the same money for less of an increase in the building performance on the energy consumption level.
	8 Estonia	Northern Europe	practitioners	Engineer-Consultant	Engineering and Construction	No	Yes, I'm a member of Icomos		Lack of renovation guidelines that include specific local building details and traditions (profiles, colors, metal elements used, window details used based on building period, etc). Difficulties finding suitable timber elements with larger dimensionons and high quality (problem starts from forestry industry, where little or no selection is made when cutting trees and manufacturing elements).	2	Arhitectural detailing and correct usage of timber in building process. Restauration skills and optimal preservation of old materials (too much substance is replaced due to seemingly poor condition).	1	Where both the original architectural look is maintained or restored and very good energy efficiency is achieved at the same time (currently either of these targets is achieved in most houses).	2	The original appearance of the building is not important to anyone but heritage officials, exept few owners who want to keep the look, but then strict energy efficiency regulations can become a barrier for them (if it is not protected building).	2	- Local detailing catalogue (profiles, colors, etc), - restoration guidelines, - supply of suitable materials from manufactures (e.g. wide floor planks or wide facades cladding), - list of construction companies on the web with the specialties and customer ratings (similar list of doctors is available https://terviseteind.ee/).	Yes, every energy renovation measure available, but the target for energy saving is lower.	Same funding as previous question with strict energy saving target.	No	No, repair costs are not subsidised if not part of energy renovation measures.	Owners often do not know how to appreciate the historical appearance and want the architecture of a new house for an old house. Society's awareness and education about old buildings is low. Old houses are arbitrarily associated with dirt floors and missing modern amenities. There are too many builders specializing in new buildings and few builders familiar with old houses (market failure).

9	Belgium	Central Europe	public authority	advisor reserch programme at the government agency responsable for cultura heritage	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	ISCES	regulations that are to strict and do not take into account the embedded energy of historic buildings	3	restoration architects and enrepreneurs lack expertise of new methods and materials for retrofit buildings / also the focus is to much on insulation and not on installations	2	low carbon installations in historic buildings	4	policies mostly promote one size fits all solutions that do not respect the individuality of owners (poor-rich) nor the building	3	guidance by professionals that is up to date, appropriate and adapted to the building	https://hiberatlas.eurac.edu/	yes- owners of protected heritage that have a recent EPC (after 2019) can get a free tailored heritage energy advice / all owners of protected buildings can get a prima to perform an energy audit/ heritage buildings conform the EN16883 Guidelines for improving the energy performance of Historic Buildings/ owners of listed buildings can get a heritage loan up to 250.000 € for energy retrofit	yes, the heritage loan up to 250.000 € is also for non listed buildings, mentioned in the inventory of buildings with heritage value	yes- For (periodic) maintenance work and small projects, you can get a heritage grant calculated on a maximum of 250.000 euros of the accepted cost estimate. you can also get a tax reduction for maintenance costs up to 25.000 euros	yes- there is a grant for repair of existing buildings (according to selected themes and via call) and there is a heritage loan	no
10	Ireland	Northern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	Ireland	Access to appropriate skills/ knowledge; financial and human resources - both for the planning and design stages as well as the implementation works; insufficient data on actual/real energy performance of historic buildings; poor project briefs, programmes and funding which do not anticipate/ understand what is involved in making historic buildings more energy efficient (more relevant for larger public and commercial projects); confusing and complicated information,	2	There is need for both additional expertise/skills within current professionals (e.g. conservation architects need more technical knowledge) as well as greater access to testing and modelling (currently quite specialist and therefore costly and difficult to access). In addition to skills, what is important is the way in which different experts work/ collaborate. So, the following expertise needs to work together - understanding the heritage values; understanding the technical performance of	2	a good diversity of building typologies and approaches. This should include modest interventions as well as the more comprehensive approaches. One building type which is not well addressed in the multi-residential/ historic building. Also good to have examples of historic area based approaches with information on how these are set up from a legal and administrative perspective, as well as the technical and design aspects. And, 20th Century heritage	4	In Ireland the policy landscape is complex and confusing for many. There is national policy and targets, alongside building regulations and planning legislation. Legally protected structures are exempt from the Energy performance part of Building Regulations, however non-protected traditionally constructed buildings are not. While there is provision to apply for a derogation from compliance with building regulations, this is seldom used in particular with regard to Part L. Alot of	3	To start with some of what is available, or shortly available - recently published National Guidance on Improving Energy Efficiency of Traditional Buildings, Irish Georgian Society Energy Efficiency in Historic Houses exhibition; Office of Public Works (OPW): Approaches to Improving Energy Efficiency of heritage buildings in state care (which includes case studies); national publication on 'Energy Upgrading of Traditional Buildings for Low Embodied	Not a single centralised data base, though there seem to be several local databases (eg Historic Scotland - https:// www.historicenvironment.scot/archives-and-research/ publications/?publication_type=45)	There is currently no funding specifically for listed buildings, however there is general funding available which is also open to listed buildings. However for listed buildings it can be difficult to meet criteria for funding, or may require inappropriate interventions. It is understood there is a plan to introduce a funding scheme.	See answer above	There is and annual grant scheme for small scale maintenance works to listed buildings. It is not specifically directed at energy improvements. There is a maximum grant of €1,500 per project	Funding to upgrade fabric for improved energy performance will only apply if building will then meet a B2 Building Energy Rating (Rating runs from A to G, with 1,2,3 sub-ratings, A1 being the best performing). If the repair works can be related to the fabric upgrade solutions it may be possible to be funded.	There is alot happening throughout Europe right now (like many, my practice is working on a number of research projects as well as physical building projects). What is important is to share the knowledge of both successful outcomes and where problems have arisen. In many instances we are undertaking interventions not previously done, and testing new materials and details. It would be very helpful to have a generally consistent approach to sharing the lessons learnt - good and less good. Also, with so much focus on energy reduction, there is much innovation in materials, systems, etc - it would be useful to have a forum to access information on these innovations. Finally - the links with embodied carbon and LCA need to be consistently integrated. How this will affect the energy retrofit work is not yet fully appreciated. It will likely be more complex and more cost.
11	North Macedonia	Southern Europe	practitioners	civil engineer, specialist in earthquake engineering	Engineering and Construction	No	Yes, I'm a member of Icomos	national committee of North Macedonia	the cost of the modern solution and their application in the case of historic building with no preserved facades	3	skills for proper application of the energy retrofit	2	integrated seismic and energy retrofitting	3	when they did not provide financial support	1	first, for rising the awareness, and then for the different possibilities	no	listed buildings is usually with preserved facades, no change of appearances is possible	there is no such possibility, unless it is granted from other financial instruments out of our country	only for listed buildings, but based on the project prepared by conservation centers	as a new measure	in North Macedonia the imperative is to develop data base with essential information first and then to work of rising the awareness and introducing the owners with the possible solution
12	Azerbaijan	Southern Europe	practitioners	Cultural heritage specialist	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	Azerbaijan NC	I think in the case of my country the main barrier is the lack of planning and vision. Making historic buildings energy efficient is not in the agendas of the main organizations responsible for them.	2	Expertise in sustainability and energy consumption	2	Using proper insulation, updating air conditioning and ventilation systems in historic buildings, researching and implementing where possible ancient how-how. For example, in many traditional houses of Azerbaijan using natural stone and limestone serves as a good insulation.	2	Policies in Azerbaijan require the use of concrete in historic structures for security reasons, which prevents using natural and traditional materials.		Guidance on how to properly approach the question of security of historic structures without using concrete would be valuable.						
13	Portugal	Southern Europe	practitioners	Architect / Reasearcher	Architecture and Design	No	Yes, I'm a member of Icomos	ISCES	Lack of contemporary knowledge/ transcription about their real performance	1	Understanding that the Energy Performance Certificates are mostly designed for concrete buildings, and that historic buildings had specific strategies	3	Neighbourhodd scale approaches	3	For instance, you must take a project of your intentions to go and talk to the protection authority, when it should be the other way around. We assume this, what can we should we do with this?	1	Neighbourhood scale views	Not in the way I would like it to be...	In Portugal, the same as for all buildings	Insulation, replacing windows and doors, solar thermal and PV, heat pumps	No funding for maintenance and, worst, no warning that they need maintenance. Most will die on place.	Only adding new stuff is considered	Individualist approaches. You can read more at Brito, Nelson. (2023). Improving the (energy) performance of (historic) buildings and communities: towards "neighbourhood Energy Performance Certification" (nEPC) . maybe this link works: https://www.researchgate.net/publication/368574660_Improving_the_energy_performance_of_historic_buildings_and_communities_towards_neighbourhood_Energy_Performance_Certification_nEPC
14	Turkey	Southern Europe	practitioners	Dr architect	Architecture and Design	No	Yes, I'm a member of Icomos	Iscarsah	Extra comfort desire of the people and lack of expertise and awareness	2	Awareness and enerhy consumption knowledge	1	At least during the restoration project each historic building must have an energy edeciency concern and level	1	In Türkiye there is not any.	1	Each kind of support	-	Yes but for structural renovation. However if the contractor aware of energy retrofit, can use the budget for it	No	No	Yes there is	Public awareness	
15	Norway	Northern Europe	academia	Professor of social science and lecturer of history	Academia and Research	No	Yes, I'm a member of Icomos	Under water cultural heritage	Many historical buildings are not built to be heated according to modern standards. In my country the main challenge is to have use of buildings which can not be heated according to modern standards	3	I think expertice exists, however it is aquestion of understanding old materials and to accept that historic buildings never can be updated to todays standards of warming and ventilation	1		3		1			It is possible, but funding is limited		Yes, but funding is limited	Yes, but funding is limited	
16	Turkey	Southern Europe	academia	Academic Staff	Academia and Research	No	Yes, I'm a member of Icomos	Turkey, ISCARSAH and applied to ISCES	Legislation and awareness	2	Installation. The balance between intervention and authenticity.	2	Nearly Zero Energy for Historic Buildings	2	Municipalities and their vision.	2	A guideline.	NA	No	No	No	Some buildings to the Foundation	
17	Bosnia and Herzegovina	Southern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	NC Bosnia and Herzegovina	Impossible to use new materials and technologies		Contemporary materials, technologies	4	Economic and sustainable solutions	1	Often allow only usage of original materials and technologies in construction process	4	More open source documents and guidelines						

18	Armenia	Southern Europe	practitioners	HVAC DESIGNER, LECTURER	Academia and Research	No	Yes, I'm a member of Icomos	ICOMOS ARMENIA	The reason is the state's priorities, increasing energy efficiency is still being applied to public, residential, industrial buildings under construction and reconstruction.	Specialists involved in the retrofitting of historical buildings generally do not possess the knowledge of thermal protection of buildings	2		2		There are not enough mandatory state regulation documents, not enough education aimed at energy saving.	3						
19	Austria	Central Europe	practitioners	Building scientist	Academia and Research	No	Yes, I'm a member of Icomos	Austria	Ignorance of the qualities of historic building constructions often die hauptsächlich den Wärmedurchgang unter stationären Bedingungen betrachten	2	Aktivierung der thermischen Speichermasse massiver Bauteile	2	Das Interesse der Bauwirtschafts-Lobby an kurzen Lebenszyklen und damit an der geplanten Obsoleszenz	4	umfassendes Verständnis der Bauphysik historischer Objekte und über das entsprechende Erfahrungswissen	2	my website https:// www.idam.at/ simple-smart-buildings/	Ja, von den föderalen Behörden	no	ja, zahlreich z.B. vom Bundes denkmalamt	Faire Berechnungsmethoden üder den gesamten (lange!) Lebenszyklus von wiege zu Wiege
20	Ireland	Northern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	President NSCES+CC (Energy Sustainability and Climate Change)	Financial	I think there are sufficient skills in Ireland however/ bizarrely those skills do not reside within the bodies (one stop shops) carrying out the majority of retrofits.	I believe retrofit of historic buildings is like haute couture, it presents highly complex and sophisticated solutions which can trickle down like the pret a porter world of the more every day buildings.	2	Typically the financial supports are the same regardless of the amount of energy that will be saved post retrofit. From my own research the vast majority of historic structures in Ireland are G rated and use 650kWh/m2/ year for space heating. However these buildings will get the same grant as a buildings at a D rating or about 200 kWh/m2/ year even though the G rated building can offer much greater savings. If the policy moved away from offering a 'one size fits all' type grant to a grant	2	I answered this in the response to the barrier question above but will repeat...a support per kWh saved would give the existing stock more financial incentive to be retrofitted.	There is an old one called Periscope and also Build to Last	As Listed Building are often exempt from retrofit requirements there is no special funding for them. However they can avail of the standard measures but another major obstacle is the more sensitive materials are often not supported due to a lack of certification for retrofit solutions using less appropriate materials. The supports for those materials are there but again in a 'one size fits all' type grant and not related to the building type or energy rating.	As above there is a suite of grants for different measures including wall insulation both EWI and IWI, Roof insulation, heat pumps, solar PV.	No	No	A notion has emerged in Europe particularly following the EPBD just passed that one stop shops need to be set up. Historic Buildings need a special form of these and should include conservation architects who can directly source the funding once it forms part of a coordinated design.
21	UK	Northern Europe	public authority	Programme/project manager	Site/Project Management	Yes	No, I'm not a member of Icomos		Overall - complexity of the whole retrofit process (choosing/ designing best technical solutions, applying for consents, selecting contractors, risks of inappropriate solutions) of HBs for property owners and even construction professionals to some extent: there are few/ no obvious solutions/ packages of solutions for HBs that are easy to identify, energy efficient, affordable, cost effective and risk free. An important other factor is probably the	understanding on how historic buildings perform in terms of moisture management or appropriate materials to be used, risks and benefits and management in relation to retrofit (moisture management, indoor air quality with 2 pollutant, fire safety standards and combustible insulation materials, etc), what retrofit strategies/ materials are appropriate, cost effectiveness of solutions and calculation of costs, whole house approach to retrofit of HBs (looking at the	Lot of good examples but not shared enough with professionals/ public or even not documented or not easily accessible (some very successful cases like in Scotland disappeared because there was no money to maintain the website/ so that 3 we are redoing the same work again and again wasting time and money), too technical for public, lack of practical information (costs, energy performance results, practical steps to implement the project - how to do it practically, lack of feedback on	2	There is always an element of interpretation with policies and practice could vary according to different planning authorities (eg. Edinburgh's place-based approach (differences between different cities or region where some planning officers could be (i) too strict in relation to what can be done in HBs blocking any improvements even if they are not harming HBs' significance and (ii) others could be too flexible with risk of damaging HBs cultural significance). Guidance on policies can be	2	Lot of guidance already available yet a lot of gaps: - Guidance on all the solutions that are possible and respect conservation principles/ practices (eg planning policies) - at 2 levels: general/ national/ international level (general/ replicable principles) or local (to suit local planning policies) - Guidance on how HBs were designed and perform (and how to use them in the most efficient manner) - Guidance on conservation philosophy and principles (so that owners understand the	3	https://www.lowenergybuildings.org.uk/ , retrofit Scotland that is no longer available	As far as I am aware, no in Scotland (at least no specific funding is available for HBs - they can benefit from retrofit funding available to any existing building)	Yes – for heating/RES and for fabric improvements. See https:// www.homeenergyscotland.org/home-energy-scotland-grant-loan	No as far as I am aware (there may be some very local schemes promoted by some cities)	In Edinburgh and a few other cities in Scotland (Glasgow, Aberdeen, Dundee, Stirling, Inverness, Perth) yes thanks to Historic Environment Scotland 'City Heritage Trusts Programme' that provide support to HBs owners to get funding to repair their HBs (repair such as window, stonework or roof repairs rather than pure maintenance such as cleaning the gutters that accumulated in a gutter). EWH Conservation Funding Programme is an example of this: https://ewh.org.uk/the-unesco-world-heritage-site/grants/#:~:text=The%20Conservation%20Funding%20Programme%20facilitates,traditional%20shopfront%20techniques%20and%20materials.	Education of owners (as clients), construction professionals (design teams, contractors) and politicians/policy maker is paramount in how to approach sensitively HBs retrofit – and to avoid going to far in unnecessary/damaging interventions at scale across the whole HB stock. There should also be a recognition that technology is not the only solution to the problem and that we should put people at the center of the approach (and consider their behavior in terms of energy consumption/use of their property).
22	Azerbaijan	Southern Europe	public authority	Project Manager	Site/Project Management	No	Yes, I'm a member of Icomos	Azerbaijan	Public support, awareness, funding	4		2		1		1	We don't have sufficient support and understanding even for energy fit of new buildings. Probably need to share best practices more widely.							
23	UK	Northern Europe	practitioners	Architect	Architecture and Design	No	No, I'm not a member of Icomos		In Scotland a lot of homes are in tenements, so privately owned flats in a building envelop with shared responsibilities. Also there is a lot of uncertainty about trapping humidity in historic buildings.	The intricacies of dealing with historic buildings, which are meant to have a certain 2 natural airflow. Damage to old buildings by introducing the wrong materials can be mould and dampness		Shared energy efficiency projects in shared buildings	2	Policies force people to achieve a certain U-value, when often the focus should first be on making a historic building wind and water tight before considering other interventions	2	Emphasizing that buildings need to be well maintained and dry before doing anything else. A whole house approach.		I'm only aware of case studies done by various heritage organisations	I don't think so	I think the Scottish Governemtn does for windows, doors and insulation	not that i am aware of	I don't know	no
24	UK	Northern Europe	practitioners	Architect	Architecture and Design	Yes	No, I'm not a member of Icomos		Cost of retrofit work in addition to the lack of skills and knowledge between professionals to deliver the job	2	lack of understanding of the physics of historic buildings and traditional matrial properties	3	whole house retrofit and low carbon heating systems	3	there is a pleasure to improve the energy performance certificate grading for historic building which usually lead to implment energy retrofit solutions that are not suitable for the historic building and that, though improve its EPC rating, could also lead to deminish its structural and heritage integrity	3	Guidance on low carbon heating systems in traditional buildings. Also the guidance are hard to find and sometimes too generic	https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=47c9f2eb-1ade-4a76-8275-aa8300897255	targeted works on windows, doors,or rain water goods. Otyer funding might be limited to buildings with high epc rating	targeted works on windows, doors,or rain water goods. Otyer funding might be limited to buildings with high epc rating	NA	NA	no

25	Luxembourg	Central Europe	practitioners	Architect	Architecture and Design	No	No, I'm not a member of Icomos		The very nature of the building and the lack of insight among environmentalis ts regarding the inherent valut of historic buildings that can last centuries if maintained. Their longevity is the best energy saving aspect of historic buildings.	1	The pertinance to know what not to do in improving the energy efficiency of historic buildings.	1		1	The obligation to improve the energy performance by actions that coud disturb the balance that has allowed the building to last sometimes for hundreds of years. The possibly soon to be obligation to add solar panels.	1	A comprehensive legislation and guidelines as to what can be done and what should not be done when restoring old buildings.		Insulating exterior walls, changing from single to double glazing, insulating roofs, changing the heating system to a heat-pump or pellets.	Insulating exterior walls, changing from single to double glazing, insulating roofs, changing the heating system to a heat-pump or pellets.		Yes		Often the work done can disturb the equilibrium of the building even to the extent of reducing its life span. Buildings that have survived for centuries should be restores in such a way"a not to compromise their life expectancy, otherwise the effect is the opposite to saving energy. Infra-red radiators could be a good means of heating historic buildings, but energy legislation might not allow this.
	USA			architect		No	No, I'm not a member of Icomos		Cost (short term) and lack of knowledge in appropriate design and sensityi of contractors and mechanics. Also a general lack of understanding of and neaject for the many ways traditional building is inherently 'green'.	2	Understanding of how to work with a structures' actual characteristics, and not impose conventional strategies.	2	Hard to see examples. Cost effective long term solutions	2	Standardized solutions favored by building codes and permitting agencies	2	Leadership form the architectural community, which is still largely stuck in modernist/ high energy design loop.	no	Public support in America is scant. Tax credits help.	?	?	?		More education and data to support intelligent and appropriate retrofits.
26	Italy	Southern Europe	practitioners	Engineer and Architect	Architecture and Design	No	No, I'm not a member of Icomos		Legal aspects, cost of workers.	1		3		2		2									
27	Portugal	Southern Europe	practitioners	Civil engineer	Engineering and Construction	No	Yes, I'm a member of Icomos		Technicians know-how	2	Perform LCA analyses	2	Seismic reinforcement coupled with insulation	2	Omission of rules directed to retrofit or rules adapted form new buildings which do not really fit existing buildings.	2	No		Yes. For thermic insulation, solar power equipments.	Yes. For thermic insulation, solar power equipments.	No	No	No	
28	Italy	Southern Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos		aestetic value	2	moisture analysis	3		3		2									
29	Switzerland	Central Europe	academia	Historian	Academia and Research	No	No, I'm not a member of Icomos		People's lack of understanding of what a historic building is	3		4		4		2	Quick and easy access to information	no	Yes, any renovation that results in an additional cost for a listed property	No	Yes, CECB subventions	Yes, RU subventions		
30	Italy	Southern Europe	practitioners	Architect and PhD student	Architecture and Design	No	No, I'm not a member of Icomos		The balance between necessary transformation and the intention to preserve the original state	4		3		4		3	Information on the practical application of solutions that can be read about in the scientific literature on the subject	https://hiberatlas.eurac.edu/de/willkommen-bei-uns-1.html		Use of photovoltaic systems, thermal coat ...		I am not aware of it		
31	Italy	Southern Europe	practitioners	Intern	Other	No	No, I'm not a member of Icomos		Making historic buildings more energy efficient faces several significant barriers. One primary challenge is the need to preserve the architectural and historical integrity of these structures. Any modifications must be carefully planned and executed to ensure they do not alter or damage original materials and features. This often limits the types of interventions that can be employed, such as external insulation or extensive window replacements, which might be inappropriate.	4		4			3								
32	France	Central Europe	practitioners	heat engineer	Engineering and Construction	No	No, I'm not a member of Icomos		Time and money. It's easier and cheaper to demolish and build then to restore a historic building.	3	heating and cooling in buildings	5	Strasbourg National and University Library	3	by reducing the amount of money spent on this type of project	2	there's a lack of publicity here	https://www.rehabilitation-batiancien.fr/	yes, if the building is listed as a historic monument (or has heritage features)					
33	Austria	Central Europe	practitioners	Architect	Architecture and Design	No	No, I'm not a member of Icomos		cost, missing knowledge, pressure by laws	4	deep retrofit with passive house components which are designed for old buildings	3	Good designed examples with renewable energy systems especially heat pumps	2	The energy requirements for deep refurbishments are very low.	3	Funding for valuable buildings	The HIBER atlas of ATLAS offers a good collection of examples	It is possible in Vorarlberg for fassades and roofs, but it is only a little amount of money.	Yes, if a commission has confirmed the value of the building.	No	I´m not shure, but I believe repairing is also funded.	The community should feel responsible for its values and help owners.
34	Ireland	Northern Europe	practitioners, academia	Material Scientist	Other	Yes	Yes, I'm a member of Icomos	ICOMOS Ireland, Past president of ISCES	Lack of knowledge when dealing with older buildings, lack of training in professions including architects, engineers & planners - lack of joined up thinking between legislation and building standards - lack of training for contractors - using calculative U values for solid wall construction - lack of proper funding through grants and tax incentives.	2	I believe it is right across the board from architects to engineers and planners in the professions and there is a serious lack of expertise in contractors and in product suppliers.	2	A wider range of typologies and post occupancy monitoring to prove what is done is working.	2	Many grant schemes in countries are linked to "Certification" of certain products and the products that have certification are not suitable for use in Heritage or Traditional Buildings. They also tend to be carbon intensive products thus negating what they are trying to achieve. Restrictions through Listed Buildings or Protected Structures also hinders even doing the right thing so there should be more flexibility but of course knowledge and understanding of a retrofit is also extremely important.	2	Much more training for all concerned - a lot of countries are now delivering guidance documents but most are not supported by legislation and the result is taking that guidance is voluntary.	Yes there are and I will share the link under separate e mail	In Ireland yes it is and the current government has introduced a number of new schemes to encourage the adaptive reuse of our older buildings and that are beneficial to the long term. The Vacant Homes Grant, owners can get up to 50,000 Euro (maximum 75% of cost) towards an energy retrofit - Derelict Farmhouses Grant, this is a two phase scheme where the owner can apply for 7,000 euro towards getting expert advice and then apply for up to 70,000 euro towards the cost of the	The above applies to listed and non-listed buildings with heritage value.	No and this is a failing because if you don't maintain our older buildings they will deteriorate quickly.	Ireland certainly a "Conservation Grant Scheme" which does subsidise repair of listed buildings but not for non-listed buildings.	I could write a book on this subject but perhaps that is not for this survey - I applaud the work of FuturHist and hope it gells the distribution and recognition it deserves.

35	Italy	Southern Europe	academia	University Professor	Academia and Research	No	No, I'm not a member of Icomos	The difficulty in integrating energy efficient solutions and innovative HVAC systems	2	Being aware that the same solutions used in non-historic buildings may not be as effective in historic buildings, thus different approaches must be considered.	3	Interesting examples of non-invasive HVAC integration	4	Policies commonly insist on thermal insulation, which is not always possible in historic buildings.	2	Just IEA Task 59 "Renovating Historic Buildings Towards Zero Energy"	Yes, fiscal incentives are available for any energy retrofit measures able to comply with specific energy performance indicators. However, they are the same as for non-listed buildings.	Yes, fiscal incentives are available for any energy retrofit measures able to comply with specific energy performance indicators.	Not aware of	Not aware of		
36	Italy	Southern Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos	level of protection	2	constructive and technical solutions; renewable energy; seismic solutions; climate proofit	1	climate adaptation and seismic solutions; renewable energy integration	1	not considering the degree of a historic building's protection	1	guidelines and rules for traditional and local architecture at the local, state and federal levels, together with technical guidance and examples	HiBERlattes; BIPV meets history; TABULA WebTool; Episcope; RtBuild	Grants are typically awarded for thermal insulation projects or initiatives that improve residential buildings' energy efficiency; EU funds: https://energy.ec.europa.eu/topics/energy-efficiency/financing-building-renovations_en; European Structural and Investment Funds (ESIF), the European Fund for Strategic Investments (EFSI), Horizon 2020, and the ELENA facility; specific programs in investEU. In addition, there is a new LIFE	Grants are typically awarded for thermal insulation projects or initiatives for renewable integration; Funds: The Renovation wave strategy under the European Green Deal	https://climact.com/wp-content/uploads/2024/03/Upscaling-the-financing-of-Residential-Renovation-in-Belgium-Final-deliverable-v2.pdf (https://climact.com/wp-content/uploads/2024/03/Upscaling-the-financing-of-Residential-Renovation-in-Belgium-Final-deliverable-v2.pdf	European Commission's Renovation Wave Strategy	Inadequate management, oversight, and assessment are among the obstacles facing historic conservation; absence of resilient systems, cutting-edge technology, and successful preservation techniques to maintain effective preservation
37	Italy	Southern Europe	practitioners	Construction Engineer	Engineering and Construction	No	No, I'm not a member of Icomos	First of all, Historical and Architectural Constraints: protection of heritage, use of original materials (which are often not the most energy efficient), high costs (specialised interventions and limited availability) and regulations, which are lengthy administrative procedures.	3	Improving training, encouraging specialization and promoting multidisciplinary collaboration are important steps to ensure that skills meet the challenges.	3	Technological innovation certainly, but also the possibility of greater use of renewable resources (less exploitation of natural resources).	2	Administrative procedures too long	2	A major hurdle is finding a balance between the need to preserve the historical and cultural integrity of buildings and the introduction of modern energy solutions. Not all owners of historic buildings are aware of the opportunities and supports available for energy adaptation. Even with incentives and funding, the energy retrofitting costs of historic buildings can be high, and not all owners can afford such investments.	no	For historic buildings tied in Italy, access to energy efficiency incentives may be more complex due to restrictions imposed by heritage protection constraints	Yes, it is possible to obtain public funding for the energy retrofitting of buildings not listed (unbound) in Italy (ecobonus, bonuscasa, Regional and local incentives, National Energy Efficiency Fund).	The main incentives are focused on energy upgrading (listed above) but there are opportunities to cover also maintenance and follow-up costsup, provided that they are documented and necessary for the completion and effective management of interventions	previous answer	no
38	Belgium	Central Europe	academia	PhD student	Academia and Research	No	No, I'm not a member of Icomos	Strict Limitations on RES technologies installations; dense urban areas in historic city centers; limited access to financial incentive; difficulty of upgrades due to complex layouts	2	Energy efficiency consultants for historic buildings; construction professionals with experience in historic buildings, legal and regulatory advisors	3		2	Comprehensive and integrated guidelines that combine energy efficiency with preservation requirements; training and education; coordination between stakeholders								
39	Italy	Southern Europe	practitioners	Civil Engineer	Engineering and Construction	No	No, I'm not a member of Icomos	Restrictions from the conservation authority	4	An integrated architectonic-energetic approach	3	Substitution of transparent envelope components, integration of Renewable Energy Sources	2	In many cases Renewable Energy Sources are not allowed, nor is the windows substitution	2	Clear and agreed (not locally amendable) regulation	Eurac's Historic Building Energy Retrofit Atlas	Fiscal incentives	The same Fiscal incentives	Locally, but very rare	N.A.		
40	Italy	Southern Europe	practitioners	Architect	Architecture and Design	No	No, I'm not a member of Icomos	Historic buildings are usually characterized by a value system that must be preserved. In this particular case, an intervention or system of interventions aimed at improving energy performance could challenge both the preservation of matter and appearance. In fact, there could be incompatibilities that trigger the occurrence or rapid evolution of degradation phenomena; introducing ventilation systems or modern plant systems, sometimes does not	4		4	-plant innovation -insulation of vertical closures, in the case of highly decorated 4 exteriors and interiors -floor insulation against the ground, without compromising the existing floor	3	Sometimes in Italy, protection policy are so constraining to prevent improvement interventions	3	More detailed case studies showcasing successful retrofit projects, including the challenges faced and solutions implemented, would be valuable. Practical examples that highlight the cost-benefit analysis of different retrofit strategies can help stakeholders make informed decisions. More information on grants, tax incentives, and other financial supports could encourage more property owners to undertake retrofitting projects.	(1) https://hiberatlas.eurac.edu/de/willkommen-bei-uns-1.html (2) less specific, but it is possible to find some exempla https://www.archdaily.com/search/projects/categories/refurbishment?page=2 (3) https://www.recmagazine.it/	I don't know if there is something specific.	There are some measures in Italy to encourage owners in retrofitting: - Superbonus: 70% Deductions For: - - Thermal Insulation Intervention: For vertical, horizontal, or inclined opaque surfaces affecting more than 25% of the building's - dispersing surface. - Replacement of Existing Winter Climate Control Systems. - Seismic Interventions. - Installation of Charging Stations for Electric Vehicles. - Installation of Photovoltaic Solar Systems. - Elimination of Architectural Barriers. Ecobonus: Tax benefits (IRPEF or IRES deduction) recognized for energy requalification works on single-family homes and condominiums. Depending on the intervention, incentives can vary from a minimum of 50% to a maximum of 75%. Specifically, a 50% rate is provided for the following interventions:	I don't know	The question is not clear enough		
41	Austria	Central Europe	public authority	Consultant	Site/Project Management	No	No, I'm not a member of Icomos	Laws	4		3		2		2								

42	Italy	Southern Europe	academia	PhD Candidate	Academia and Research	No	No, I'm not a member of Icomos		There may be a lack of awareness or expertise among building owners and contractors regarding how to effectively and sensitively improve energy efficiency in historic buildings. In case of listed buildings , solutions might be more expensive than the normal ones. Limited availability of funding specific for historic buildings' energy retrofit.	3		4				2		The HiBERatlas	I don't know	Ecobonus in Italy	As far as I know, there is no		
43	UK	Northern Europe	public authority, practitioners	Heritage conservation professional and digital development coordinator	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	United Kingdom	funding and willingness to spend available funding sensibly	3	The problem is to identify the right skill set for specific work. And we might not have enough workers with the required skill sets.	4	A history of refurbishment products would be useful to understand how refurbishment will look like in, say, 30 years. Thereby, we might be able to judge if today's products might be replaced by then. This could help avoid maladaptations.	2	In the United Kingdom, new-build construction is exempt from value added tax (VAT) whilst for repairing existing buildings you need to pay VAT.	2	financial support is missing specifically for the energy retrofit of buildings of cultural significance	https://hiberatlas.eurac.edu/de/willkommen-bei-uns-1.html	Yes, but not specifically targeting for listed buildings and often not particularly suitable	Yes	No, public funding is not generally available for maintenance	No, public funding is not generally available for repair	Good luck with the project FuturHist :)
44	Italy	Southern Europe	practitioners, academia	Industrial PhD student	Academia and Research	No	No, I'm not a member of Icomos		The (right) respect to historic/cultural value	1	In case of engineers they don't have a historic background	2	Real good practice, even of unknown buildings	2	In Italy we had 110, anyone, even without expertise has carried out energy upgrades without respect for historical values, ruining an entire building stock (60s/70s)	1	Guides exist but are not public	https://www.ibs.it/guida-al-recupero-dell-architettura-libri-vintage-daniela-bosia/e/2570120267662			no		
45	Germany	Central Europe	practitioners, academia	Architect, Researcher Building Sector	Architecture and Design	No	No, I'm not a member of Icomos		lack of enenergy interaction with surrounding buildings an district, lack of smart and sufficient technologies dealing with sufficient comfort levels	3	HVAC and electric systems integration in a sufficient and non invasive way	1	envelope technologies rather well explored - building systems not at all	2	lack of knowledge of heritage authorities (who will describe the rules) concerning technical equipment and solutions	1	understandable described unified guides describing solutions and good practices	no	change of windows, heating system, renewables	change of windows, heating system, renewables, envelope	no	funding only for cultural heritage important parts	low EU thresholds for EU wide tenders -> high administration loads. No clear definition of qualities of materials, the way to be mounted at the building, the influemnce on the heritage/building and the definition of quality for the contractors. Same for monitoring of the results
46	Germany	Central Europe	academia	Scientist	Academia and Research	No	No, I'm not a member of Icomos		Building physics (thermal bridges), decorative elements worth preserving	3	cross-sectional expertise about monument preservation, energy efficiency, design	2		2	frequently changing regulations, complicated workflows	2		No	Yes	Yes	Yes	New measures	Some owners hesistate to retrofit because of the high expenses and ignorance
47	France	Central Europe	practitioners	Engineer	Engineering and Construction	No	No, I'm not a member of Icomos		Costs, knowledge of adapted solutions, even more actors than usual (heritage authorities), bad advices from professionals	3	Crafspeople with excellent skills do exist. But they are not always called by contractors to work on historic buildings. Buildings owners have no idea of the heritage significance of their building, them they hire contractors that have no idea either! A contractor specialized in historic buildings will find the right craftpeople.	1	I would like to have a lot of example, but not always perfect.	3	Policies do exist, but buildings owners discover them sometimes very late in their project. And adapting to these policies at this stage of the project is harder than in the beginning.	4	There is enough of them, but buildings owners don't know them.	HiBERatlas (Europe, since 2021) 91 7.2 Effinergie's low-energy building observatory (France, since 2010) 94 7.3 BUILD UP case studies database (Europe, since 2019) 98 7.4 Passive House Database (International, since 2010) 101 7.5 Construction21 (International, since 2012) 104 7.6 STBA knowledge center (UK, since 2012) 109 7.7 Spara och bevara (Sweden) 113 7.8 CREBA (France, since 2018) 115 7.9 MASEA-ENSAN database (Germany, 2016) 121 7.10 Database of thermal properties of historic materials InRenova (Italy, 2026) 123	There is no specific public funding for the energy retrofit of listed buildings In France. For the energy retrofit, yes. For the restoration of listed buildings, yes.	Same answer.	I don't know, maintenance is not my field of expertise. But I think taht there is nothing more than operating budget.	Same answer.	In France, little awareness of what is a historic building. Buildings owners don't know (don't care?) and don't surround themselves with the right people.
48	The Netherlands	Central Europe	public authority	Business manager	Site/Project Management	No	No, I'm not a member of Icomos		Regulation	3	Sustainable heating solutions	2		2	Historic buildings are excluded from necessity of renovation; Changes to the exterior (and sometimes interior) are restricted or not allowed	2		No	Yes, heatpumps, insulation. Additional funding is possible when it is also a building for public use like schools)	Yes, heatpumps, insulation. Additional funding is possible when it is also a building for public use like schools)	No	? Restoration, including enhanced energy efficiency should be possible	
49	Ireland	Northern Europe	practitioners	Architect + Urban Designer	Architecture and Design	No	Yes, I'm a member of Icomos	ICOMOS Ireland and ISC20C	Demand, finance and time	3	Balance between energy efficiency and embodied carbon	3	20th century buildings	4	Building regulations lag behind policy	4	Case stuies	No	Repair or restoration only	Yes, modest grants for homes	No	Yes	No
50	UK	Northern Europe	practitioners	Engineer	Engineering and Construction	No	No, I'm not a member of Icomos		Cost and planning regulations in the UK.	2	Not enough suitably knowledgeable and skilled people	4	Private homes	2	In the UK it is widely believed that planning regulations will make it difficult to retrofit historic buildings. Whether or not this is correct, it deters people from even trying.	2	The available guidance is not widely disseminated; and guidance about the planning regulations is lacking.	No	I do not know.	In the UK, the ECO scheme pays for work to homes of poor people	No	I don't know	

51	Italy	Southern Europe	academia	Professor	Academia and Research	No	No, I'm not a member of Icomos		The difficulties in introducing new equipment and maintaining the original configuration and way of use	2	Usually, their approach is limited to verify the law limits, without taking into account the specific of historic buildings expecially regarding the inertia factors	4		3	The rules are too much generalist as they were not thought for buildings built in different age, with different techniques and so on	2	Formation acquired through specific courses	Historic Building Energy Retrofit ATLAS	only interventions which allow to improve the quality of the indoor environment guaranteeing a defined target of energy efficiency	only interventions which allow to recover the cost of investment through the improvement of the energy efficiency,	In Italy there are .	Sometimes, there are		
52	Ireland	Northern Europe	practitioners, academia	Architect Researcher	Architecture and Design	No	No, I'm not a member of Icomos		Professional training, skilled workforce, lack of regulations, and recommendations (that make a difference between existing buildings and historic/ traditional ones).	2	When is professional, lack of knowledge about historic materials, performance features as often they differ from one place of origin than for this other, lack of knowledge about the use of simulation tools specific to characterize the performance of historic buildings.	4	There are good examples about Religious buildings, but people spend short time there, more examples about offices or residential buildings would be interesting, as people spend considerable time there.	3	contradictory regulations, lack of clarity about the level of intervention according to the building typology, age of the building and its cultural/ architectural value.	2	Education, people sometimes don't understand the value of an historic building, they understand more the importance of energy efficiency, facilitate the understanding of both concepts and how they are connected, as well as their relevance would be very helpful.	I know those that have been made available by EURAC, 3ENCULT and EFFESUS.	Built Heritage Investment Scheme supports small to medium size projects, the Historic Structures Fund (HSF) support public and private buildings, for the use of local or regional materials, a second option of this fund is for the preservation of historic building facades (windows, entrances, small architectural details).	There are public funds for the installation of solar panels, as well as for heat pumps.	I'm not aware of that.	-		
53	Italy	Southern Europe	academia	Full Professor at the University of Genova - Architecture and Design Departmentchitecture	Academia and Research	No	Yes, I'm a member of Icomos	Italian Committee	Their architectural characters, features, spaces, structures and material and phisycal consistency	1	Genearl awareness and expertise about energy performances of existing buildings, expecially ancient and made of masonry structures	1		1	when they impose abstract and general standards conceived for the construction of new buildings	1	Guidelins, technical supports at any level of the building process and in any involved administative and technical involved organisms and institutions	NO	I do not know, a part the PNRR funds for the enregy transition	Yes	No	Yes there are, few and difficult tobe obtained	Invest in knowledge, education and training of the involved professionals at any level and also of the entrepreneurs and workers	
54	Italy	Southern Europe	academia	Professor	Academia and Research	No	No, I'm not a member of Icomos		Making historic buildings more energy efficient faces several barriers: Preservation and Aesthetics: Regulations and aesthetic concerns often restrict alterations to maintain historical integrity. Changes must respect the original design and appearance, limiting options for modern upgrades. Structural and Material Limitations: Historic buildings are often constructed with fragile materials and non-standard techniques that complicate the	2	Energy retrofits of historic buildings often lack professionals with combined expertise in historic preservation and energy efficiency. Key skills needed include: Conservation Specialists: Knowledge of preservation techniques to avoid damaging historical features. Energy Auditors: Ability to assess and improve energy performance. Integrated Design Teams: Collaboration between preservationists and energy efficiency experts. Skilled Craftspeople:	1	Case Studies and Best Practices:	2		2	Public support for energy retrofits of historic buildings is often insufficient. Lacking are integrated guidance, detailed case studies, technical manuals, information on financial incentives, specialized training programs, regulatory navigation support, and opportunities for networks for sharing expertise and experiences.							
55	Poland	Central Europe	academia	Researcher	Academia and Research	Yes	No, I'm not a member of Icomos		Limitations connected with acceptable technical modifications.	4	Understanding of the results and influences of the introduced changes upon durability of the building and its components.	3	Detailed reports on conducted and successful retrofit of the various buildings.	2	Lack of strict regulations and financial support.	1	Specific requirements are needed, technical guide and financial support.	No.	I do not know about any specific support for historic buildings, general support for reduction of energy is available.	Yes, it is possible. For improved insulation of external building shell, more efficient heating and ventilation heat recovery system, PV systems.	No, as far as I know.	Yes, improvements are subsidized.	No.	
56	UK	Northern Europe	public authority	Engagement manager	Site/Project Management	No	No, I'm not a member of Icomos		Cost; wide variety of advice; uncertainty over longevity of technology	3	Ability to communicate clearly the options, costs and implications	2		3		1	Simple easy-read guidance; personal advice; information relating specifically to historic buildings	No	Not sure	Not sure	Not sure	Not sure	No	
	USA			Architect		No	No, I'm not a member of Icomos		Lack of interstitial space for running utilities, matching historic detailing at fenestration and doors,	3	Sensitivity to historic appearance	4	Historic doors and windows re-engineered to higher energy efficiency without compromising appearance	2	Most policies are developed based on what is possible in contemporary construction then adapted for historic buildings. Better policy would be possible if it was developed for historic buildings initially	3	Current government support programs offer too little support. We need more generous support for complete energy retrofit of historic buildings	No	Not specifically for historic buildings	Yes, some US states have tax refund based programs but historic buildings are often owned by non profits that can not benefit from tax breaks	No	There is funding for repair of existing historic buildings which varies by state but not specifically for historic buildings	The technology exists to reduce carbon to near zero in many existing buildings but it is very expensive and there is no feasible payback period. This is the largest barrier for non profits that are usually cash short i. The US.	
	Argentina			Architect, Professor		No	Yes, I'm a member of Icomos	VP ISC20C	Knowledge	3	How to retrofit without changing the building interiors	3	Any kind, public buildings	3		2	Education	Hiberatlas	May be	Difficult	Very little	Just few	no	
57	Sweden	Northern Europe	practitioners	Architect	Architecture and Design	Yes	No, I'm not a member of Icomos		Knowledge along property owners and profiessionals	3	LCA-analysis, methodologies to assess and jointly evaluate solutions against impact on heritage values and CO2- or energy benefits.	3	Sensitive indoor insulations and window renovations. LCA-based deviation making.	3	Policies need to generally open for technical innovation, of course based on assessments by skilled historic buildings professionals	2	Practical methodology guides	Spara and Bevara, HiBERatlas	All types	Not commonly	Yes	Yes		
58	North Macedonia	Southern Europe	public authority, practitioners	N/A	Other	No	Yes, I'm a member of Icomos	ICOMOS Macedonia	Professional skills, Legal restrictions	4		2		2	Restriction of application of building materials and technologies	4		No	No	No	No	Yes	No	
59	North Macedonia	Southern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	ICOMOS Macedonia	Professional skills, Legal restrictions	4		2		2		5	Educational brochures and manuals	No	No	No	No	Yes	/	
60	France	Central Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos		political will	2	hydric behaviour and problem of water condensation	4	walls or windows insulation	2	barriers given by architects in charge of policy	1	specific numerical tools		yes any energy renovation needs	same answer .. but other helps	more complex	also to repair	no	

61	Bosnia and Herzegovina	Southern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	Bosnia and Herzegovina, ISC20C	Less of knowledge	2	Creativity	4	Residential, 20th century architecture	3		2	Municipality, education			Yes, elevation isolation	As previous	No							
62	Italy	Southern Europe	practitioners, academia	Research Fellow/Architect	Academia and Research	No	No, I'm not a member of Icomos		There may be a number of barriers, e.g., historical–artistic and landscape constraints of the buildings, compatibility of solutions with respect to the technologies and materials of historic buildings, dialogue between different architectural languages, invasiveness and reversibility of solutions, lack of tailored solutions for historic buildings, etc.	2	Lack of knowledge of the thermophysical behavior of a historic building, which is often very different from new construction, lack of knowledge of tailored and specific solutions for such buildings, lack of a preparatory knowledge phase of the historic building to find the most suitable solutions, etc.	2		2	Lack of incentives to promote renovations in historic buildings or specific policies	2	Updated guidelines, easy and quick reference information panels summarizing the procedure leading to the definition of intervention solutions, etc.	Alessia Buda, Conservazione ed efficienza energetica dell'edilizia storica, Nardini 2023			Opaque envelope insulation, window replacement, installation of technological systems (solar collectors, heat pumps, photovoltaics, building automation, etc.)		Yes, there is funding to subsidise the repair of existing buildings			
63	Estonia	Northern Europe	academia	Professor	Academia and Research	No	No, I'm not a member of Icomos		A heritage conservation office that understands natural sciences.	1	Heritage authorities understanding of natural sciences.	4	Higher energy performance and zero-emission buildings.	3	Restriction of minimizing heat loss of building envelope.	4	Showing that drastic improvement of energy performance of historic building is possible	"Low carbon emission renovation of historical residential buildings". https://www.sciencedirect.com/science/article/pii/S2352484724001719		Yes. To all measures.	Yes. To all measures.	Less than energy retrofit. Therefor it is important to renovate building so that it requires small maintenance.	No without improvement of energy performance	Heritage authorities. Owner financial capability.		
64	UK	Northern Europe	public authority	Project Coordinator	Site/Project Management	No	No, I'm not a member of Icomos		Building regulations (lack of knowledge), skills,	2	Construction companies in the UK have struggled since the pandemic to reemerge as viable concerns. The construction industry continues to lose key skilled workers who will be critical to industry growth in the short-to. There were 2.08 million people employed in UK construction in 2024 Q1, which is 1.9% lower than both Q4 and a year ago.	4	http://www.prewettbuckley.com/mews-house-deep-retrofit https://www.oxleyconservation.co.uk/20th-century-homes-hampshire	3	Current policies in the UK can present several barriers in the planning process for building projects. Some of these challenges include: Complex Regulations: The planning system in the UK involves numerous regulations and guidelines that can be complex and difficult to navigate, leading to delays in the approval process. Local Plans: Local authorities have their own development plans that must be adhered to, which can vary significantly	4	The energy retrofit of historic buildings can be a complex process due to the need to balance preservation with modern energy efficiency standards. Some areas where support and guidance may be lacking include: Tailored Guidelines: There is often a lack of specific, accessible guidelines that address the unique challenges of retrofitting historic buildings, including appropriate materials and techniques that maintain historical	https://historicengland.org.uk/advice/technical-advice/retrofit-and-energy-efficiency-in-historic-buildings/	In the UK, there are several funding options and programs available for energy retrofits of listed buildings. Some of the key initiatives include: The Green Homes Grant: Although this program has ended, it previously offered funding for energy efficiency improvements. Check local councils for any similar initiatives that may have emerged. Historic England: This organization offers	Yes, it is possible to obtain public funding for the energy retrofit of non-listed buildings in the UK. Various programs and initiatives are designed to support energy efficiency improvements in residential and commercial properties. Here are some common measures that may be eligible for funding: Insulation: Funding can cover improvements to insulation in walls, roofs, and floors to enhance energy efficiency. Energy-efficient heating systems: Upgrading to more efficient heating systems, such as heat pumps, condensing boilers, or district heating technologies. Double glazing and window upgrades: Installing energy-efficient windows or secondary glazing to reduce heat loss. Renewable energy installations: Funding may be available for the installation of renewable energy systems, such as solar panels, solar thermal systems, or biomass heating. ..	Funding for maintenance or accompanying measures related to energy retrofits of listed buildings can be more limited compared to funding for the main energy efficiency improvements.	In the UK, funding for the repair of existing buildings can be available, although it often depends on the specific funding program and the nature of the repairs.	no	
65	Belgium	Central Europe	practitioners	Architect - Research scientist	Architecture and Design	No	No, I'm not a member of Icomos		I think that there is a lack of information for decision-makers and that renovation is not sufficiently seen as a multi-criteria process.	3	A big picture	2	Some very concrete and representative examples	2	I think it has to work both ways: heritage administrations need to take a more energetic view, and renovation strategies need to focus more on what already exists.	2	Raising awareness is a crucial shortcoming for both public authorities and private individuals.	https://hiberatlas.eurac.edu/de/willkommen-bei-uns-1.html	Yes, but energy measures need to be discussed.	Not to my knowledge.	For support, there are "facilitators" (specialized in the environment, not heritage) who can be contacted free of charge.	I think this is a real failing. Maintenance and repair should also be funded.		
66	Portugal	Southern Europe	practitioners	Architect	Architecture and Design	No	No, I'm not a member of Icomos		I dont' think that historic buildings have to be more energy efficient	1	More knowledge about traditional materials and passive solutions	4	Vernacular buildings usually have great performances on this issue while monumental ones usually have such inertia that nothing else's necessary	1	absurd laws on thermal, acoustics, etc... that are conceived for new buildings and don't apply to historic ones.	1	Support and guidance focused on this kind of buildings and not only on new ones.	There are some studies but disperse and not well known	For most attempt studies on vernacular (materials and passive)	Same of before	I don't know any	Yes there are	No	
67	Norway	Northern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos	ICOFORT	You have to change historic building, because of everlasting quality, to new ones with poor quality.	3	Calculation of energy retrofit data	3	Regulating single family housing	3		2	Calculation data based on retrofit, not new buildings	No		Im not aware of it		Yes	There is funding for historic buildings	We have to collect data of retrofit in historic buildings that compare the entire life span of a building. It has been found that a building that is retrofitted after 2-300 years, that need to be compared to new energy effective buildings with a excpected lifespan of 30 years. Which building has the lowest carbon footprint?	
68	Ireland	Northern Europe	academia	Researcher (social science)	Academia and Research	No	No, I'm not a member of Icomos		regulations, lack of funding	3	energy efficiency of historic buildings specifically	3		5	The lack of policies to support improved energy performance can be a barrier in the retrofit planning.	3	Support for professionals and users during the decision making process, and also best practice information.							Only that I am not an expert on this subject and I was not sure how to answer some of the questions - sorry I could not be more helpful	
69	Poland	Central Europe	academia	Associate Professor	Academia and Research	Yes	No, I'm not a member of Icomos		Difficulties in implementing typical energy-saving solutions that are cheaper to invest in	3		2		3		2					program Czyste Powietrze in Poland					
70	UK	Northern Europe	academia	Associate Professor	Academia and Research	No	No, I'm not a member of Icomos		Lack of guidance	3	I don't think they know how important historic buildings are and lack of understanding of heritage values, hence how to balance energy efficiency and values.	3	different uses, locations(climate conditions), construction materials	2		2	how to maintain heritage values and or unintended consequences (moisture related problems)			I think there are some funding bodies where you can get funding. However, I have not applied to them.					

71	Belgium	Central Europe	public authority, practitioners	Conservation Specialist	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	ICOMOS Belgium and ISC20C	architectural quality of outside skin, obsolescence of techniques (heating, cooling, ventilation), the legislation is too severe and not nuanced, lack of subsidies	2	flexibility is necessary in insulation degree, so different alternatives have to be compared with one heritage grid. The comparaison of different options/ solutions involve the knowledge of historic and contemporary materials and techniques, and skills in heritage assessments/ grids	3	La Cité Moderne garden city in Berchem-Sainte-Agathe (Brussels) built by Victor Bourgeois in the early 1920s. protected as heritage, and currently being restaured with different techniques on different housing typologies with traditional and natural insulation solutions, with always the heritage evaluation on top of criterias. La Royale Belge office building in Watermael-Boitsfort (Brussels), built by the architects Pierre Dufau,	4	too strong requirements in zero-degree or so closely possible (label A). For example concerning the renting market : an owner is not able to increase rent if energy performance is less than D or C. Also, owners need the rents to do insulation works... so nothing happens and many housing are becoming obsolete. Even well subsidised the policies need nuanced approaches with sustainable and respectfull solutions.	4	a lot of research is being done at academic level and a lot of good practices are being published. Efforts need to be better absorbed by policies. Permanend education and formation of experts is needed. It is a very technical debate and many people undergo difficulties to fully understand the challenges, heritage values and final visual projection; therefore it is necessary to make the things easier to understand, with strong and structured arguments, a lot of pedagogy	www.postwarbuildingmaterials. behttps://www.bamb2020.eu/about-bamb/https://www.epfl.ch/labs/lsam/innovaccrocrete.eu.rotordac.com	mainly subsidies because of their heritage status	funding for insulation, sun panels. collective housing with geothermic investments	yes but not enough	yes but enough	probably the main issue in near future and mainly regarding recent architectural productions
72	Poland	Central Europe	practitioners, academia	Architect, Urban Designer, Researcher	Architecture and Design	Yes	No, I'm not a member of Icomos		protection of the form and function, the barriers of the conservation officers, architects are afraid to try anything innovative - they are afraid not to get a permission, long time of permit receiving	2	basic knowledge of the possibilities of retrofit solutions, weak knowledge of new materials and they	2	current process, luck of literature - websides in Polish, not enough knowledge of the possible detail solutions	2	the longiness of the process stops the possibilities for the discussion,	2	the architect is chosing the most easiest / non controversial solutions	3	schoolings conducted / recommende by the conservation officers, their recommended sources and materials - if approved by the local preservation officers than more welcomed by the architects	The Sendzimir Foundation publications	I have basic knowledge	Yes, the sources are publicly announced. E.g. the photovoltaics sellers propose the use of the outside sources. The government, the local government	Not for private users	Only for high class monuments	
73	Germany	Central Europe	academia	Physicist	Academia and Research	No	No, I'm not a member of Icomos		Adaptation of the retrofit to the historic value	3	special treatment of details (windows, insulation, correct materials, etc.)	4	Retrofits which preserve the historic value of the building	4	Sometimes it is not easy to improve energy-efficiency due to details which must be kept	4	Support form experts of historic monuments offices	no	For private people there is refund of the additional effort for a CH building retrofit + tax refunds	I don't know	I don't think so	Yes I think so.	
74	Estonia	Northern Europe	academia	Associated Professor	Academia and Research	No	Yes, I'm a member of Icomos	Estonia	lack of joint interdisciplinary effort : the silos in management	4	Heritage experts have lot skills , but project managers for energy efficiency projects lack experience	5		4	energy efficiency has more weight than sustainability	4	for project managers	ICOMOS Europe group / ISCES study	https://kredex.ee/en/project-users	https://kredex.ee/en/materjalikeskus	no	yes	
75	Italy	Southern Europe	academia	University Lecturer	Academia and Research	No	No, I'm not a member of Icomos		conservation constraints	2	knowledge of historic construction materials and techniques	3		2		3	official guidelines from cultural heritage superintendence						
76	Estonia	Northern Europe	public authority, practitioners	Project manager of LIFE heritageHOME	Site/Project Management	No	Yes, I'm a member of Icomos	ICOMOS Estonia	1. Funding - to cover the cost of, both, energy efficiency improvements and restoration of historically valuable details. 2. Lack of knowledge of possible and suitable technical solutions (including traditional techniques and materials) for heritage buildings. 3. Excessive paper work when it comes to listed heritage buildings.	3		4	Energy retrofits that have brought about sufficient energy savings,	2	while preserving culturally valuable aspects of the building.		General restrictions regarding any changes to the construction and	2	appearance of the building which does not allow to discuss about the retrofitting solutions.		Lack of guidance that would sufficiently combine knowledge on energy retrofitting and respectful	2	restoration of historical buildings – usually these two competences lie in different people and tend to be controversial.	An ongoing project in Estonia called LIFE heritaHOME is collecting such data from local examples.	Yes. For recostruction of the building (insulating, window retrofitting etc) and for HVAC measures.	Yes. For recostruction of the building (insulating, window retrofitting etc) and for HVAC measures.	Not that I'm aware of.	Yes	The public funding currently available in Estonia is not bad fit for energy retrofitting listed buildings because it takes minimum 6-12 months to prepare all necessary documents (research, special conditions given for a specific building, designs, permitting, biddings) to apply for the subsidies but the information of upcoming funding is given in short notice and there is no certainty when a next funding opportunity will open and which will be the criteria in that specific case. Meaning, that those not able to carry out the works without subsidies are left behind. Also, the VAT on preliminary works (primarily the designing which is costly) out of their pocket if they do not have a certain outlook of subsidies - leaving those buildings without the possibility of retrofitting.
77	Switzerland	Central Europe	academia	Historian	Academia and Research	No	No, I'm not a member of Icomos		The main barriers to transforming historic buildings into more energy efficient include regulatory constraints, technical challenges, financial issues, aesthetic considerations, and gaps in expertise. Preservation laws limit modifications, while traditional materials and designs complicate upgrades. Costs are higher due to specialized needs, and aesthetic concerns require careful design to maintain historical integrity. As a historian, I emphasize the need to respect the cultural and	3	The main expertise and skills that are also lacking in making historic buildings more energy efficient seem to me to be following dimensions: Architectural Conservation: Experts who understand the principles and practices of preserving the historical and architectural integrity of buildings while implementing modern upgrades. Energy Engineering: Professionals skilled in designing and implementing energy-efficient technologies that can be integrated into historic	4	https://www.geneve.ch/themes/amenagement-construction-energie/protection-patrimoine/exemples-restauration/maison-favel https://www.geneve.ch/themes/amenagement-construction-energie/protection-patrimoine/exemples-restauration/villa-moynier		Many government incentives and grants for energy efficiency are tailored to new buildings or standard renovations and may not be available for historic properties. This lack of targeted financial support can make it difficult	3	for owners of historic buildings to afford the necessary upgrades. The process of obtaining necessary permits for energy efficiency upgrades can be cumbersome and slow. In some cases, multiple layers of review and	Financial incentives: Governments could offer tax credits, and low-interest loans for energy efficiency upgrades in historic buildings. These financial supports are crucial to offset the higher costs of specialized materials and skilled labor. Training and Education: Specialized training programs for architects, engineers, and contractors focusing on the intersection of historic preservation and modern energy efficiency. These programs		- Insulation Improvements - Window and Door Upgrades. - Heating and Cooling Systems. - Efficient Lighting. - Ventilation Enhancements. - Draught Proofing.			

78	Switzerland	Central Europe	public authority, practitioners	heritage conservator, architect, retired	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	Switzerland	Each historic building has its own specific characteristics: a rural building is completely different from a church in terms of energy efficiency. Currently, energy efficiency standards are calculated on an element-by-element basis and do not take account of actual consumption. This method of calculation puts historic buildings at a huge disadvantage.	2	There is often a lack of understanding of the existing construction and materials.	4	here is a lack of examples in ordinary historic buildings.	3	hen the cost of legal requirements is too high for owners.	4	?	no		yes, for insolation measures.	In Switzerland, these policies vary from canton to canton; in Geneva, public funding is granted for non-listed buildings.	Yes in Geneva.	In Geneva, public subsidies are available for the repair of existing historic residential buildings.	no								
	USA			CEO		No	No, I'm not a member of Icomos		Electric wiring, plumbing layout	4	Not the case, usually	4		3	When both state, county and city codes are involved	4		No		Boilers and insulation	Same as above	Not aware, but they exist in cerain states and cities	Not sure	No							
79	Turkey	Southern Europe	practitioners	Architect/Engineer	Architecture and Design	No	Yes, I'm a member of Icomos	ICOMOS Turkiye / ISCARSAH / ICORP	Restorators not aware of the thermal transmittance of the materials they use.	1	knowledge on construction materials and methods	1	A historic building at least keep its initial energy efficiency after retrofitted.	1		1	the owners of the assets need to be aware of the energy efficiency benefits.	https://hiberatlas.eurac.edu/en/about-atlas-917.html	No.	No.	No.	N/A	N/A								
80	UK	Northern Europe	practitioners, academia	Building Services Engineer (MEP)	Engineering and Construction	No	No, I'm not a member of Icomos		Funding, ownership agreement, general public knowledge, lack of guidance	5	I think we are still a bit far away from fully understanding how historic buildings would work with modern energy efficient methods and we also lack of understanding in finding that balance	1	Well recorded pilot projects including POE	3	When there's a net zero goal to meet, we have to understand that some historic building might never achieve that level of energy efficiency due to many factors	1	Building guide for historic building,	No - but I think this would be useful and personally would love to help building one	It's very difficult with ownership issues - public buildings have better chances but the process can be very long and not all the buildings get funding even if the buildings are at risk	Maybe. Depends on the purpose of the building and funding provider.	That would be the next step and would be brilliant but I found it hard to justify even with this super passion in historic building retrofit as there are so many social issues to address and those might gain priority	Yes - but I think they are very often running under time restrictions and some people don't really apply as they don't understand the importance of it and the complications of certain buildings ownership would also make funding access difficult	No							
81	France	Central Europe	practitioners	R&D Director	Other	No	No, I'm not a member of Icomos		Knoledge on Technical solutions and lack of dedicated product	1		1		2		2															
82	UK	Northern Europe	practitioners	Architect	Architecture and Design	No	No, I'm not a member of Icomos		Lack of funding, lack of knowledge and understanding.	2	Understanding of historic building types and performance. Breathability.	2	Sensitive and holistic examples	3	Policies sometimes do not sufficiantly take account of historical significance of old properties.	3	Clients or home owners guide is required to inform them if correct approach. Professional accreditation scheme would safeguard owners.	No		Yes, limited sources	As above	Don't know	Don't know	No							
83	France	Central Europe	public authority, practitioners	Local Urban Planner	Architecture and Design	No	Yes, I'm a member of Icomos	Spain	Costs associated technically to heritage buildings Lack of technical know-how amongst architects, technicians and builders Lacl of technical performance data for retrofits in mixed material buildings Reticence of heritage authorities to the modification of heritage-listed buildings and restrictive regulations Lack of assistance to individual owners as well as joint ones (copropriétés)	2	Knowledge outside specialised heritage construction companies about dealing with ancient materials Bad specifications, specification sheets and suppliers not appropriate for historic and traditional buildings	2	Cost-effective solutions Organising projects and financing in multi-ownership residential buildings	3		1	Project setup Specification skills amongst building professionals Analysis and understanding of heritage significance by building professionals (not heritage professionals)		Yes, for the diagnostic and specific improvement measures	Yes, for the diagnostic and specific improvement measures	No	Yes, there is more funding for existing buildings that for new ones		There is a lack of data on the performance of historic buildings, their energy rating does not add up to the sensory or lived experience. EU energy ratings are not able to measure and understand historic buildings to the same extent as newer ones. In France, the cost of energy retrofit of older buildings is pushing poorer residents out of historic districts and buildings.							
84	Czech Republic	Central Europe	academia	Architectural historian	Academia and Research	No	Yes, I'm a member of Icomos	Czech NC, ISC20C, CIVVIH, TheoPhilos	If "historic" means "pre-modernist", there is not enough of traditional fuel (wood, coal).	2		3	Buildings made of stone in cold countries. "Historic" modernist buildings with glass facades.	3	Approved insulation methods can destroy the architectural expression of buildings.	1				Yes, the governmental grant (in Czechia) for a "polystyrene" insulation.											
85	France	Central Europe	public authority, practitioners	Research Engineer	Engineering and Construction	No	No, I'm not a member of Icomos		Efficient technical solution that provide heritage value	2		2	examples of building that have been retrofit and then monitored to prove their energy efficiency			2															
86	UK	Northern Europe	practitioners	Traditional Builder	Other	No	No, I'm not a member of Icomos		Incorrect advice given to building professionals Budget. Craft skills. Lack of understanding from building control when it comes to a historic buildings	2	Misunderstanding or traditionally built structures and the use of correct building materials	3	Domestic buildings e.g small terraced houses in deprived areas.	3	There must be a clear distinction between solid and cavity wall construction and correct material use	5	The information is out there but often overlooked by architects, designers and local authority	BS 7913	Unsure	unsure	unsure	unsure									
87	Switzerland	Central Europe	practitioners	Engineer	Engineering and Construction	No	No, I'm not a member of Icomos		Lack of knowledge of existing tools/ products, lack of openness on the part of authorities, tedious procedures.	3	Above all, a lack of knowledge of existing adapted tools/ products (niche markets).	2	A database of examples of different types of buildings and renovations, in the various energy fields (building envelope, heat and power generation).	3	long, tedious procedures, very (too) demanding requirements	2	Personalized support, a step-by-step guide to help you make the right decisions, and redirect you to the best solutions (the right partners, the right tools and the right products).			yes : Building envelope improvement, heating replacement, implementation of photovoltaic systems (https://www.francaenergie.ch)	Probably on a case-by-case basis in the various communes (https://www.francaenergie.ch)	Probably on a case-by-case basis in the various communes (https://www.francaenergie.ch)							

88	Czech Republic	Central Europe	practitioners	Village Planner, Preservationist	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	CIAV, ISCES	Orientation of the market and companies primarily on new buildings, products, and material.	2	Multidisciplinary expertise/skills.	2	Unconventional measures based on heritage-based solutions, use of natural materials, etc.	2	Preference for modern measures to traditional ones, subsidy policy leading to maladaptations.	2	Construction and material-friendly approach in relation to historic values.	Yes, e.g. https://hiberatlas.eurac.edu	Yes, most support areas (thermal insulation, energy sources, adaptation, and mitigation measures) provided the consent of the monument preservation authority. Nevertheless, program conditions are not always compatible with protection in practice.	Yes, most support areas (thermal insulation, energy sources, adaptation, and mitigation measures). Unfortunately, it often leads to maladaptation in practice.	No, there is no funding for regular maintenance.	Yes, but only in the case of the listed cultural monument (under the Ministry of Culture) or non-listed buildings in protected areas in some regions (under Regional Authority/Office).	Maladaptation, loss of historical value and/or expression.
89	UK	Northern Europe	practitioners	Heritage Conservation	Cultural Heritage Professionals	No	No, I'm not a member of Icomos		Understanding of the performance of traditional buildings (their fabric and services and how they manage air and moisture flows)	3	1) Condition assessments, 2) building trades with traditional materials and methods, 3) specifying sympathetic and commensurate measures to work with the existing building	4	Need good examples across a wide range of typologies, as well as across 'levels' of retrofit	2	Policies often encourage single-measure solutions which creates perverse incentives to install such measures regardless of the appropriatenes s of the measure. Quality checks are also often lacking.	3	General guidance is there but further support for professionals in the sector is needed; clients need to properly resource retrofit projects to ensure individual buildings are properly assessed and measures are properly specified and installed.	There are best practice databases of guidance, but am unaware of databases of solutions (hiberatlas of course)	No / unaware	No / unaware	No / unaware	No / unaware	The best place to blanket spend money in this space is likely to be in the upfront assessment; the more that is known about a building at project conception, the more likely the better the outcomes.
90	UK	Northern Europe	practitioners	Chartered Surveyor	Other	No	No, I'm not a member of Icomos		Cost and confidence in the measures available	2	Survey and assessment of what is required, and the trades to do the work	4	Domestic scale, simple proportionate retrofit	3	It is often the perceptions of the policies that dominate lay thinking; most policies are reasonably permissive.	3	Examples of upgrade work by building typology	Historic Environment Scotland Refurbishment Case Studies seehttps://www.historicenvironment.scot/archives-and-research/publications/?publication_type=65	Yes, but only as part of a wider repair scheme, and normally public buildings.	Yes, but measures are generally modern systems that are not always technically appropriate.	No	Yes, but only on publicly accessible buildings, generally not private ones.	Building fabric upgrade is only one part - the plant and equipment is a significant factor, and often as expensive (and not always long lasting either...)
91	UK	Northern Europe	practitioners	Architect	Architecture and Design	No	Yes, I'm a member of Icomos		Knowledge	1	Interest in workmanship	1	Windows & Doors, tenements and terraces.	1	VAT!!	1	Every kind	EWHT etc	Sometimes, for studies	Difficult	No	Sometimes	
92	Italy	Southern Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos		interventions on envelope are often impossible on listed buildings	2		2				1							
93	Estonia	Northern Europe	public authority	Products Manager	Site/Project Management	No	No, I'm not a member of Icomos		EU directives, domestic rules of law but also nature of buildings.	2		2	Energy retrofit for building built not earlier than the end of 19. century.	2	Choice of materials. It's hard to combine ancient construction materials with nowaday's needs.	3	State/nation based detailed normatives, regulations.	No.	It is. Reconstructio n and renovation grants for apartment houses, private houses, municipality buildings.	It is. Reconstruction and renovation grants for apartment houses, private houses, municipality buildings.	No.	Yes, there is.	
95	Italy	Southern Europe	academia	Full Professor, University of Ferrara	Academia and Research	No	No, I'm not a member of Icomos		The prejudice that, because it is a historic building, there are no technologies suitable for intervention without losing its testimonial values and risking reaching unsustainable intervention costs	2	Skills that enable the identification of the most appropriate intervention strategies and technologies, without altering the historical and heritage values of historic buildings. Skills that enable designers to support their choices, also with experimental data, in discussions with the institutions responsible for authorising interventions on listed buildings.	3	examples integrating renewable energy sources (especially in window glazing); examples with thermal insulation with thermo-hygrometric regime control/ monitoring and without vapour barrier; examples mitigating increased thickness in roofing; delocalised VMC solutions	1	Prejudices of many ministerial institutions combining interventions on the possibilities/ opportunities of working on listed historic buildings, and thus the absence of a targeted attitude and policies of incentives.	2	technical and scientific support	none sufficiently and scientifically structured	too complex answer	too complex answer	too complex answer	unclear question	
97	Italy	Southern Europe	academia	Professor (University)	Academia and Research	No	No, I'm not a member of Icomos		preservation of historic and materials features	2	energy efficiency calculation, ability to balance conflicts	2		3	It depends if the historic buildings are listed or not. If they are listed, policies are not a barrier	2	tools for end users	yes, task 59 IEA	It was possible, not at the moment	It was possible, not at the moment	no specific funding	no specific funding	
98	Estonia	Northern Europe	practitioners	Built heritage adviser	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	ICOMOS Estonia	Main barrier is the lacking knowledge of the owners how to make historic building more energy efficient without dishoving the cultural values. Also the bureaucracy and sometimes the restrictions on renovation the building of cultural value. Not enough professionals (engineers, officials) who could help owners with the making their home more energy efficient.	3	Knowledge about the best retrofit solutions for the historic house of cultural value.	4	The complete renovation of the building (insulation, ventilation, windows, roof cover ect.) while the energy efficiency has increased but the cultural value has been kept.	3	At the moment the	2	A comprehensive guide to building renovation in digital form	No	In Estonia the public funding also takes into account the energy retrofit of listed buildings, however, there is no targeted funding extra for the energy retrofitting	The support from the local governments for the energy retrofit of buildings on the environmentally valuable area. The Foundation created by the Estonian Ministry of Economic Affairs and Communications also gives support for the energy retrofit of non-listed buildings		yes	I would like to get the report of this survey

99	UK	Northern Europe	practitioners	Chartered Engineer	Engineering and Construction	No	No, I'm not a member of Icomos		Lack of correct technology as air source heat pumps are inappropriate	1	Few people that understand older buildings which will lead to severe Mistakes	1	Understanding how old solid wall buildings work	1	Encouraging inappropriate technologies instead of waiting for appropriate ones and complete ignorance of politicians	1	More understanding of the fact that severe mistakes can be made and if you search you can find it but nobody bothers			Very few grants are actually available and what there are are spend on dubious works	Yes for some insulation if on social measures	No	No	The use of hydrogen must be encouraged
100	UK	Northern Europe	public authority	Management Consultant	Site/Project Management	No	No, I'm not a member of Icomos		Planning restrictions, skills shortages, methodologies.	1	Traditional joinery, working with lime-based aggregates, masonry, lead and zinc work.	1	Effective use of heat pumps in old buildings with high ceilings.	1	Reluctance to allow modern materials, constraints on replacing relatively recent fittings in listed buildings, too much focus on peripheral concerns such as the reflection of glass on conservation windows, lack of capacity and expertise on old buildings in planning departments.	1	Facts! There is a lot of contradictory information out there and inconsistent planning decisions. Is it really worth insulating walls on a stone house with walls that three feet thick? Is it worth insulating floors? Will an air source heat pump be sufficient to heat a Georgian house?			There should be a standard rate of VAT on all building work. It is ridiculous we have to pay 20% on retrofitting old buildings but if we knocked them down and built a new one, no VAT would be due.	There are grants available for replacement windows.	Not that I know of.	I don't know.	The energy rating system is not appropriate for old buildings and needs reform.
101	UK	Northern Europe		retired doctor	Other	No	No, I'm not a member of Icomos		Cost and planning restrictions	3		3	small domestic buildings	4	restrictions on double glazing and installation of solar panels	1	Financial	no		not sure	very little	no	a little for repair	
102	UK	Northern Europe	practitioners	Architect, energy and sustainability consultant	Architecture and Design	Yes	No, I'm not a member of Icomos		There are may: lack of technical knowledge (especially of moisture-failed risks), cost, lack of political/ policy support, etc.	2	Understanding and managing moisture risks	2	Examples related to UK dwelling types.	3	Not all UK local planning officers and Historic Buildings Advisors can balance heritage issues and the retrofit imperative as well as they should be. The official UK heritage bodies are improving this situation, but reconciling the two challenges and delivering appropriate retrofit is still difficult.	1	There is plenty of technical guidance and there are standards such as PAS 2035 and PAS 2038, but funding and incentives are scarce.	There has been some very good work on this under the PROTECT project at Middle East Technical University in Ankara, Turkey, which is a joint project with University College London (contact Dr Yasemin Arkas at UCL (y.arkas@ucl.ac.uk)). There has also bee a totof work on this issue by the uK Sustainable Traditional Buildings Alliance (https://stbauk.org/)	In the UK, yes, mostly for fabric measures, and for heat pumps	In the UK, yes, for nearly all retrofit measures: fabric, heat pumps, renewable energy systems	No - that is left to building owners.	In the UK there is little or no funding for repairs - that is a task left to building owners	More public awareness of the need to retrofit buildings is essential. The case is being eroded by electricity and heat pump companies promoting heat pumps as a panacea without the needforsignificant insulation to reduce deand.
103	UK	Northern Europe		Retired	Other	No	No, I'm not a member of Icomos		Cost, who is a trusted professional	3	I really don't know whether professionals have sufficient skills. I'm sure many do, but how can we be sure?	1	How would we know?	1	I don't think these are really considered in the planning process.	1	Publicity	Not aware		There does seem to be funding for fabric and pumps, but not nearly enough for most buildings that currently have gas boilers.	Same as above.	Don't know but suspect not.	Don't know.	
104	Spain	Southern Europe	practitioners	Sustainable Energy Technician	Other	No	No, I'm not a member of Icomos	POCITYF EU Project	Protection figures and integration costs	2	Historic buildings need very soecific integration technologies and installing abilityes that are not known by the regular companies	2	Regulatory solutions to let innovative and integrated retrofit in historical buildings	2	The policies usually do not let any integration of modern technologies, the professionals in cultural/ environmental institutions lack the knowledge of integration technologies and are scared of letting companies destroy important heritage	1	We are far of a proper support, there is need of bette knowledge of integration technologies and techniques, and examples of already done solutions, and possible ways to improve policies in such cases	Just some examples we identified through our project and what we are doing in our project here www.pocityf.eu	Not known	Not known	Probably not, I do not know any funding scheme for maintenance costs. It would be more an economic schem such as ESCO companies or something like that	Similar to previous answer	Not now
105	UK	Northern Europe	practitioners, academia	Built Heritage Planner	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	Wood - UK	Financial cost (short term), and property investment markets targeting yield not quality of outcome	2	Most	3	19/19-80's construction particularly in environments of intense and frequent driven rainfall.	2	No examples I can give	4	Guidance is adequate	Not aware	Not that I am aware of but there may be	Not that I am aware of but there may be	Not that I am aware of and unlikely to be the case	Not that I am aware of but unlikely	Disincentivise the use of unsustainable materials, EG through taxation, and vice versa
106	Norway	Northern Europe	practitioners, academia, public authorities	Chief Scientist in climate adaptation of buildings	Other	No	No, I'm not a member of Icomos		lack of skills and available cost-efficient solutions. Also, solutions and policies and incentives that promote such.	4		2	demonstration projects regarding solutions for single buildings (technology, incentives, processes, services), but also regarding neighborhood scale.	2		1	economic support, knowledge support			Partly, energy retrofit is not exploit, see https:// riksantikvaren.no/tilskudd/ - see also next question	Consultancies and technical equipment (PV, heatpumps etc) -https://www.enova.no/privat/		See above ("Enova" is for new and existing huuldings)	
107	Poland	Central Europe	practitioners	Architect, researcher	Architecture and Design	Yes	No, I'm not a member of Icomos		I think the main barriers are tied to the cost of materials and labour required to use solutions that are compatible with preserving heritage while enhancing energy efficiency and the general unwillingness to invest in them by project sponsors.	4	LCA, post-occupancy evaluation, IEQ and IAQ measurement	3	Examples in which energy efficiency is the project's main objective, instead of it being something that is tacked on just to make the project code compliant.	2	In Poland, most policies towards heritage are fully discretionary, which means that heritage conservation officers give dedicated, individualised guidelines for every listed building, and these can and often do conflict with energy efficiency, as heritage preservation is prioritised over everything else.	3		I do not know of any such database apart from HIBERatlas.HIBER	Yes, it is possible through the National Environment Protection and Water Management Fund, which evaluates full retrofit projects and subsidises main heat source replacement and envelope retrofits. Separate subsidies fund RES-based heat sources, mainly photovoltaics. The subsidies are not limited to listed buildings. A retrofit can also be subsidised as a part of a broader maintenance project that is available solely for	Yes, for main heat source replacement, envelope retrofits and RES.	Ongoing maintenance that consists of small works is not funded in any way. Retrofits are considered a form of 'major' maintenance works and they are subsidised.	Repair is subsidised, and thermal retrofits can sometimes be equated with repair.	The main barrier in Poland is that energy efficiency is considered non-essential when dealing with heritage, as things like the overall technical condition and usability of listed buildings are seen as more pressing. We're just not at that level yet, economically and mentally.

108	Sweden	Northern Europe	practitioners	Heritage consultant	Cultural Heritage Professionals	Yes	No, I'm not a member of Icomos		Big question with no easy answer. I would say visual impact, impact on historical material and impacat on historical knowledge	3	I think there is rather a lack of understanding and will	2	All kinds of examples, additional insulation, installations, ventilation, solar panels.	2	Unfortunately, economics comes first. This applies to both urban planning and building permit issues.	4	I believe that we have the necessary support but that available and consiant information is required.	no		It depends. For example, if the measures contribute to better preservation of cultural and historical values	I don't know. I don't think so	Not that I know of	If it is listed - yes. Otherwis - not that I know.	
109	Poland	Central Europe	practitioners, academia	architect, academic teacher	Architecture and Design	No	No, I'm not a member of Icomos		historical architectural substance	2	knowledge about historical structures and materials	3	Residential buildings: majority of European historic towns and districts are still inhabited. The residents have the right to live in contemporary, confortable conditions and be supported by cities/ governements to change theirs homes into more energy efficiency ones.	2	Equal protection of every historic building, regardless their style, historic/ artistic value and conditions. No clear rules for "historic protection zones".	1	Any	no		no	it is easier	I am not aware of any	I am not aware of any	I am not aware of any
110	UK	Northern Europe	academia	Book editor	Academia and Research	No	No, I'm not a member of Icomos		Finding effective measures that are consistent with conditions for listed building consent.	3	I don't know enough about it to judge.	1	Heat pumps. Solar panels.	2	Edinburgh Council is rightly protective of historic structures, but I believe compromise solutions will be necessary which to some extent contradict heritage authenticity. Finding a balance between competing exigencies will be difficult but necessary.	1	Widely accessible support/ guidance for non-specialist members of the public.	No.		Don't know.	Don't know.	Don't know.	Don't know.	No.
111	UK	Northern Europe	academia	Architect	Architecture and Design	Yes	No, I'm not a member of Icomos		The costs and ROI of suitable solutions that are acceptable	3		1	cost effective, climate -positive solutions that strike the balance between improved performance and impact on heritage values.	3		3		https://hiberatlas.eurac.edu/de/willkommen-bei-uns-1.html		the funding framework changes regularly. at the moment in the UK there is funding for heat pumps on domestic properties (not just historic ones)	As well as support for heat pumps finacial support for insulation is available to some households depending on income levels.	not to my knowledge	it depends	The use of PV technologies that are more acceptable in a heritage context usually comes at a higher cost and/or with lower efficiency, compared to standard PV panels. Specific subsidies to cover the additional costs could be helpful to encourage greater uptake of PV and BIPV on historic buildings.
112	France	Central Europe	practitioners	Engineer	Engineering and Construction	No	No, I'm not a member of Icomos		It's a complex issue, but I'd cite the following as some of the main factors : a lack of awareness of the diversity of technical solutions that can be implemented among any building professionals (engineers and architects included...), a lack of familiarity with these techniques among craftsmen, who tend to use conventional solutions that are unsuitable, and a failure to adapt public policies, particularly renovation grants, to the specific characteristics	Ideally, it would be necessary to assess the performance of the building and the compatibility of solutions, particularly in terms of durability, for each case. The lack of knowledge about the properties of heritage materials and how they behave when in contact with new or improved components is an inhibitor. Each solution needs to be adapted to the building, but enough examples of configurations and key evaluation points need to be provided to the	2	There are numerous platforms with performance feedback, such as HiberAtlas, that offer a high level of detail (energy performance level, carbon footprint, stakeholders, plans and sections, photos during construction phase, implementation details, construction difficulties, heritage compatibility, technical compatibility, challenges encountered, etc.). More examples of this type are needed to illustrate the diversity of effective techniques. The high level	2	At any level actually and more specifically for unprotected historic buildings for which there are not many technical requirements in case of energetic renovation. And as mentioned before, public policies (in France) are still mainly focused on energy efficiency to any "technical costs" with, for example, grants to change windows without any assessment of their historic value) and with simulations tools that rarely take into account the technical specificities of	3	There are some, but they are rarely evaluated in terms of their actual use by professionals, especially architects. So, we don't know if they are relevant, used, etc. Not to mention the lack of monitoring, dissemination, and training on how to use these tools, which are somewhat left on their own...	See deliverable T1.3 of CALECHE :) A lot of details about the advantages and drawbacks of each of the current databases listed in the project. There might be more of them. But among the main failures, the heritage assesement (before and after yhe rehbilitation project).	Yes, it is and it may concern any measure as long as it is well argued.	Yes, the same ones that are available for any buildings (including non-historic ones) for energetic savings. Those measures include insulation of the attic space and roof, insulation of walls from the inside or outside, replacement of aging heating equipment with more efficient devices, installation of double-glazed windows, installation of a double-flow mechanical ventilation system, conducting a thermal assessment... But there are also Foundation that will give grants as long as the heritage features are preserved or restored. But those last grants requires a very a detailed file justifying the heritage interest of the unprotected building.	Not that I know of...	Some specific funding focused on heritage preservation might fund repair and restore measures like it is the case for the French Heritage Foundation. But the main national and regional renovation public funding are energy and new measures focused.	No
	Canada			Executive Director		No	No, I'm not a member of Icomos		Costs, even with government subsidies (in Canada).	3	There is a lack of professional builders with crews who are equipped and knowledgeable of retrofit (at alone historical buildings.	2	Right now, we have some examples. We need many more to help develop the best tools and techniques. Canada is likely lagging Europe.		Unsure.		In Canada, the movement is nascent. We need more projects to build a body of knowledge to help guide retrofits across the country.	Hiberatlas	Yes. Various government grants and other funding opportunities (in Canada)	Unsure	Unsure. But my educatd guess is that is uncommon and where it does exist, it is likely not enough.	There is funding available for energy efficiency upgrades.	The barriers are in many cases the same as barriers to the retrofit market in general - right now they are too expensive and there are not enough professionals, especially experienced tradespeople who actually do the retrofits. In Canada, you can find architects, engineers, retrofit coaches and energy advisors to design a retrofit, but it is VERY difficult to find a contractor or experienced builder to execute the retrofit.
	Canada			architect		No	No, I'm not a member of Icomos		Economics, skilled trade shortage, building science expertise/ confidence, owner understanding of the benefits.	2	Understanding of how to construct continuous thermal, vapour and air control layers, thermal bridge mitigation. Understanding of how to install a balanced, properly commissioned HVAC system. Over sizing of heat pump systems is rampant.	2	Passive House level performance upgrades.		Where I live we have policies that encourage standalone measures and or incremental retrofits, which when not very carefully phased mean that projects have limited impact. Once the first task is completed, say new windows, there is little unlikely to subsequently add insulation for example. Also we have incentives for heat pumps/ electrification, so people install a heat pump, but if their building envelope is not robust then they still have problems with things like mould, energy, air quality, drafts etc but if they	1	Owners do not understand their options, do not know how to find funding, do not know how to hire qualified design professionals and contractors.	RetrofitCanada.com has a case study library. PHI and PHIUS have some retrofit examples on their websites	In my area owners can get $15,000 for facade updates, which could be used for better windows. Efficiency Nova Scotia has incentives for residential and commercial retrofit measures for HVAC and building envelope work, which some listed buildings could access.	Efficiency Nova Scotia has incentives for residential and commercial retrofit measures for HVAC and building envelope work.	no	Efficiency Nova Scotia has incentives for residential and commercial retrofit measures for HVAC and building envelope work.	
113	Poland	Central Europe	practitioners	Architect, Academic	Architecture and Design	No	No, I'm not a member of Icomos		too much expectations	5	local determinants	5	More to think about historical authenticity than contemporary requirements	2	Private owners often cannot afford the cost of renovation.	1	Private owners often cannot afford the cost of renovation.	No		Yes, but it is not a solution.	I don't know.	I don't know.	I don't know.	I am not convinced that energy retrofitting in historic buildings is a key issue for heritage and civilisational identity.

114	UK	Northern Europe	practitioners	Community climate and retrofit activist	Other	No	No, I'm not a member of Icomos		They weren't built with today's standards for comfort and energy efficiency in mind, so there is a lot of work to do. Planning restrictions (listed buildings and conservation areas in the UK). Availability of suitable skills for sensitive intervention. Tension between reducing operational emissions and costs, aspired full life-cycle carbon emissions. In buildings in joint ownership (eg tenement flats) there is not (yet) any obligation (nor a culture) to	2	Understanding of construction. Underfloor insulation (for ground floor suspended wooden floors). Wooden sash and case window renovation. Air-tightness improvement.	1	Edinburgh pre 1919 tenement flat buildings.	3		1	Financial support. Encouragement to invest more than the minimum to maximise operational emission savings over time. Independent, affordable professional assessment and advice. Policies and external, skilled, facilitation to guide joint owners of multi-owned buildings (eg tenement flat owners) to working successfully cooperatively together.		There has been occasional support, particularly in Edinburgh from the Edinburgh World Heritage 'Climate Emergency Grants'.	unknown	I don't think so.	Scottish Govt grants only support new measures.	People need to be educated (required?) to maintain their buildings, and to see repair, pro-active maintenance and retrofit planning and implementation as a continuum. There is possibly too much media focus on retrofit, as if it is something independent from repair and maintenance, and can be tackled separately.
115	France	Central Europe	academia	Architectural Historian	Academia and Research	No	Yes, I'm a member of Icomos	France, BC20C	Lack of knowledge and information, combined with pressure of the regulations/ fabricants.	3	As an architectural historian, I don't have the ability to answer this question	3	As an architectural historian, I don't have the ability to answer this question	2	As an architectural historian, I don't have the ability to answer this question	1		no		As an architectural historian, I don't have the ability to answer this question	As an architectural historian, I don't have the ability to answer this question	As an architectural historian, I don't have the ability to answer this question	As an architectural historian, I don't have the ability to answer this question	As an architectural historian, I don't have the ability to answer this question	no
116	Sweden	Northern Europe	academia	Associate Professor	Academia and Research	No	No, I'm not a member of Icomos		Cost	4		4		2	Contradicting requirements, unclear assessment	2	Economic support									
117	Sweden	Northern Europe	practitioners	Sustainability consultant within architecture	Architecture and Design	No	No, I'm not a member of Icomos		Knowledge within the organisation on adopted solutions (not newbuild/ industrial solutions)	2	I think both research answers and skills on how to balance between the historic values and the energy solutions are lacking. The energy solutions are targeted on new built or easy fix (changing a window instead of renovating a window) due to the fact that the building industry has worked and what the expectations from clients have been. I lack a disseminated knowledge within the professional consultants and handicraft and material industry on a	3	Innovative renovations using old knowledge and materials, less is more approach, based on cultural heritage competence combined with building physics research giving new knowledge and involving architectural value as well - what one experience in a room	3	In the early 2000 the Swedish Energy Agency had a campaign to replace old windows with new but it took until 2010 (or something like that) before renovating windows were given the same grant. The policies have been and are to a high degree determined by "new building knowledge - the industry of concrete-, plastic-, glasswoolsolutions, and such knowhow and research" not on "old building materials" or even woodknowledge and there is to little research and pilots today but there are	1	If I answer looking at historic buildings as buildings that can be protected there is way to little money/grants for renovation. In Sweden there is for private persons a reduction: ROT (Repairs, Conversion, Extension) or RUT (Cleaning, Maintenance and Laundry) https://spararochbevara.se/ a tax reduction a ROT or RUT deduction for the labour cost, but there is none for organisations making energi efficient renovations, repairs, conversions and extensions. We have an maintenans depth for buildings from		To some extent if research is involved.	Not without a lot of effort and not constant - there might be different calls but no systematic support, see earlier answer.	No, se last answer	No systematic support	no
118	UK	Northern Europe		Retired	Other	No	No, I'm not a member of Icomos		conflict between building conservation policies and current energy efficiency solutions.	2	The scale of the problem (to retrofit say 80% of historic buildings in a city like Edinburgh) is such that there are insufficient resources of all types to tackle the problem in the next 10 years	3		2	Currently it is near impossible to install solar panels on properties within Edinburgh's World Heritage Site - yet in Cambridge they have been installed on Kings Chapel, one of the most iconic buildings in the country. Why the inconsistency?	1		no		No sufficient to address the demand.	No sufficient to address the demand.			
119	UK	Northern Europe	public authority	Local Authority Worker	Other	No	No, I'm not a member of Icomos		Cost, Lack of Traditional skills, lack of maintenance and repair	3	conservation specialist contractors - e.g. joiners and stonemasons	2	retrofit at the domestic scale, examples of small scale interventions that prioritise feasibility for individual homeowners	4		2	the guidance is often either too specialist or too prescriptive - encouraging wholesale approaches that may not be suited to the buildings in question				various scottish government grants for heat pumps and solar panels	not aware of any but is needed	not aware of any but is needed	the primary barrier is the current condition of much of the historic building stock in the country - far too much emphasis is placed on interventionist measures that are not necessary until the building is in good condition - the application of these measures while the building is in a state of disrepair could damage the long term health of the building leading to greater problems in the future
120	UK	Northern Europe	academia	Technologist	Other	No	No, I'm not a member of Icomos	No	Restrictions based on building typology affect a significant portion of the historic building stock. Upgrading tenements, flats, duplexes, and the like is inherently challenging or unfeasible due to the complexities of multiple ownership rights and the associated financial and legal conditions. Additionally, there is often a misalignment between the technologies and techniques constraints of listed or conserved buildings, energy efficiency requirements,	2	Clear and unified objectives are essential for environmentally responsible retrofitting. Specifically, a statutory framework is needed to identify and implement retrofit strategies on a case-by-case basis, balancing whole life carbon with operational efficiency. The industry appears to be shifting towards large-scale deep retrofits, without a quantified understanding of the environmental implications, including impact on the lifespan of existing fabric/ equipment,	3	Constrained retrofits, retrofit of private multi-residential, adaptive reuse in general.	1	Constraints on upgrading sash and case windows to double glazed units. (Local to Edinburgh) a suspicious relationship with proprietary manufacturers of insulated shutters/blinds with sub-par performance and high failure rate. Listed status by association for buildings that do not meet the historic relevance benchmarks, but look nice next to buildings that do. This adds additional retrofit constraints to swathes of older building stock. Viewpoint approach to conservation	2			Quite the opposite in the UK. Retrofitting is subject to VAT, while new development is not. There is some funding but it requires using the services of a government approved/ accredited installer. The is generally an associated uplift in fee for accredited installers, negating some or all of the cost benefit in obtaining the grant. In a general sense it isn't feasible on smaller domestic projects to have a separate subcontractor, as insulation is within the main contract	Yes, see previous.	No		
121	Spain	Southern Europe	practitioners	Master Ingeniero de Caminos Canales y Puertos	Engineering and Construction	No	No, I'm not a member of Icomos		Las excesivas medidas de proteccion de fachadas	5		1	Medidas de mejora de fraisntlancias conservando el aspecto exterior del edificio	1	Proteccion de fachadas sin valor historico artistico	1	Programas de rehabilitacion energetica edificatoria subvencionado s	no		no	solo en edificios residenciales Plan Rehabilita del Ayuntamiento de Madrid	en edificios residenciales	en edificios residenciales	Programas equivalentes a los edificios residenciales para todos los usos

122	UK	Northern Europe	academia	University Researcher	Academia and Research	No	No, I'm not a member of Icomos		as an ordinary member of the public, I think public awareness of the options and then the affordability of the options. I'd like to make my single-glazed windows more energy efficient but I suspect the cost will be prohibitive.	3	I don't know. I put 3 for I don't know.	3	I don't know. Again, I'm a failed building owner but just an ordinary member of the public and I don't know.			1	any? I don't know of any.							
123	UK	Northern Europe		Retired	Other	No	No, I'm not a member of Icomos		Costs and restrictions on what can actually be done - re Category A nd B listed buildings	2	understanding the need to preserve as much historic wood, stone etc of the building. Not all understand how to correct damp.	2	Building that has been fully renovated in Edinburgh - showing best practices.	2	Edinburgh city centre has tenements. Big push to fit air pumps, solar panels etc - Will affect look of the building -	2	I am aware of Home Energy Not explored what assistance they provide for historic buildings.	I am aware of Under One Roof - provides advice for historic building and tenements	I am aware grants are release in edinburgh -	You can with Home Energy Scotland - improving insulation and more	Not aware	If you are an owner - no		Took a long time to agree double glazing could be inserted into listed tenements. some of the windows are large - very expensive to replace single glazing to double glazing - strict rules on replaces wooden sashes - even on back of building.
124	Belgium	Central Europe	academia	University Professor	Academia and Research	No	No, I'm not a member of Icomos		conflict between heritage value and energy saving measures, budgetary issues, need for multidisciplinary expertise	4		3		4		3	guidance on assesment of energy savings, and degradation risk		yes	yes, typical subsidies for energy saving measures	no		
125	UK	Northern Europe	practitioners	Director	Other	No	No, I'm not a member of Icomos		PLanning Department, lack of Qualified Tradesmen	2	Roofing, INsulation systems, Carpentry for Windows	2	Proper double glazing, roof insulation in old buildings	1	Full Double Glazing is not allowed	2	Consistent Planning rules, implementation, funds and grants	No	No, very difficult, money runs out each period	Dont know	No	Dont know	Tenements require mandatory escrow accounts to be established
126	Denmark	Northern Europe	practitioners	Consulting	Other	No	No, I'm not a member of Icomos		I believe that regulations regarding listed buildings is the largest barrier to develop historic buildings. Furthermore the pricetag is also an an issue - according to the possibility for customizing many of the solutions.	4		3		2	Ex. changing windows - new window solution do not have the same design as old windows have - so in many cases they will be approved by the authorities as an durable solutions.	2	More flexibility regarding approval of solutions from the authorities!	no	Som times - but difficult.	Som times - but difficult.	Som times - but difficult.	Som times - but difficult.	
127	Norway	Northern Europe	academia	Head of Department	Academia and Research	No	No, I'm not a member of Icomos		knowledge about old constructions and materials	1	engineering as well as architectural	1	Examples that include long term emission calculations and life cycle assessments	1		1	Easy instructions for engineers and craftsmen	No	Yes, partly	for example climate monitoring and control	Yes	Yes	
128	Denmark	Northern Europe	academia	Senior Researcher	Academia and Research	No	No, I'm not a member of Icomos		These buildings need careful renovation and increasing their energy efficiency is often associated with a high level of complexity. The conflict between conservation and energy performance requirements exist. The historic buildings are often more complicated in terms of hygrothermal performance. In particular, if internal insulation is applied, dehumidificatio n is needed for robust and risk-free future use, while maintaining the building's cultural value.	3	The historic buildings are often more complicated in terms of hygrothermal performance, that knowledge could be missing.	4	All kind of different buildings.	5	E.g. the use of photovoltaic can be very difficult due to the building requirements.	3	A good overview	www.hiberatlas.com		In Denmark we have a fund for year-round residences. It covers when renovating the building both the thermal envelope and the installations. We have also a fund for heat pumps.	No	Normally, for existing buildings, it is adding extra insulation to an existing facade or getting new windows.	no	
129	Denmark	Northern Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos		Limitations/ restrictions regarding which measures can be implemented. Knowledge transfer from, e.g., research projects to praxis.	2	State of the art solutions for, e.g., internal insulation, ventilation systems etc.	2	Examples for most types of measures would be beneficial, however, it is most important to demonstrate how to find solutions for the more complex situations.	4	Setting requirements that cannot be met, e.g., requiring a certain level of insulation for a building where only very limited space is available.	1	Examples with detailed descriptions of solutions but also descriptions on how/why this solution works and in which cases it is applicable and relevant to consider	HiBERatlas. In Denmark we also have a few "databases" with renovation cases, however, they are not focused entirely on historic buildings.	Yes, there are various possibilities depending on building type, owner type etc., but not particularly for listed buildings	Yes (see above)	Funding for maintenance can be achieved for certain types of buildings	Funding for repairs (maintenance?) is possible for certain types of buildings	The level of replicability can be a problem since most renovations of historic buildings will depend on solutions that are individually adapted to the specific case. This makes it difficult to develop directly useable best practice databases. An idea would be to focus solution databases more on principles and overarching methods rather than very specific solutions (the latter can still serve well as inspiration though and help identify the right solution for a given case).
130	France	Central Europe	practitioners	Town planner specialized in World heritage	Cultural Heritage Professionals	No	No, I'm not a member of Icomos		The main barriers to energy retrofit in historic buildings seem to be linked to a lack of knowledge of historic buildings specifics (locally sourced materials, inertia, specific ventilation system, ...) and advantages, especially in warm period, and lack of funding to have adapted global rehabilitation projects.	2	Energy retrofits experts have to know better historic buildings caracterics and specifics and vice versa. Energy retrofits experts too often don't understand historic buildings caracterics and try to apply technological solutions, not adequate to historic buildings, and even dangereous for historic buildings (like thermal insulation from the outside).	2	Examples of sustainable energy retrofit in historic buildings, build on a global rehabilitation project benefitting for both sides, architectural and thermic.	2	French Energy performance diagnosis doesn't take into account historic buildings caracterics and specifics , and could lead to create lots of uninhabitable and unused housing . Because historic buildings have bad Energy performance diagnosis notes and scores won't be able to be let, unless they are severely transformed and maybe loose their historic caracterics. Moreover historic buildings present important benefits and housing qualities during summer and	2	Knowlegde of historic buildings caracterics and specifics is proggressing but not enough. Historic buildings image and housing benefits is damaged bys French Energy performance diagnosis system. Energy retrofits of historic buildings needs money to be able to do special studies, special solution to each building .		It possible to get public funding for the energy retrofit of listed buildings. It depends on each rehabilitation project. National public funding can be complemented by local governement s funding.	There are different king of public funding for non-listed buildings but there are lots of these buildings, forming great part of cities. National public funding is unsufficient these non-listed buildings and the rest depends of the local governements. The future uses of many non-listed buildings is threathened by the french Energy performance diagnosis system. Architects, engineers, buildings experts are alerting and trying to better knowlegde, information and studies to give good examples.	Funding can only be available for very expensive global rehabilitation projects, very few for maintenance.		Barriers to energy retrofit in historic buildings seem to be linked to a lack of knowlegde of historic buildings specifics (locally sourced materials, inertia, specific ventilation system, ...) and advantages, especially in warm period. Thermal insulation from the outside in energy retrofit is dominating in France, partly du to strong lobbies. This could endanger all the non listed historic buildings and historic cities. It seems different in others europeans countries, especially of northern Europe. I would like to know the results of the survey.

131	Sweden	Northern Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos		Financial aspects	2	Finding alternative solutions that are not mainstream. Often their knowledge is on new constructions with new materials, and thereby the professionals are not the solutions (made for new constructions) also in renovation projects.	4	Renovation of windows, from beginning to end, toghether with its costs and carbon impact.	5	Sometimes the regulative framework regarding energy use is not in line with other regulations, such as circularity or carbon impact, and vice versa. As a result of this complexity, nothing is done, and business as usual is followed to avoid making any mistakes.	4	In Sweden, there are not enough carpenters with renovation skills. They are good at new built, but not taking care of existing buildings. Since there is a lack of skilled persons, the competition is low, with high costs as a result.	https://bsk37.ipa-ehc.org/	Grants may be awarded for culturally and historically justified additional costs for the conservation of buildings of cultural heritage value.	You can apply for a grant to cover the material costs of certain measures related to the heating system of your house. Please note that labour costs and fees for connecting to a district heating network, for example, are not covered by the grant. You can apply for grants for energy efficiency measures on heating systems and climate screens. A climate screen is a layer of glass, external walls, windows and doors that form the boundary with the outside world. To receive a grant for measures on the climate screen, you must first have received a grant for heating system measures in the same detached house after 8 November 2022. Heating system measures You can apply for a grant for the following heating system measures: installation of a water-based or air-based heat distribution system connection to a district heating network installation of a controllable exhaust air heat pump, air-to-water heat pump, ground	No	No funding for repair.		
132	UK	Northern Europe	academia	University Lecturer	Academia and Research	No	Yes, I'm a member of Icomos	UK	owners funding and reluctance, limited maintenance culture, not clear information or insight which is the most effective retrofit measure	4	I think the solutions are there, but owners would go for the cheapest and most immediate one. Also, lack of a decisive and economical assessment method pushes for those immediate solutions (cavity insulation, new window, new boiler)	3	HES, SEPA and EWH have been involved in a few	3		4	A more operational dissemination of exemplary case studies among contractors.		I think there is, but is probably limited.	This is probably limited to some very specific measures.	I think it is even less available, apart from possibly some very local schemes		I think so		
133	Belgium	Central Europe	academia	PhD researcher	Academia and Research	No	No, I'm not a member of Icomos		heritage services' hard restrictions, little room for negotiate. Cost of specialised building materials fitted for historical buildings.	3	looking further than the classis systems. Not always with spefic materials/ systems for historical buildings.	2	simple single family houses where the retrofit is done without a budget of millions	2	Historic buildings are exceptions in legislation, so there is no real incentive to do the retrofitting.	2	very specific guidance on historic buildings and solutions on specific installations and materials. they are often overseen by owners. Financial support can also help.	hiberatias.	it is possible, but not aware of the details.	yes, certain cities give subsidies for remarkable buildings	not that i know of		not that i know of		/
134	Spain	Southern Europe	academia	Researcher	Academia and Research	No	No, I'm not a member of Icomos		Budget and awareness.	2	Impacts in cultural heritage	3		2		2	Technical details	Hiberatias	Depending of the region	Depending of the region	Depending of the region		Depending of the region		
135	France	Central Europe	public authority	Heritage Manager	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	Spanish National committee	original materials are not adapted to new climate patterns; adaptation to contemporary energy standards might lead to the destruction of traditional decorative elements or the overall aesthetic of the building; loss of living surface in small historic dwellings	3	understanding the behaviour of historic building solutions and the required performance; aesthetic and historical sensibility	3	all	2	not specific policies/ exigencies apply to historic (non gazeted) buildings	3	national level consensus and guidelines	no	of buildings in general (all kinds of insulation works that entail a certain level of energy savings)	same as above	yes, evaluations etc		yes		
136	Iceland	Northern Europe	public authority	Specialist at the building collection at the National Museum of Iceland	Cultural Heritage Professionals	No	Yes, I'm a member of Icomos	Iceland	Interference with original building fabric and appearance	2	General skills on how to integrate the two both from a technical and conservational perspective	3		2	In Iceland I believe that policies do not generally take conservation into account	2	In Iceland, everything	Yes from the Nordic countries (National Heritage Agencies)	Not specifically in Iceland	Not that I am aware of	No		Yes, funds for listed buildings that the Heritage Agency manages		No
137	UK	Northern Europe	public authority	Strategy Officer - Climate Change Team	Other	No	No, I'm not a member of Icomos		1. Lack of skilled tradies that are aware of the complexities of historic building materials and construction style. Real lack of joined-up thinking, fitting on new, measure without assessing the full building. 2. Poor / lack of guidance available on the best measures for historic buildings Due to lack of data, historic buildings are often just labelled as 'hard to treat' 3. Inflexible planning law and policy - UPVC windows may not be historically accurate or innkeeping, but will allow the	2	Insulation and ventilation experts for historic properties Lime Plasterers. stone masons, roofers - we need more roles that understand the makeup of historic properties, too often tradies use the wrong materials (e.g. spray foam) and damage the building	3	Tenements, pre-1920s of all types, 1950s/ 60s brutalist	4	- Often can be contradictory - we need to retrofit all buildings to certain EPC levels / away from fossil fuels but tighter controls on historic / listed / conservation area buildings. - Lack of flexibility for different types of historic/ property - very one size fits all policies. - Perception of policy being read by individual planning officers, some take stronger views.	2	Archetype-specific guidance, again very one size fits all. Support / guidances for wartime/ community area too, not just Scotland or UK specific.	No	Unsure	From personal experience this is very limited if any.	Unsure	Unsure		Possibly from a skills perspective, there is a need for better advertisement and understanding of careers on historic buildings, would be great to push retrofit courses for historic buildings through colleges / apprenticeships more (I'm college has started a 16 week industry / college partnership course on this).
138	Poland	Central Europe	practitioners	Architect	Architecture and Design	Yes	No, I'm not a member of Icomos		Money	5	We are not mainly lacking in design expertise, but also in fund application and subsequent accounting. financial installation is a huge problem for investors	2	Like the one in Kopenhagen.	1	EU funding policies, have very clear frameworks and criteria. This is by no means a problem if the investment is prepared correctly. However, if the project documentation is deficient, the execution phase can be difficult and complicated, not only in execution but also in settlement of the project.	2	It would be good if there was some kind of summary/ publication that investors could use.		there are many different types of funding and obtaining them is not a problem. The main problem is accounting for these funds	as above	not that i know of				

139	UK	Northern Europe	academia	Building Scientist	Other	Yes	No, I'm not a member of Icomos		Neoliberalism.	2	Almost everything. The energy people don't tend to know enough about historic buildings, the historic buildings people not enough about energy and particularly technical systems, and the policymakers and regulators often fail to strike an appropriate balance between historic significance performance and energy and carbon saving. Construction professionals tend to want to do too much, and very few people seek to put people first	2	Across the whole range of interventions, from soft touch to deep retrofit, with much more on cost-effectiveness for both money and carbon, and much more attention to technical risks and unintended outcomes. Since all buildings are different, a clear appreciation of context is important. One size does not fit all!	The tend to be either too draconian or too lenient, and can be poor at taking account of context. And they are too often based on theoretical (eg EPCs) rather than actual performance.	2	Perhaps the most important is about how to select a good team, and how to manage them through the process. Too many projects I have seen have gone off the rails owing to tunnel visions of various kinds. And they tend to work out too expensive.	Not really. There are scattered examples, but few of these have been followed up in the longer term.	With difficulty. Often the constraints of the funding don't really suit the circumstances . But I am no expert on this.	In the UK this normally applies to insulation, draughtproofing and heating systems including heat pumps.	Not normally. There is of course also a problem of neglected maintenance. "Fabric first" should mean maintenance first, not insulation first!	Normally, only new measures, though there are some exceptions. For example in the UK, thermal upgrading of windows can be exempt from 20% VAT, and sometimes this has allowed the fairly comprehensive repairs necessary as a pre-requisite to be included in the exemption.	While historic buildings professionals tend to know about in-use performance, the majority of the construction industry doesn't! There is a huge amount of work to do to get into the retrofit market. This is a systemic issue of culture, which information and training is unlikely to solve effectively. We also need more multi-skilled practitioners, particularly for the smaller projects. And locally-based too.
140	Italy	Southern Europe	practitioners	R&D Manager	Other	No	No, I'm not a member of Icomos		Integration of Cooling/heating systems and Renowable Energy	4	MEP Engineering	4	Integration of PV Systems	4	Eco/sisima bonus	4	Best practices handbook.								
141	Belgium	Central Europe	public authority	Civil servant, heritage consultant	Cultural Heritage Professionals	No	No, I'm not a member of Icomos		Preservation of heritage values must be weighed against any gains	3	Knowledge of the possible solutions such as the integration of contemporary technologies	4	Preservation of historic joinery. Accepting the strength that older buildings have and accepting any limited loss of conformance in the process.	1	"Epc-regulations" in Belgium impose the same requirements on historic buildings as on new constructions	2	Support to support and inform individuals facing a restoration or renovation work. Guidance on the sustainability and circularity that old buildings hold.	RDMZ, monumentenwacht, Embuild.	https://www.omgevenderfgoed.be/voor-verfijening-van-de-energieprestatie	No, not as a function of preserving heritage values	https://www.omgevenderfgoed.be/voor-beheers-herstellingswerken-tot-250000-euro	https://www.omgevenderfgoed.be/voor-beheers-herstellingswerken-tot-250000-euro	People are often unaware of the sustainability of old buildings. The carbon 'debt' of older buildings has long since been repaid. This debt is also much smaller than that of new buildings because with traditional ones building blocks. On the other hand, old building techniques are more traditional and circular (re-use, possibility of dismantling for local repair, sustainable and local materials, etc.).
142	UK	Northern Europe	owner	Retired	Other	No	No, I'm not a member of Icomos		Coatfor the owner	3	The expertise may exist - but the historic owner may not know what kind of expertise is most relevant, or where to get it.	3	Like our house - individual dwelling, 200 years old, not an outstanding monument		It's complicated. I have to consider what is feasible from among: underfloor heating, air source heat pumps, solar panels, battery storage, flexible electricity tariffs, additional insulation in a roof, internal insulation that might spoil the character of the building, and possibly other options. Grants and loans are available for some of these, but not all. What would be most helpful is an expert appraisal of the house, leading to a costed plan.	2	See above	No	As far as I know, not specifically for listed buildings	Partially - see Home Energy Scotland	Not as far as I know	Not as far as I know	Part of the problemfor non-experts like me is that the issues are not only complex, but keep changing - both the technology and the policy environment.
143	France	Central Europe	academia	Research Engineer	Academia and Research	No	No, I'm not a member of Icomos		insulation, energy production	4	Integration of PV elements in historic buildings, conservation of old materials	3	More news about good examples should be disseminate		Requirements concerning the acceptable solutions related to esthetic and protection.	2	information about steps towards solution acceptance, kind of acceptable solutions.	None	call for projects for insulation and renewable energy addition	All kind		Most of the time funding are provided to new measures.	None
144	Italy	Southern Europe	academia	Associate Professor at University	Academia and Research	No	No, I'm not a member of Icomos		Awaresness about passive strategies for valorization of intrinsic characteristics of historic buildings and the conviction of using the same project's solutions used for not traditional buildings without a modification in the approach	2	Awaresness about passive strategies for valorization of intrinsic characteristics of historic buildings and the conviction of using the same project's solutions used for not traditional buildings without a modification in the approach	3	For sure, examples of public buildings, but it could be important to see more private buildings too		Before the complete exclusion, then the freedom to intervene but with the legislative restriction "if the solutions do not implies relevant modifications" .. policies are too general, precise rules are still missing to guide professionals	2	a robust, unique and recognized code is needed, with indications about the approach to follow in case of different kind of historic heritage	https://riberaitlas.eurac.edu/it/benvenuti-1.html	yes, for the public ones for the retrofit of envelope (insulation) and plants	yes, several	I am not sure	yes, there is	
145	France	Central Europe	practitioners	Civil Engineer	Engineering and Construction	No	Yes, I'm a member of Icomos	French committee	2 Barriers : First the time and money project owners allocate for projects conception and preliminary studies and second the lack of skills among players.	1	Tailoring work based on standard intervention (on the contrary of specific intervention in any case). We are lacking also ventilation skills in renovation.	3	We have usually good examples of very nice energy retrofit with large budget. It would be usefull to have "modest" examples with quite common houses or offices in historic buildings. It is also important to consider different level of need of preservation.	4	In France it is quite difficult to discuss the energy retrofitting with heritage authorities early enought in the project. Usually it is too late.	3	Guidance / support with technical consideration for professional such as detail notebook	https://www.rehabilitation-batiancien.fr/ - https://riberaitlas.eurac.edu/en/welcome-1.html - https://www.observatoirebbc.org/batiments/patrimoine/?obs_b_mosaicartlPrefB_patt	Yes it is possible but the amount of money is quite low.	Yes, there is CEE funding (https://france-renov.gouv.fr/aides/cee) for each measures with energy effect. There is also regionnal fundings and national fundings dependant of the incomes of the building owner.	no	no	
146	UK	Northern Europe	practitioners	Building Conservator	Cultural Heritage Professionals	No	No, I'm not a member of Icomos		Occupant behaviour, lack of maintenance, attitudes towards thermal comfort, lack of urgency surrounding climate emergency	3	Expertise/skills very unevenly distributed amongst professionals.	2	A holistic approach that considers occupant behaviour, energy consumption and an assessment of the environmental impacts of energy retrofit against the reduced operational impacts.	1	VAT payable on maintenance/ retrofit costs, new build costs VAT exempt. Conservation Officer decision making process, failure of Building Control to allow for special character of historic buildings and their unique hygrothermal qualities.	1		Historic England and STBA: https://responsible-retrofit.org/greenwheel/	ASHP	ASHP	No	No	

147	UK	Northern Europe	practitioners	Builder	Engineering and Construction	No	No, I'm not a member of Icomos		Conflict between planning restrictions and building control restrictions.	2	Lack of understanding about what keeps an historic house warm.	1	Georgian townhouse	1	Draft proofing windows. Double glazing windows. At the same time triple wards to windows and limits to double glazing.	1	We have worked on category a listed building for 24 years, probably over 100. We have never had any contact with Historic Scotland or similar.	No		Don't know	Don't know	Dont know	Not aware of any. Used to be vat help	Vat rates back to 0% would be a start.
148	Belgium	Central Europe	practitioners	Engineer-Architect	Engineering and Construction	No	No, I'm not a member of Icomos		financial, legal (long course of proceedings to obtain permits, sharing energy sources, ...)	2	holistic view on renovations and the focus on aesthetical measures that are not always compatible with the desired thermal comfort/ underestimation of mold - humidity related problems when insulating from the inside.	2	How to renovate a family dwelling with a reasonable budget?	2	Focus on the visual outlook of buildings is too strict. Lack of regulation that encourage shared energy services.	3	In Belgium: scattered subsidy schemes, depending on the region your building is located in, same for energy labelling: different demands in different regions. Aligning these subsidy schemes and benchmarks based on climate zones (even on a European level) could enhance large renovation schemes.	yes, through the EU Horizon heritace project		yes, for renovating the building envelope (depending on the energy-score that is obtained through renovation), for PV installations (energy independency)	yes, for renovating the building envelope (depending on the energy-score that is obtained through renovation), for PV installations (energy independency).	no	only new measures	Aligning these subsidy schemes and benchmarks based on climate zones, on a European level, could enhance large renovation schemes.
149	UK	Northern Europe	academia	Lecturer	Academia and Research	No	No, I'm not a member of Icomos		Supply chain; quality of service provided	1	Understanding the consequences associated with each intervention, and the consequences of inappropriate installation	2	Long term performance of energy efficient historic buildings	4		3	Maybe there is too much guidance. There is a need for non-conflicting practical guidance across the different organisations	the HiberAtlas :)			Funding in the UK is primarily for social housing (listed or not)	no	no	
150	Greece	Southern Europe	practitioners	Architect and Consultant	Architecture and Design	No	Yes, I'm a member of Icomos			2		1		1		1										

Northern Europe	Architecure and Design
Central Europe	Academia and Research
Southern Europe	Engineering and Construction
	Cultural Heritage Professionals
	Site/Project Management
	Unsorted

Annex 3 – WP1 Interviews – Complete List of Interview Questions

List of interview questions used for FuturHist Work Package 1

Abbreviations: PRA: Practitioner, PUB: Public Authority, PRO: Professional Owner, PRI: Private Owner

Question ID	Interview question	PRA	PUB	PRO	PRI
QROLE	What is your professional role in relation to energy retrofit of historic buildings? For how long have you been working in the field?	x	x	x	
QBARRIER	What are the main barriers to making historic buildings more energy efficient?	x	x	x	x
QTECH	Barriers can be divided into technical, regulatory, financial and social. Can you think of any technical barriers, and how important would they be? Technical barriers are challenges related to the specific needs of historic buildings because of their construction and the materials used. It can also be lack of competence regarding such needs.	x	x	x	x
QREG	Can you think of any regulatory barriers, and how important would they be? Regulatory barriers are related to policies in different sectors, as well as lack of information to stakeholders regarding such policies.	x	x	x	x
QECON	Can you think of any economic barriers, and how important would they be? Economic barriers are challenges to make energy retrofit projects financially viable for historic buildings.	x	x	x	x
QSOCIAL	Can you think of any social barriers, and how important would they be? Social barriers are related to attitudes and awareness related to energy retrofit in historic buildings.	x	x	x	x
QTARGET	FuturHist deals with the energy retrofit of historic buildings, what do you think about current renovation rate? Are we going to meet national/european targets?	x	x	x	
QPOLICY	How well does current policy related to energy retrofit work in practice? What are strengths and weaknesses with current policies?	x	x	x	x
QEXEMPT	There is a possibility in the EPBD to exempt listed historic buildings from demands on energy efficiency. What do you think about this option?	x	x	x	x
QSUST1	Can current policies on energy efficiency hinder other dimensions of sustainability?	x	x		
QSUST2	If yes, what can be done to avoid negative effects on other sustainability dimensions?	x	x		

QIMPROVE	In sum, what do you think could be improved at the level of policy-making regarding energy retrofit of historic buildings?	x	x		
QGUIDE	Are there guidelines/standards for the overall planning process of energy retrofit in historic buildings? How are they used?	x	x	x	
QASSESS	How are energy retrofit projects in historic buildings generally assessed? (both before and after implementation)	x	x	x	
QMONITOR	What is generally monitored in retrofit projects? What stages (before, during, after?) Do you have internal routines/guidelines?	x	x	x	
QREASONS	Have you done any major renovation in your building(s) in recent years? What was the main reasons for the renovation?			x	x
QPLANNING	Do you plan any major renovation in your building(s)? What are the main reasons?			x	x
QEE	What have you done to make your building(s) more energy efficient? Do you have plans for future actions?			x	x
QPRA1	Which guidelines/standards, tools/softwares, practices do you use for the different steps in the planning process as described below?	x			
QPRA2	Are there any guidelines/tools that you would like to be developed?	x			
QPRO1	Do you know of any case where the protection of heritage values came into conflict with aspirations of energy efficiency? Can you describe the case and how it unfolded?			x	
QPRI1	Why is it important to save energy in your building (if you think so)?				x
QPRI2	Have your ambitions to make the building more energy efficient come into conflict with the preservation of heritage values?				x
QPRI3	Are you aware of any subsidies that are relevant for the energy retrofit of historic buildings (in particular for HBs)? Can you get subsidies for energy efficiency measures? Have you applied for such subsidies?				x
QPRI4	Do you know where you could go to find good advice?				x
QPRI5	Is there any any kind or information (guidelines, best practice, etc) that you are missing (in relation to energy retrofit).				x
QPRI6	What do you monitor (IEQ, energy use) in your building? What stages (before, during, after?)				x
QPRI7	How do you use the monitoring data?				x
QPRI8	Would you like to monitor more and if so, why?				x
QLAST	This was the last question. Is there anything you would like to add (related to the themes we have discussed?)	x	x	x	x

Annex 4 - WP1 Interviews - Practitioner form

Form to be filled by practitioners regarding guidelines/tools

Step	Guideline/standard	Tool (software etc.)	When
Heritage value assessment			
Pros/cons			
Assessment of the use of the building			
Pros/cons			
Condition survey and technical documentation			
Pros/cons			
Energy performance assessment			
Pros/cons			
Indoor environmental assessment			
Pros/cons			
Economic viability (e.g. LCC)			
Pros/cons			
Environmental impact (e.g. LCA, waste)			
Pros/cons			

Annex 5 - WP1 Interviews – Detailed analysis of feedback provided through practitioner forms

Heritage value assessment

Step	Guideline/standard	Tool (software etc.)	When
Heritage value assessment *(6 respondents)*	There is a strong consensus that heritage conservation legislation/standards are the main guidelines/standards or databases used for heritage value assessment. They are developed at different level: international (e.g. Venice Charter, The Athens Charter for the Restoration of Historic Monuments) for 3 respondents (Spain, Poland, and Sweden), national for 4 respondents (2 in Spain, 1 in Poland, and 1 in Sweden), regional (e.g. Andalucia) or local (city level).	Consensus amongst 3 respondents (Spain, Poland and Sweden) on the need to implement the task to study the history of the building and its context and to carry out a site visit (Spain, Poland, Sweden). In both cases, no specific tool was mentioned. 2 respondents (UK and Sweden) mentioned the need to implement the task to analysis of the significance of the building, but no specific tool was mentioned. 2 respondents (Spain, Poland)) mentioned the tools	Clear consensus amongst 6 respondents (3 in Spain, 1 in UK, 1 in Poland and 1 Sweden) that this step should take place at the beginning of the retrofit process (either at pre-design stage or at the start of the design phase) 1 respondent also mentioned that the heritage value assessment should also take place happening at a more advanced point in the design - i.e. the building permit stage (when a planning permission/listed building consent is sought from a city council or

	Other pieces of legislation were mentioned: environmental legislation (European and national level), construction/planning legislation (national level). Professional practice/processes/methods at national level (e.g. conservation statement in UK or Kulturhistoriska värdering av bebyggelse/Cultural-historical evaluation of the buildings in Sweden) to analyse historic significance were also mentioned.	(databases/software), managed by local/regional/national authorities, that compile, provide access to and enable the visualisation of data on historic buildings (e.g. monument/historic buildings registry/geoportal). This could be also considered as an external resource. 2 respondents mentioned the tools used to create drawings (e.g. Polycam, Autocad). One respondent said he did not use any tool.	local authority).
Pros/cons	Accessibility of heritage conservation legislation/standards was mentioned as an advantage whilst the difficulty to adapt them to individual buildings was seen as a disadvantage (mentioned by 2 respondents). Other advantages mentioned for		

	heritage conservation legislation/standards: well-integrated system, the fact there are international standards, clear legal framework, protection of the character, appearance and aesthetic of assets. Other disadvantages mentioned for heritage conservation legislation/standards: they limit or prevent retrofit interventions; it is a time-consuming documentation process. There were more advantages mentioned than disadvantages.		

Assessment of the use of the building

Step	Guideline/standard	Tool (software etc.)	When
Assessment of the use of the building	There was potentially a problem with the wording of the question - as one respondent said he was not	The feedback is quite diverse and touched on various aspects. 1 respondent said that it is not the	Consensus on timing amongst 3 respondents (1 in Spain, 1 in UK, 1 in Poland) that this step should

(6 respondents)	sure to understand the question. Some respondents seem to have adopted a holistic approach to answering the assessment of use - considering structural survey to probably define what type of loads (applied to the building structure) and activities can be acceptable in a given building. A respondent said it was not the architect's responsibility to assess the use of the building and that is was done before the design phase. The intent of the question was to focus on the assessment of the historic/future use of the building. It seems that some respondents understood it. Strong consensus on the need to refer to construction/planning legislation/standards at national level (3 respondents) and heritage	architect's responsibility. 1 respondent mentioned the tools to engage with users and collect users feedback (e.g. in-house Home Standard Tool) and the tools to understand the use of the building by users (e.g. heat maps). 2 respondents (Spain and Poland) mentioned the task to carry out structural tests, 1 respondent the task to carry out a site visit, 1 respondent the task of gathering/analysing historical documentation on the building, and 1 respondent mentioned the task to carry out consultation, engagement events outside the building, door to door with to residents, and resident meetings. In all these instances, no specific tool was mentioned. 1 respondent mentioned technical	take place at the beginning of the retrofit process (either at pre-design stage or at the start of the design phase)

	conservation standards at international (2 respondents) and national level (1 respondent).	expertise - which is rather a skill.	
Pros/cons	2 respondents (Poland and Spain) found that the structural requirements are very well defined (existing guidelines/standards (presumably in construction/planning legislation/standards). 1 respondent felt that existing legislation/standards provides a comprehensive approach. However, it was felt that the legislation/standards are not very focused on use and space planning, that there is uncertainty about structural condition and limited adaptation flexibility.	1 respondent said that there is always an important degree of uncertainty about the condition of the structure in terms of structural integrity - when referring to site visit/structural tests.	

Condition survey and technical documentation

Step	Guideline/standard	Tool (software etc.)	When
Condition survey and technical documentation *(4 respondents)*	1 respondent indicated that technical documentation is often poor or non-existent. 2 respondents mentioned construction legislation/standards at national level. 2 respondents mentioned heritage conservation standards at international level. 1 respondent mentioned heritage conservation standards at national level.	1 respondent is not aware of any condition survey tools. There was a consensus amongst 3 respondents (2 in Spain and 1 in Poland) about the task to carry out a building pathology analysis (ie understanding damages to masonry, wooden elements, etc.). No specific tool was mentioned. 1 respondent mentioned the task to analyse the resistance of the building's structural elements (bearing walls, domes, etc) and the task of carrying out a historic analysis of the building. In both cases, no specific tool was mentioned. 1 respondent mentioned the tools for the collection of 2D/3D	Consensus on timing amongst 3 respondents (2 in Spain and 1 in Poland) that this step should take place at the beginning of the retrofit process but diverging view on the specific point in time (either at pre-design stage or at the start of the design phase or during the stage when a light touch design is being informed). 1 respondent also mentioned that this the heritage value assessment should also take place happening at a more advanced point in the design - i.e. the building permit stage (when a planning permission/listed building consent is sought from a city council or local authority).

		technical information (e.g. Photogrammetry, 3D scanning). 2 respondents (Spain and Poland) mentioned the processing of 2D/3D technical information (e.g. FARO PhoToPlan, BIM, photogrammetry tools within AutoCAD)	
Pros/cons	2 respondents (Poland and Spain) found that that there were detailed criteria provided by existing guidelines/standards (presumably heritage conservation standards at national/international level). However, one respondent felt that the legislation/standards do not work as a specific guide for any kind of building. 1 respondent felt that up-to-date technical documentation of the buildings is often not available.	2 respondents (Spain and Poland) considered that the tools for the collection of 2D/3D technical information (e.g. Photogrammetry, 3D scanning) and for the processing of 2D/3D technical information (e.g. Photogrammetry, 3D scanning and BIM), as well as the task to carry out a building pathology survey, provide precise documentation on the current condition of the building. However, the 2 respondents found that there was a lack of information about internal structure (building pathology	

		survey). 1 respondent also found that the tools are expensive (Photogrammetry, 3D scanning and BIM). 1 respondent considered the tasks of undertaking building pathology and structural surveys to be indispensable.	

Energy performance assessment

Step	Guideline/standard	Tool (software etc.)	When
Energy performance assessment *(5 respondents)*	Strong consensus on the use, for energy performance assessment, of energy performance legislation for buildings at European level (EPBD), energy performance legislation/standards for buildings at national level and of energy performance standards (non-governmental) for buildings at national level (3 respondents	A lot of tools were mentioned, and they can be split between those being compulsory or recognised by national governments to produce EPCs or required for energy modelling calculations, those who are not compulsory but are widely used and in-house tools. The most frequently mentioned	General consensus on timing amongst 4 respondents (2 in Spain 1 in UK and 1 in Poland) that this step should take place at a more developed design stage or building permit stage. 1 respondent also mentioned that this step should happen at several design stages, to check the

	respectively). Energy performance standards (non-governmental) for buildings at international level and construction legislation/standards at national level were also mentioned (2 respondents respectively).	tools (by 4 respondents (2 in Spain, 1 in the UK and 1 in Poland) are the software programs for energy modelling that are compulsory at national level or recognised by governments (e.g. Herramienta Unificada LIDER-CALENER (HULC), CE3X and CE3 in Spain, SPA/RdSAP in UK, ArCADia-TERMO and BuildDesk in Poland). 3 respondents (Spain, UK and Poland) mentioned the tools (software) for: - energy modelling incl. Dynamic Simulation Modelling (software) that are non-obligatory (e.g. Audytor OZC, TRNSYS, PHPP, DesignBuilder EnergyPlus) - hygrothermal risk assessment - condensation in walls, roofs, ground floors (e.g. WUFI, BuildDesk)	performance of the design. 1 respondent also mentioned that this step should also happen after completion of the project.

		Tool (software) for thermal bridges modelling were mentioned by 2 respondents (Spain and UK). Various tools(software) were mentioned by 1 respondent to: - model heat fluxes through buildings components, thermal load and temperature and relative humidity evolution. Note: these can be covered by energy model software - calculate U-values (e.g. BuildDesk) 1 respondent mentioned the combination of tools (software) to generate 3D models and to assign energy performance values to the walls, roof, floor (Design PH platform which plugs into SketchUp).	

		1 respondent mentioned an in-house tool to report on current energy performance of a building.	
Pros/cons	The feedback is quite diverse and touched on various aspects. There is a feeling that there are very well-defined standards, detailed guidelines and that there are clear targets, and some flexibility on how some standards can be used (i.e. following the steps but not necessarily the specific targets). There was a consensus that the main challenge is complexity: complexity of the standards/legislations themselves,	The feedback was extremely diverse and tends to be specific to the various tools used. However, some general conclusions can be made: there are a large number of tools available for energy performance assessment and they cover various aspects (some more integrated such Dynamic Simulation Modelling and some focusing on specific aspects such as hygrothermal risk assessment). The fact that the tools are easy to use (e.g. when based on Excel like PHPP) and provide results quickly	

	an increasing complexity due to the large numbers of standards/legislation that can generate contradictions between each other (a suggestion was made to group them in one single standard/guideline), the fact that different procedures are required depending on the standards/tools being used, and the difficulty in applying the standards to historic buildings.	is a strong advantage, whilst the fact that a tool is very time-consuming, requires skills and is slow to operate is problematic. Precision is very important and so is the ability to generate a lot of data that can be reused during the design process - whilst some tools can provide results that are not precise. Some tools are more focused on compliance with regulations (mandatory as part of national legislations) and there may be the need to use different tools - in which case, it is important that the interface between different tools is easy, as well as the possibility to use the data from one to another is important. It appears important that the tool is flexible and can allow comparison between different retrofit scenarios to test them and facilitate data interpretation - it was mentioned	

		that this is an iterative process which needs optimising (e.g. using AI), because it is very time consuming, and that some software programs are not designed to enable an iterative process. Some software programs do not cover all design options. Some software programs lack data (e.g. climate data). One respondent highlighted these tools are indispensable, but the existing tools have their limitations. A well-designed monitoring campaign is absolutely necessary to calibrate and validate the energy models. Otherwise, their results are not reliable.	

Indoor environmental assessment

Step	Guideline/standard	Tool (software etc.)	When

Indoor environmental assessment *(5 respondents)*	2 respondents mentioned energy performance of buildings legislation/standards at national level (Spain - RITE that stands for regulation on indoor heating and air-conditioning systems). 2 respondents (Spain and Poland) mentioned indoor air quality in buildings standards (non-governmental) at national level. 2 respondents (Spain and Poland) mentioned construction legislation/standards at national level Ad hoc approach/outsourced service to specialists and conservation guidelines were also mentioned.	The feedback was generally diverse. 3 respondents (2 in Spain and 1 in Poland) mentioned tools for indoor environmental assessment (Verde 2022 Rev03, Design Builder (Energy Plus); WUFI; TRNSYS). These tools were already mentioned for energy performance assessment, and some are integrated energy modelling software programs. The following tools were mentioned by 1 respondent each: - Tool for microclimate measurements/building performance monitoring (temperature, humidity and carbon dioxide) - Tool for multi-criteria certification	No consensus on timing amongst 4 respondents (2 in Spain 1 in UK and 1 in Poland) as to when this step should take place. 2 respondents (Spain and UK) mentioned that this step should happen after completion of the project. 2 respondents (in Spain and in Poland) said that this step should take place at a more developed design stage or building permit stage. 1 respondent mentioned that this step should take place at the beginning of the retrofit process (at the start of the design phase). 1 respondent also mentioned that this step could happen at several design stages - at the beginning of the retrofit process and after completion of the works.

		- Tool to look at comfort levels/carry out thermal survey (thermal camera) The following tasks were mentioned by 1 respondent each, but no tool was mentioned: * Task to carry out post occupancy evaluations (outsourced these reports to other companies) * Task to ask data from clients on operational parameters: energy use, temperature settings * Task to visit of the property and interviews with residents or building owners	
Pros/cons	2 respondents (Spain and Poland) found the standards/guidelines were clear. It was mentioned there was a comprehensive approach.	The feedback collected was diverse and was either specific to the various tools used or more general. 1 respondent mentioned that there is always uncertainty in the	

	However, there was a consensus that the main challenge is complexity: complexity of the standards/legislations themselves, increasing complexity due to the large numbers of standards/legislation that can generate contradictions between each other, and difficulty in achieving compromise between comfort and protection of historic buildings	results of these parameters associated with indoor environmental assessment due to the actual use/occupancy of the building once it is retrofitted. 1 respondent indicated that these tools provide data for other assessments (e.g. Wufi for hygrothermal risk). 1 respondent in Spain indicated that Verde 2022 Rev03 is a very useful tool for technical staff and also for general public, such as future buyers without specific knowledge in architecture, but that it is also complex to implement.	

Economic viability (e.g. Life cycle costing)

Step	Guideline/standard	Tool (software etc.)	When
Economic	3 respondents mentioned they do	There seem to be 3 approaches on	No consensus on timing amongst 3

viability *(5 respondents)*	not use or do not know the guidelines/standards for economic viability. 2 other respondents (Spain and Poland) mentioned professional guidelines on economic viability - and one of the two respondents mentioned standards (non-governmental) at national/international level and National Grant Program Guidelines.	the assessment of the economic viability of a project: using a dedicated software or using an inhouse tool or analysing basic data on running costs. 2 respondents (Spain and Poland) mentioned cost management software (e.g. Presto, Norma PRO, Zuzia,/BIMestiMate,BLCC Building Life Cycle Cost Program) that may have variations - they can or cannot be integrated with BIM and can or cannot include LCC calculations. 1 respondent mentioned the task to analyse running costs and said that he was not using LCC tools. 1 respondent mentioned custom LCC Excel formulas.	respondents (1 in Spain 1 in UK and 1 in Poland) as to when this step should take place. 1 respondent mentioned that this step should take place during the stage when a light-touch design is being informed. 1 respondent mentioned that this step should take place at a more developed design stage and at the tender stage. 1 respondent mentioned that this step should at each stage when a cost is presented to the client.
Pros/cons	The feedback given by the 2 respondents aware of guidelines/standards for economic	The feedback collected was diverse and was more linked to	

	viability was diverse. In terms of benefits, existing guidelines/standards can be helpful to obtain a general preview of the economic balance, get clear cost structure, enable comparisons, the consideration of full building life cycle and a basis for long-term decision making. In terms of challenges, there were two categories of issues. Issues related to historic buildings/conservation works: difficulty in estimating conservation works and complexity of calculations for heritage buildings. And issues about the difficulty to estimate/anticipate construction costs in general: market price	specific tools. 1 respondent made the general comment that he is not using LCC because they spend a lot of time trying to guess –“about how much do you think it's going to cost to replace this massive piece of ventilation kit in 15 years” time? And they feel that “they don't know.” 1 respondent said that the software Presto is clear and simple, yet Presto is not very intuitive 1 respondent saw an issue in that ZUZIA is not officially required by any institution in Poland.	

	volatility, uncertainty of long-term economic forecasts and guidelines/standards does not reflect the current status of the construction market		

Environmental impact (e.g. Life cycle assessment, waste)

Step	Guideline/standard	Tool (software etc.)	When
Environmental impact *(4 respondents)*	The feedback given by respondents was diverse. There is no clear consensus on guidelines/standards for environmental impact. 1 respondent did not use any guidelines/standards for environmental impact. Guidelines/standards for environmental impact that were mentioned include construction legislation/standards at national level, energy performance of	The feedback collected was diverse due to the diversity of aspects of environmental impact that tools could help with and showcased different tools/approaches. 1 respondent mentioned a software for Environmental impact (e.g. Verde 2022 Rev03). 2 respondents mentioned Life Cycle Assessment (LCA) software (e.g. SimaPro, OneClick). A 3rd respondent mentioned that they	General consensus on timing amongst 3 respondents (1 in Spain 1 in UK and 1 in Poland) that this step should take place at a more developed design stage or building permit stage.

	buildings legislation/standards at national level, environmental legislation at national level, environmental standards (non-governmental) at national level and internal procedures.	are using an in-house tool that could be inhouse or commercial tools. The in-house tool is a software to compare retrofit interventions/packages by mapping projected carbon reduction over a 60-year lifespan of a building and is primarily focused on operational energy rather than embodied carbon. 1 respondent said they do not do pre demolition audits. 1 respondent said they do not don't use them.	
Pros/cons	Only one respondent gave feedback on this - although this was not requested in the form used. In terms of benefits, existing guidelines/standards can be helpful to grow environmental	The feedback collected was diverse - although no feedback on pros/cons was required for environmental impact tools. 1 respondent said that there are tools available. However, 1 respondent said that	

	awareness. In terms of challenges, there is a high cost associated with the conducting of these analyses, a lack of specific guidelines for heritage buildings.	there is a lack of reliable databases of materials and products, and that this is a big issue with LCA evaluations. 1 respondent said they are currently upskilling in whole life carbon assessment (being more focused on the cradle to gate, i.e. the A modules of whole life assessment, and on operational energy).	

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At FuturHist, we research and test energy-efficient retrofit interventions tailored to historic building typologies. We implement these solutions in real-life demonstration cases in Poland, Spain, Sweden and the UK. We focus on innovative solutions such as bio-based materials, internal insulation systems, window retrofits, HVAC, and RES integration.

DURATION OF THE PROJECT: JANUARY 2024 – DECEMBER 2027

COORDINATOR

eurac research

Aalborg University – Department of the Built Environment

Junta de Andalucía – Consejería de Fomento, Articulación del Territorio y Vivienda – Agencia de Vivienda y Rehabilitación de Andalucía

Calchèra San Giorgio – Materia e Colore

Cracow University of Technology

ERIK arkitekter

Edinburgh World Heritage

holz manufaktur Rottweil

ICOMOS – international council on monuments and sites

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