RENOVATING HISTORY

How to bring historic buildings into the 21st century

Monday 11 July 2022
10:30 - 11:30

EuroACE
Energy Efficient Buildings

Event moderated by

Céline Carré, President of EuroACE

Speakers

Marco Mari,
Italian Green Building Council

Alexandra Troi,
Eurac Research

MEP Marcos Ros Sempere
(S&D, Spain)

Introduction

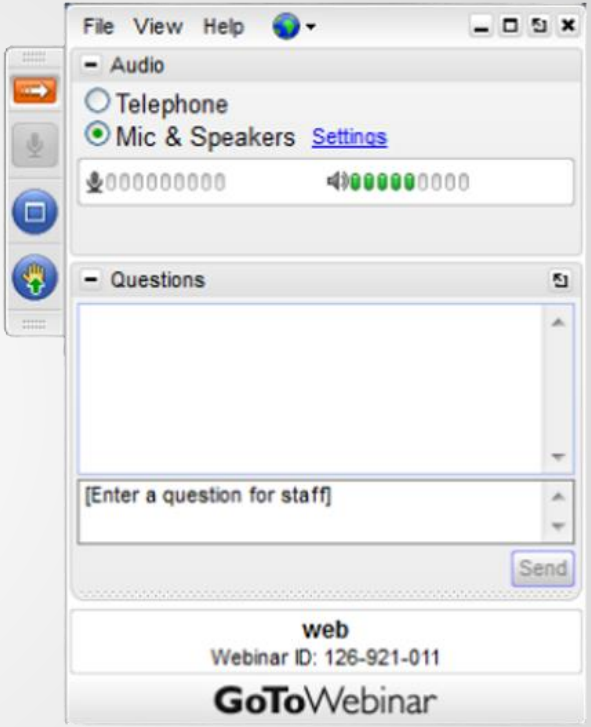
Céline Carré

Saint Gobain – President of EuroACE

EuroACE
Energy Efficient Buildings

Instructions

Please send your questions via the Q&A box.



EuroACE
Energy Efficient Buildings

EuroACE – Energy Efficient Buildings

- The European Alliance of Companies for Energy Efficiency in Buildings
- Formed in 1998 by Europe's leading companies involved with the manufacture, distribution and installation of energy saving goods and services
- A business association working together with the European institutions to help Europe move towards an efficient use of energy in buildings (new and renovated)

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Energy Efficient Buildings

EuroACE – Energy Efficient Buildings

Our members provide the products, equipment, and services that go together to provide energy efficient buildings for the peoples of the EU

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We know that improving the energy efficiency of buildings, especially renovating existing buildings, is the most cost-effective method of:

- Creating employment and securing economic growth
- Alleviating energy poverty over the long-term
- Achieving energy security
- Providing people with comfortable and healthy homes
- Meeting carbon reduction targets

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2022 EPBD Webinar Series

Series of webinars focusing on different aspects of the EPBD which have the potential to considerably increase energy renovation rates in the EU.

The topic of the energy renovation of historical buildings is linked to the EU Fit for 55 agenda (EED & EPBD).

First episode:

https://youtu.be/Q831ueWSszY

EuroACE
Energy Efficient Buildings

Today's agenda

10:30 | Introduction and guidance to participants – Céline CARRÉ, President of EuroACE

10:40 | Energy Efficiency of Historic Buildings in Legislation, National Plans and Projects

Adrian JOYCE, Secretary General of EuroACE

10:50 | Practical solutions and strategies for the renovation of historic buildings

- **The GBC Historic Building certification scheme**

  Marco Mari, President, Italian Green Building Council

- **The IEA EBC Annex 76 on renovating historic buildings and the HiBERatlas project**: Inspiring good practices: a database to trigger energy efficient renovations of historic buildings

  Alexandra Troi, Vice Head of the Renewable Energy Institute, Eurac Research

11:10 | Discussion

11:30 | End

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Energy Efficiency of Historic Buildings in Legislation, National Plans and Projects

Adrian Joyce
Secretary General
EuroACE

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Energy Efficient Buildings

The Challenges

- Multiple definitions across the EU
- Some sources say 30% of stock is historical or heritage
- Perception that these buildings cannot be touched
- Raising awareness of extensive knowledge on EE in historic buildings

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The Reality

- There are many examples of successful energy renovation
- They are spread across the EU
- All types of buildings are represented
- Multiple guidance documents exist
- Many MS are funding energy renovation of heritage buildings

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Long Term Renovation Strategies

- **DE:** KfW provided subsidies for heritage buildings
- **SI:** Specific categories of protected buildings to be renovated
- **HR:** By 2040 annually 4% of buildings with cultural value to be renovated
- **MT:** Specific grants for privately owned heritage buildings included

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National Recovery and Resilience Plans

- **SK:** €130m for historical and protected buildings
- **HR:** €40m allocated to energy renovation of heritage buildings
- **BE**: €40m allocated to energy renovation of public heritage buildings
- **RO**: Reforms to devise non-invasive approaches to renovation of heritage buildings

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EU Legislation (1)

EPBD

- **Commission Proposal:** Deleted blanket exemption for heritage and historical buildings
- **Cuffe Report:** Requires quantification of protected buildings; Specifically calls for protected buildings to reach Class “D” level
- **Kanev Report:** Calls for specific guidelines to be developed for protected buildings

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EU Legislation (2)

EED

- **Commission Proposal:** Deleted blanket exemption for heritage and historical buildings
- **Fuglsang Report:** Exemption only if works would unacceptably alter the character and cultural value of building
- **Council:** Option to exempt historical buildings from reaching ZEB level

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Examples of Energy Renovation (1)

Spain:
Mercado del Val

75% reduction in energy demand

Constructed in 1880
Renovated in 2016

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Examples of Energy Renovation (2)

Italy:
Viale Murillo

80% reduction in energy demand

Constructed in 1905
Renovated in 2019

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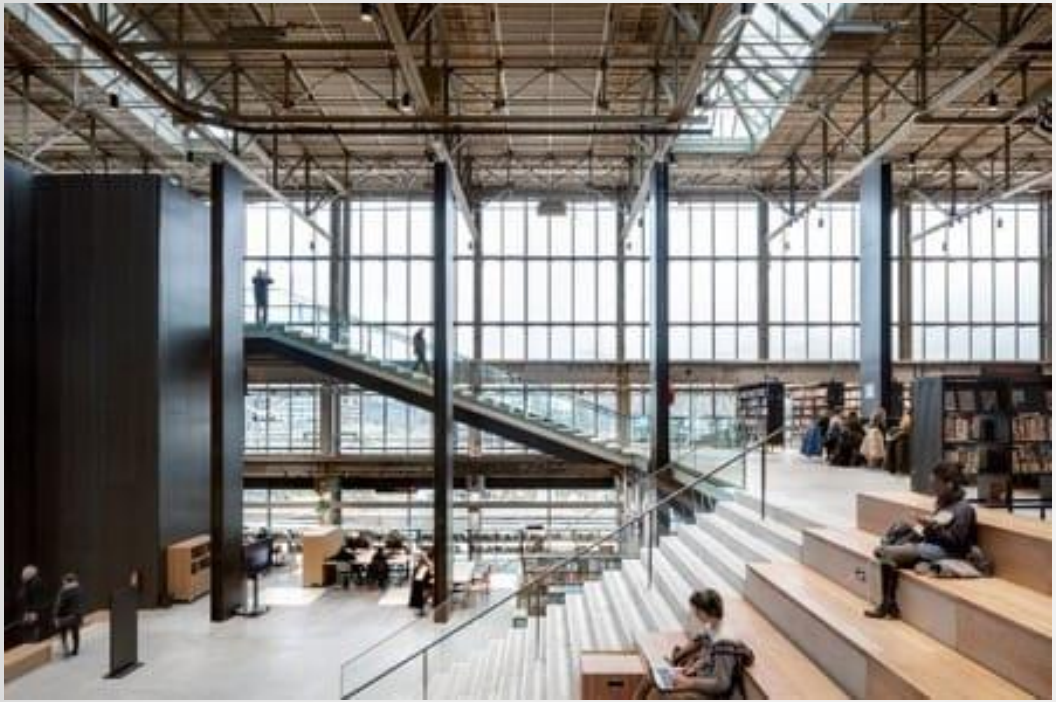
Examples of Energy Renovation (3)



Netherlands:
LocHal

54% reduction in energy demand

Constructed in 1932
Renovated in 2019

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Guidance (selection)

Ireland:

- EE in Traditional Buildings (2010)
- Shaping the Future (2012)
- Deep Energy Renovation of Traditional Buildings – Addressing Knowledge Gaps and Skills Training

France:

- Effinergie label for heritage buildings:

UK:

- Sustainable Traditional Buildings Alliance (STBA): Guidance on responsible renovation

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The GBC Historic Building certification scheme

Marco Mari

Green Building Council Italia,
President

EuroACE
Energy Efficient Buildings

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HERITAGE & SUSTAINABILITY

A new holistic paradigm for cities rigeneration

Marco Mari
Green Building Council Italia President

Green Building Council Italia

GBC Italia is a non-profit association
with the mission of guiding the entire building chain
in the sustainable transformation of buildings for a
healthier, safer, more comfortable and efficient build environment

Building Impact

40%
Matherial

14%
Potable whather

38%
Emissions CO_2

30%
whaste

72%
Energy

Design for PEOPLE
(confort – health)

CULTURAL HERITAGE

Building Impact

A new paradigm : Heritage & Sustainability

We need to extend the useful life of the building as a whole, or by facilitating the continuation of the intended use

- **life extension of the building**
- **renewal of historical and traditional buildings** and **heritage** (re-design)

A new paradigm : Heritage & Sustainability

A new paradigm : Heritage & Sustainability

?

how can we bridge the gap between

1. **energy and environmenthal** efficiency

2. **heritage** preservation

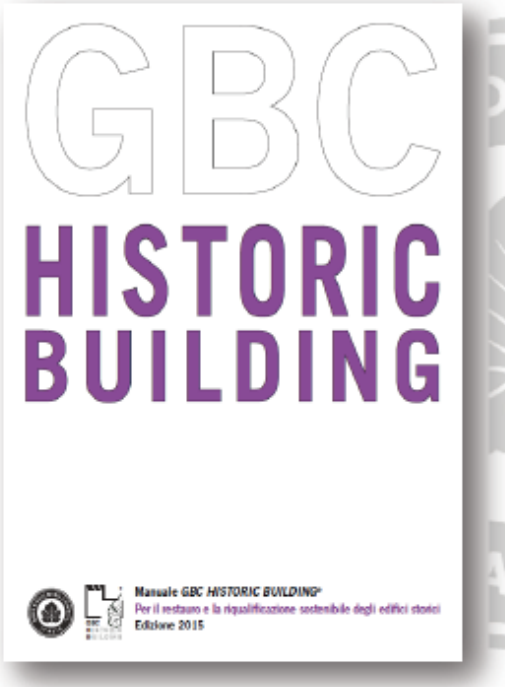
A new paradigm : Heritage & Sustainability

SUSTAINABILITY

RESTORATION

*" **Restoration is sustainable** when allows future generations to recognize the same **cultural** and **environmental** values that we recognize today "*

GBC Historic Building – protocol structure

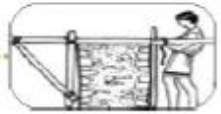


- HISTORIC VALUE
- SUSTAINABLE SITES
- WATER EFFICIENCY
- ENERGY & ATMOSPHERE
- MATERIALS & RESOURCES
- INDOOR ENVIRONMENTAL QUALITY
- INNOVATION IN DESIGN
- REGIONAL PRIORITY

GBC Historic Building - applicability

PRE-INDUSTRIAL (TRADITIONAL) ARCHITECTURE

- PRE-INDUSTRIAL BUILDING PROCESS
  PHASES, OPERATIONS AND OPERATORS)



- PRE-INDUSTRIAL MATERIALS AND TECHNIQUES

- PRE-INDUSTRIAL BUILDING ELEMENTS

Heritage : GBC Historic Building applications examples

MEIS - Museum of Judaism and Shoah (FE)

Heritage : GBC Historic Building applications examples

Palazzo Santander (TO)

Heritage : GBC Historic Building applications examples

Palazzo Gulinelli (FE)

Heritage : GBC Historic Building applications examples

Castello Estense (FE)

Heritage : GBC Historic Building applications examples

Chiesa di Denore (FE)

Heritage : GBC Historic Building applications examples

Chiesa di S. Giuseppe dei Falegnami (Roma)

Heritage : GBC Historic Building applications examples

Museo Galleria Borghese (Roma)

Heritage : GBC Historic Building applications examples

Palazzo Silvestri Rivaldi (Roma)

Green Building examples : ... TO SMALL COMMUNITIES

Circular Small Village in Historic Monaster Rocca of S.Apollinare
GBC Historic Building - Certified Gold Level (first exemple in the world)

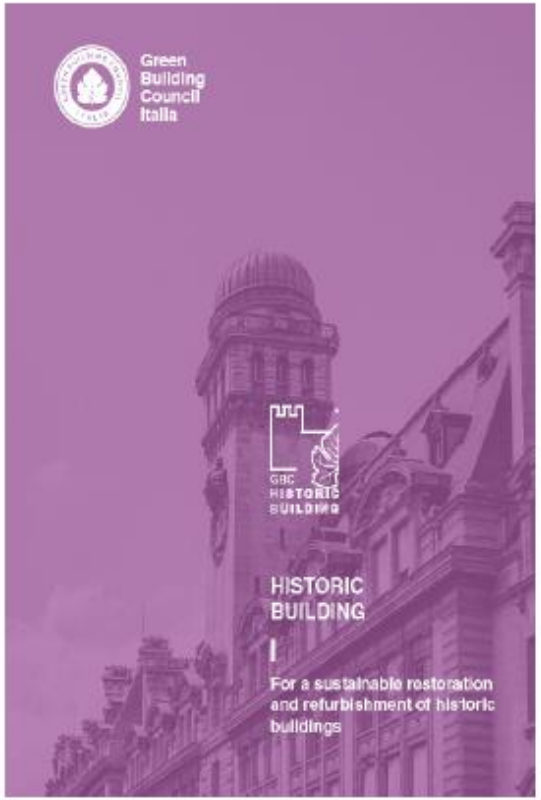
Smart & Circular

The 15 minutes-city prototype

Historic Villages

«BORGHI STORICI»

GBC historic Building - internationalizzation process




GBC Historic Building®

When to use

GBC Historic Building® Internationalization process

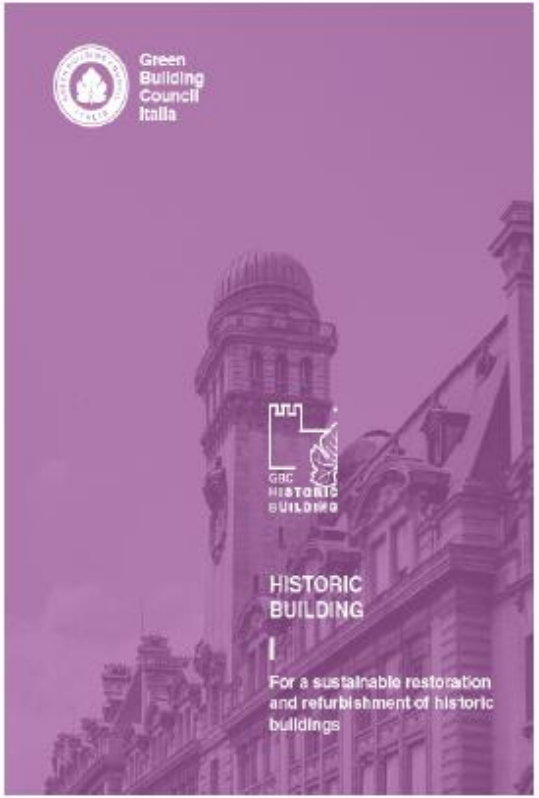
GBC Italia is defining the GBC Historic Building internationalization process on projects promoted by a leading international partners.
The main objective of GBC Historic Building International Pilot Project submission is to ensure that this innovative rating system is feasible and guides the market in order to create a meaningful, fair and effective way to encourage green development of the historic heritage.
The internationalization process will be carried out in an inclusive way and GBC Italia is available to organize web-calls to deepen topics.

To participate, partners can register Pilot Project submitting the form INTERNATIONAL PILOT PROJECT XPRESSION OF INTEREST (asking by mail to certificazione@gbcitalia.org) Here follows the main information of the protocol in the version currently applied in Italy.

Rating system contents

Become an accredited professional GBC HB AP

GBC historic Building - internationalizzation process



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GBC historic Building - internationalizzation process

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Thank you for your actention

HERITAGE & SUSTAINABILITY

A new holistic paradigm for cities rigeneration

Marco Mari

Green Building Council Italia President

E-mail presidente@gbcitalia.org – mob. +39 3356961892

Inspiring good practices: a database to trigger energy efficient renovations of historic buildings

Alexandra Troi
Eurac Research,
Vice Head of the Renewable Energy Institute

EuroACE
Energy Efficient Buildings

TASK 59 | ANNEX 76

The IEA EBC Annex 76 on renovating historic buildings and the HiBERatlas project

Inspiring good practices:

a database to trigger energy efficient renovations of historic buildings

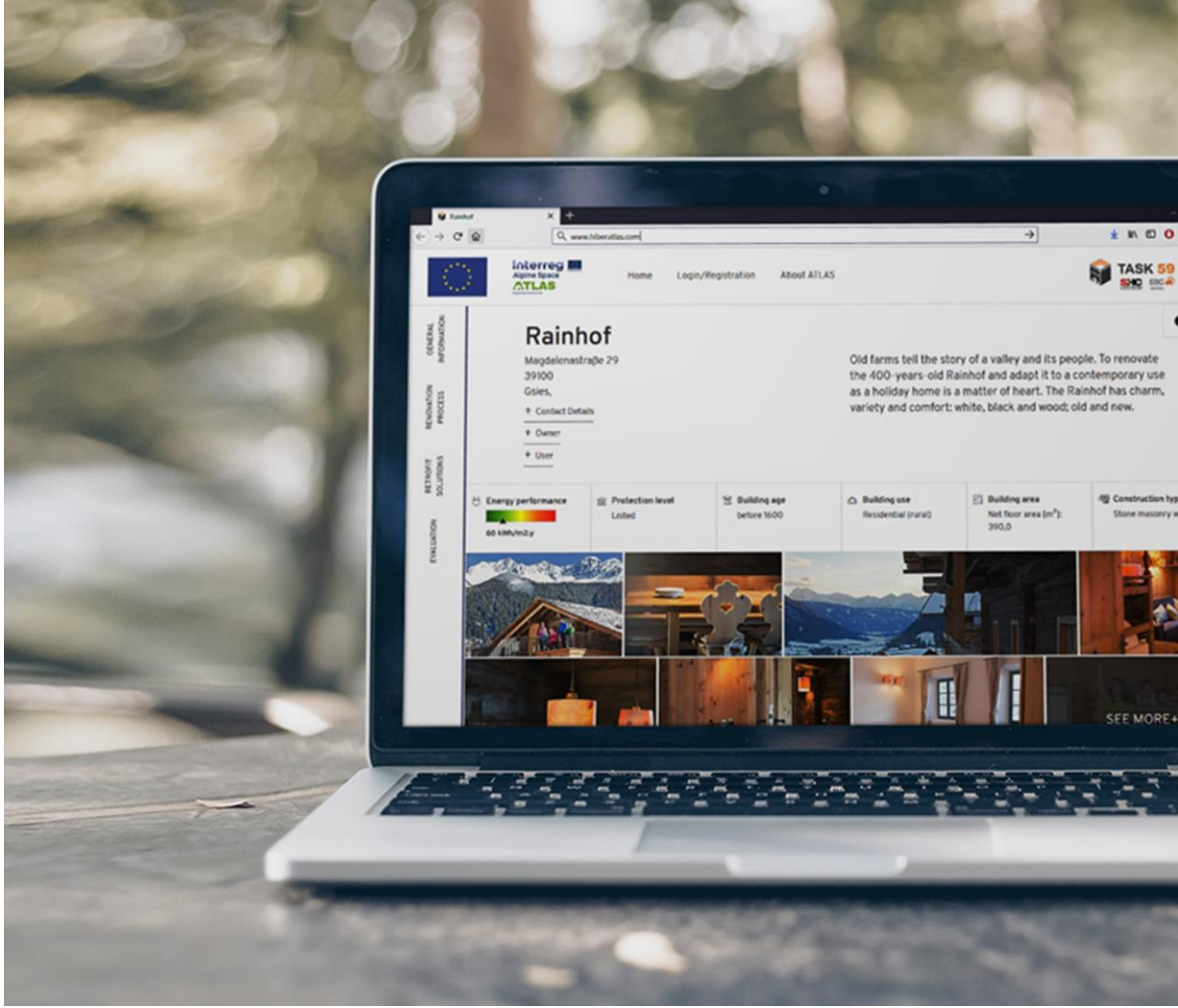
Alexandra Troi

alexandra.troi@eurac.edu

eurac research

A BEST PRACTICE DATABASE FOR **ENERGY EFFICIENT** RENOVATION OF **HISTORIC BUILDINGS**

The Historic Building Energy Retrofit Atlas compiles cases of building renovation that are exemplary both in terms of heritage conservation and energy efficiency in order to inspire and foster energy retrofits.



A BEST PRACTICE DATABASE FOR

ENERGY EFFICIENT?

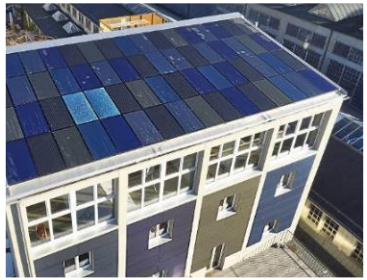
RENOVATION OF

HISTORIC BUILDINGS?

Renovating toward NZEB by bringing together design, efficiency and local use of renewable energy

According EN 16883 all buildings with elements **“worthy of preservation”**

all types & ages, not just listed/protected buildings



Rainhof

Lichtmayrgüt
l in Graming

Basilica di Santa
Maria di

Beim Jäger

Mercado del Val,
Valladolid

Klitgaarden

Mariahilfer Straße

Villa Catelli

Klostergebäude
Kaiserstrasse

Hof 6,
Schwarzenberg

Notarjeva
vila

Osramhuset (The
Osram Building)

before
1600

1600-
1700

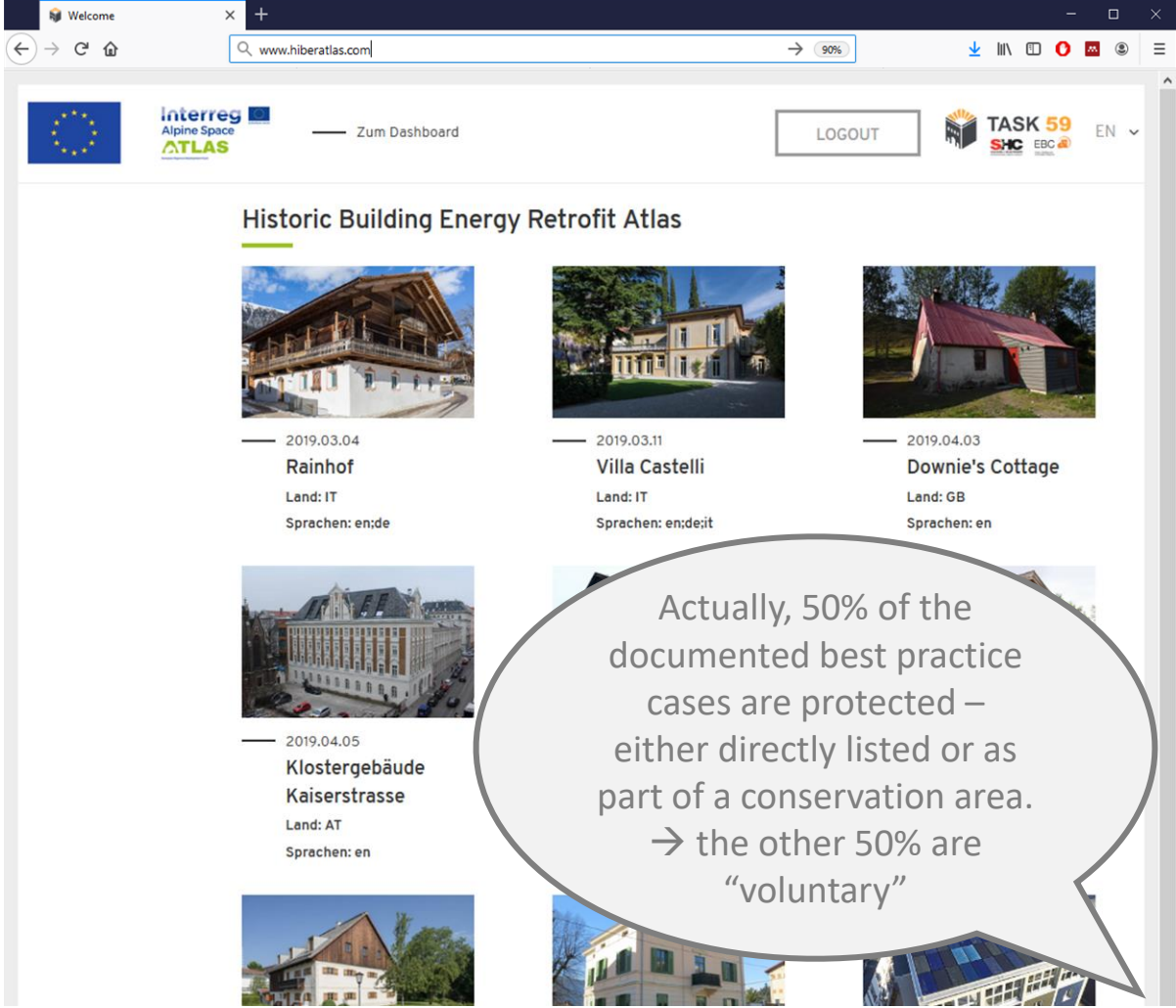
1850-
1899

1900-
1944

1945-
1959

WHAT is documented?

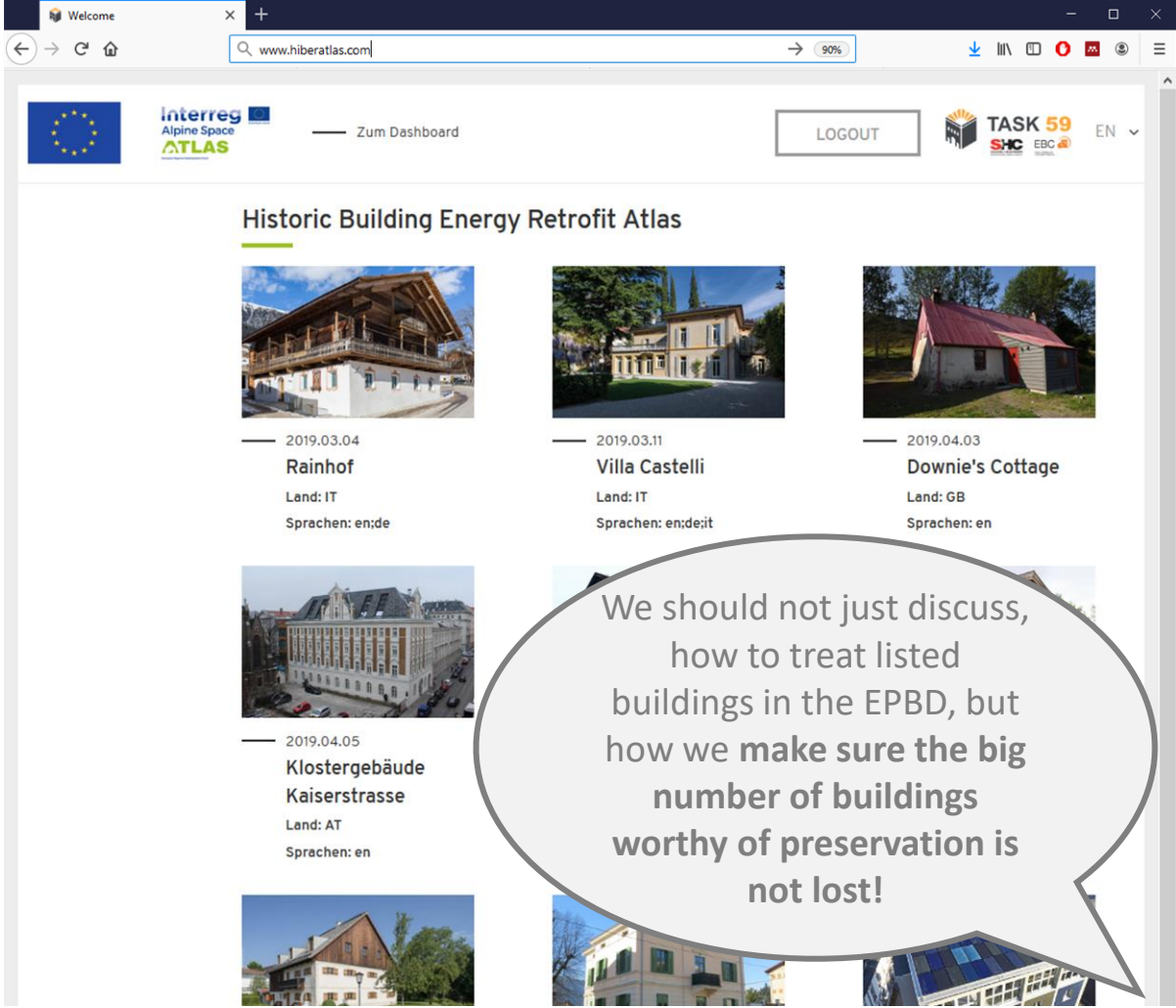
Any building of historic and/or cultural value **independent of the level of protection** is considered - from medieval buildings over buildings from the 1920s to post WWII architecture.



WHAT is documented?

The basic requirements for best-practices are

- ✓ Implementation of the project **completed**
- ✓ Renovation of the **whole building**
- ✓ **Significant reduction** of energy consumption (towards “lowest possible energy demand”)
- ✓ Evaluation of the **heritage compatibility** of the solutions
- ✓ Available **documentation** of technical solutions

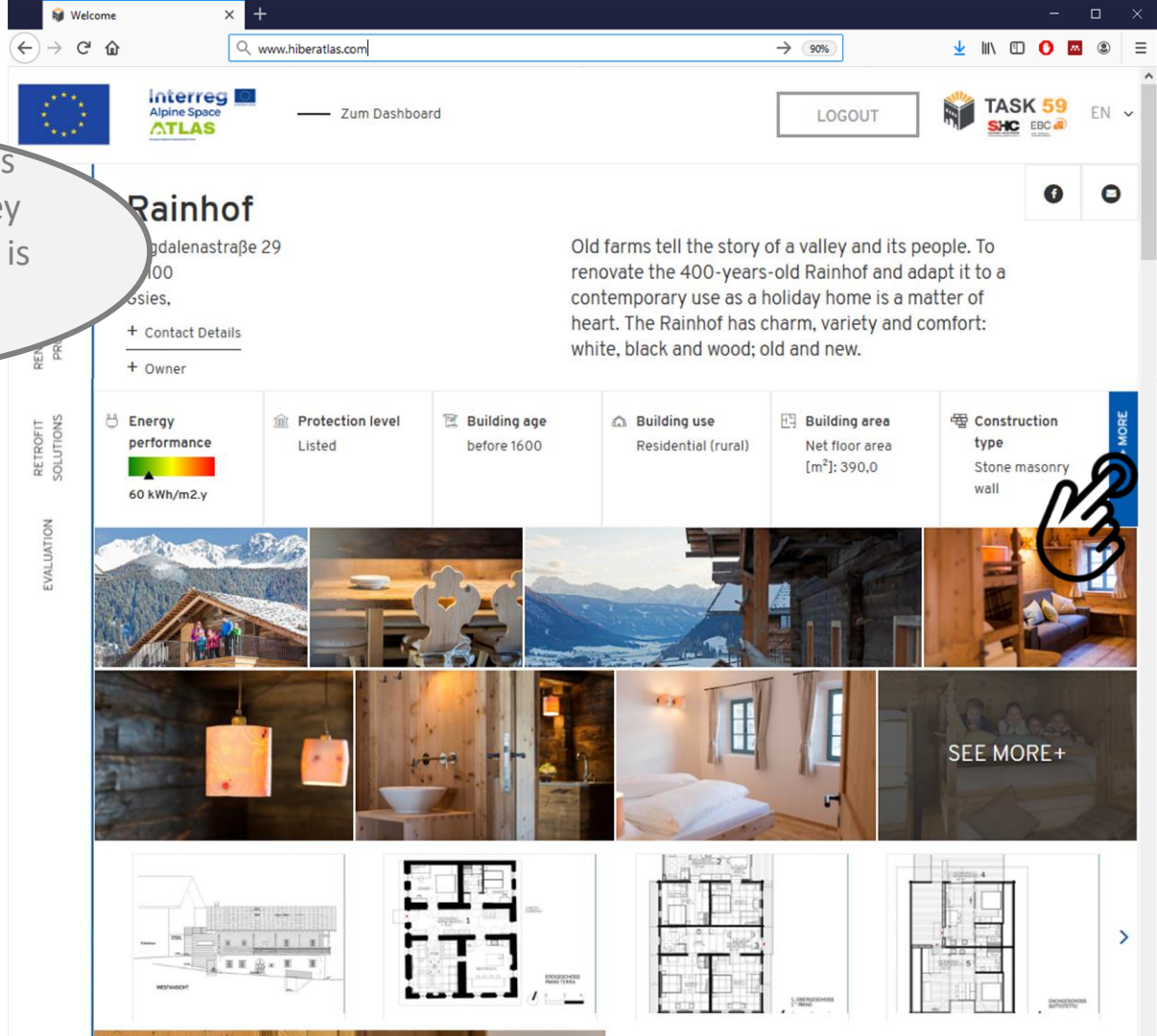


Keeping historic buildings in use – showing that they are attractive living space is the best way to protect them

HOW is it documented?

Second level of detail data and information

1. **images of the building and key figures of the intervention**
2. a description of the context and the rationale behind the solutions adopted
3. the different retrofit solutions implemented
4. evaluation of the intervention in terms of energy efficiency, internal climate, cost and environmental impact.



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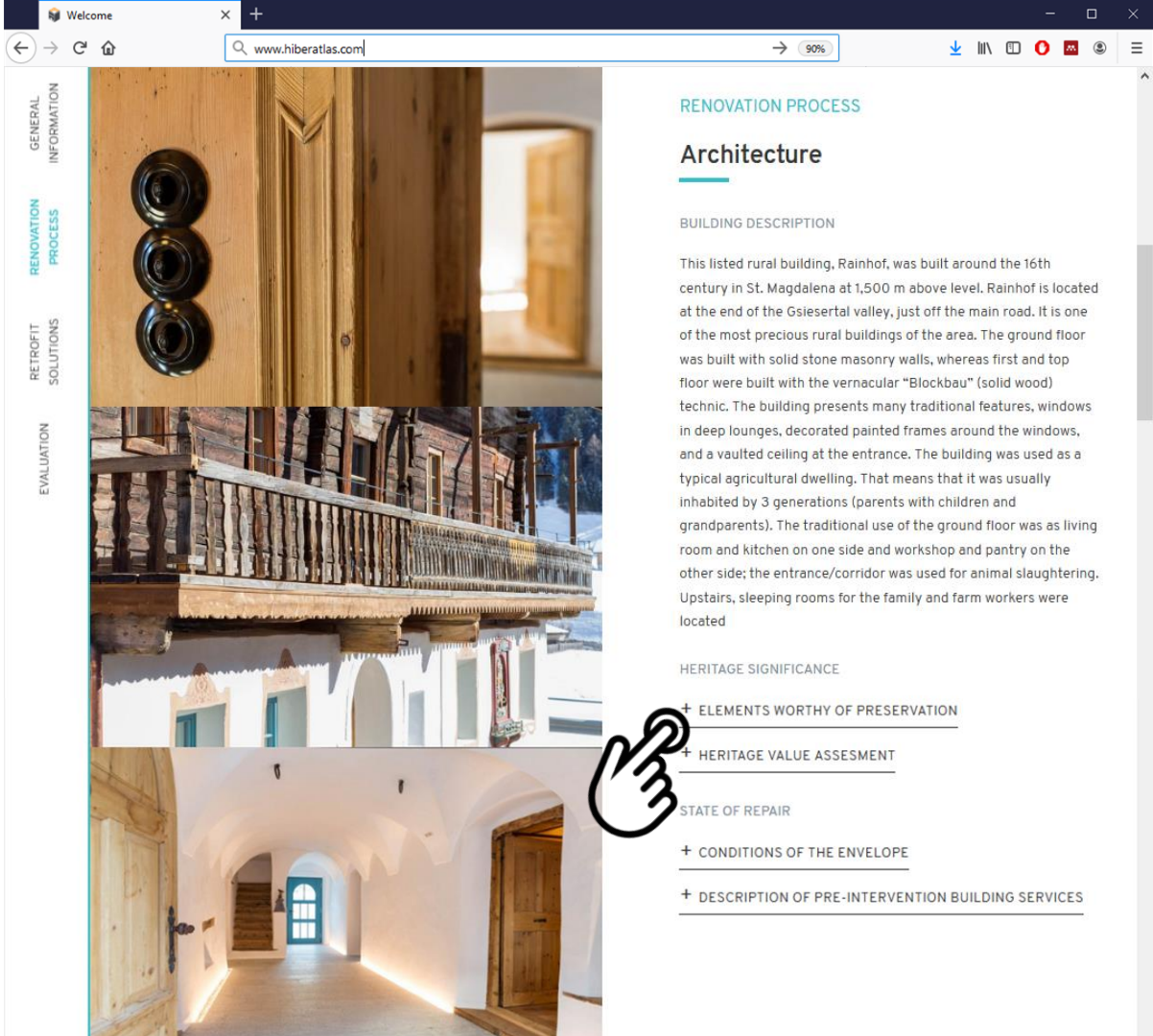

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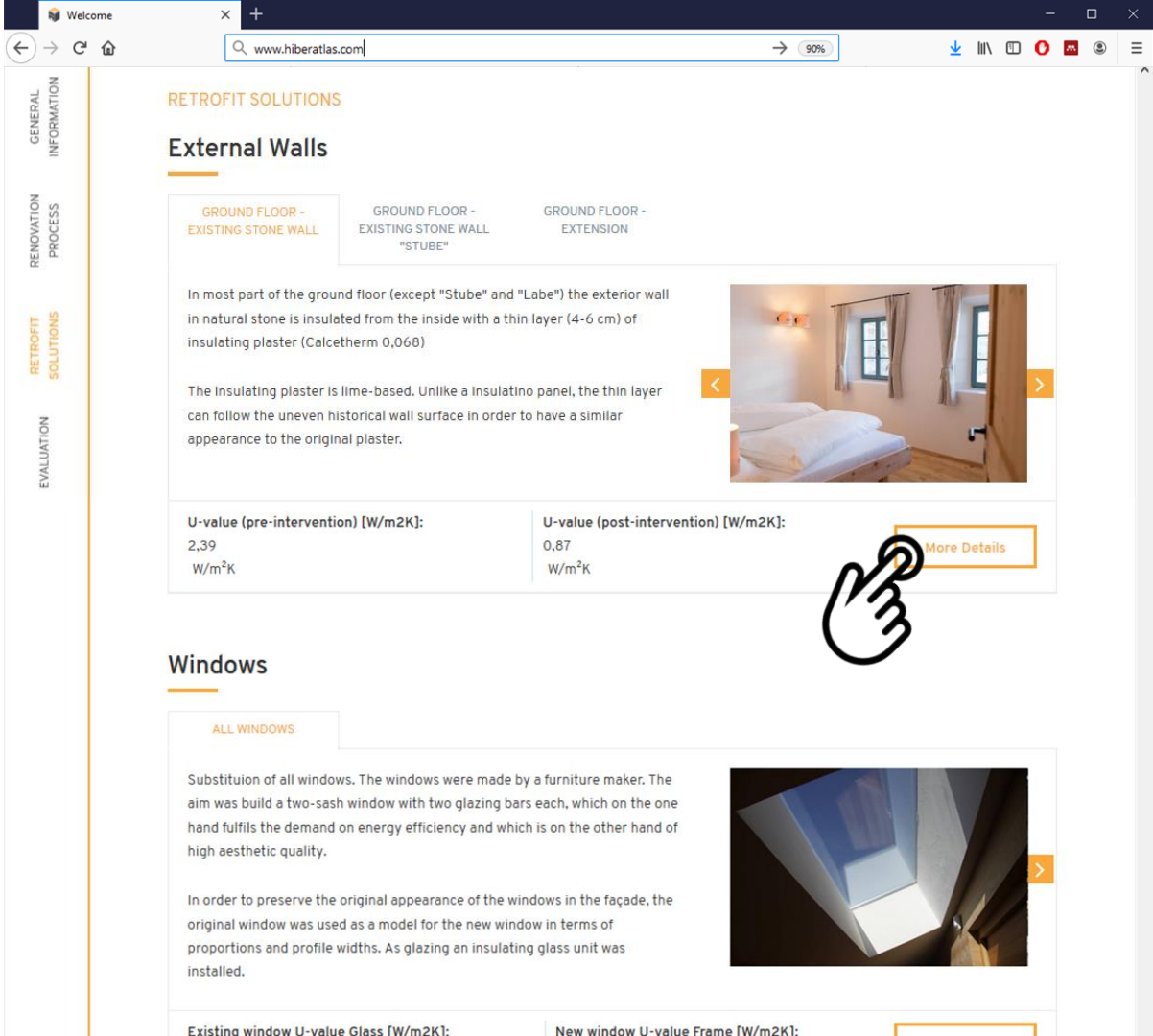

The **variety** of applied solutions is very large – the important point is to find the **right solution for the specific building**, taking into account **multiple values,** which include **heritage** values, but e.g. also **whole life cycle** considerations

					Building use			Building area			Protection level			Intervention			Construction details				HVAC				Renewable energy source				Evaluation / Monitoring data			
											listed / protected	conservation area	non-listed / non-protected	Renovation	Renovation + extention	Other	External walls	Windows	Roof	Ground floor	Heating	Cooling	Ventilation	Air conditioning	PV	Solar	Biomass	Geothermal	Energy efficiency	Costs	Internal climate	Environment
Osramhuset (The Os																		plan													
Rainhof																	plan		plan	plan											
Villa Castelli																		plan	plan	plan											
Klostergebäude Ka																		plan	plan												
Klitgaarden																															
Basilica di Santa Ma																															
Lichtmayrgütl in Gra																	plan	plan	plan	plan											
Beim Jäger																			plan	plan											
Notarjeva vila																															
Hof 6, Schwarzenberg, Ve																		plan	plan	plan											
Mercado del Val, Valladolid																															
Wenyuan Building																															
Hollyrood park lodge																															
Solar Villa																															
Wohn- und Geschäftshaus Feldbergstras																															
Haus Pertner	Truden	IT	1900-1944																												
Ansitz Kofler	Bozen	IT	1700-1800																												
Doragno Castle	Rovio	CHE	before 1600																												
Downies Cottage	Braemar	GB	1800-1849																												
Mehrfamilienhaus Magnusstrasse	Zürich	CHE	1850_1899																												
Maison Rubens	Schaerbeek	BE	1850-1899																												
Half-timberframed house	Alken	BE	1600-1700																												
Elementary school "Cour de Lorraine"	Mulhouse	FR	1700-1800																												
Solar Silo	Basel	CH	1850-1900									?																			
Timber-framed house	Schnersheim	FR	1700-1800																												
Dom trentarskih vodnikov	Trenta	SLO	1900-1944																												
Bauernhof	Trins	AT	1600-1700																												
				15	7	10	10	21	5	1	18	8	8	23	4		24	25	24	19	25	3	15	3	4	7	8	6	24	21	11	10

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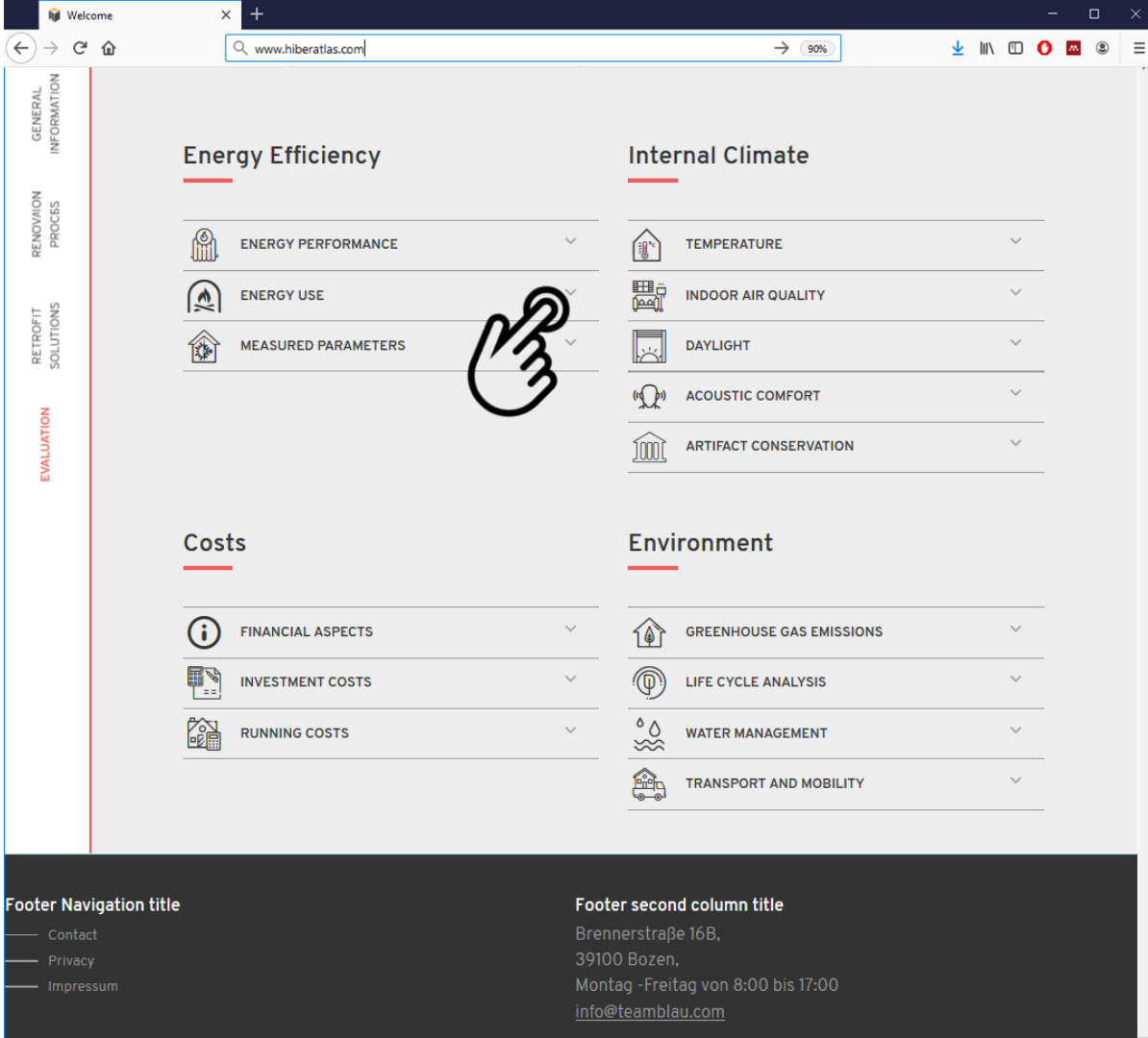


Hof 6, Schwarzenberg, Voralberg, Austria

Lichtmayrgütl in Graming

Rainhof

Doragno Castle in Rovio, Cant

Basilica di Santa Maria di Colle

Beim Jäger

Bauernhof Trins

Half-timberfr med house ir

Timber-framed house in Alsace, Franc

Ansitz Rotter

Mariahilferstrasse 182

Wohn- und Geschäftshaus Feldbergstrasse

Mehrfamilienhaus Magnusst

Dom Andreja Manfreda

Klitgaarden

Klostergebäude Kaiserstrasse

Haus Pernter

Downie's Cottage

Villa Castelli

Nekdanja vila

before 1600

1600 – 1700

1700 – 1800

1800 – 1850

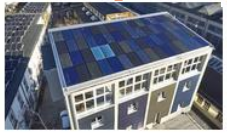
1850 – 1900

1900 – 1944

ab 1945

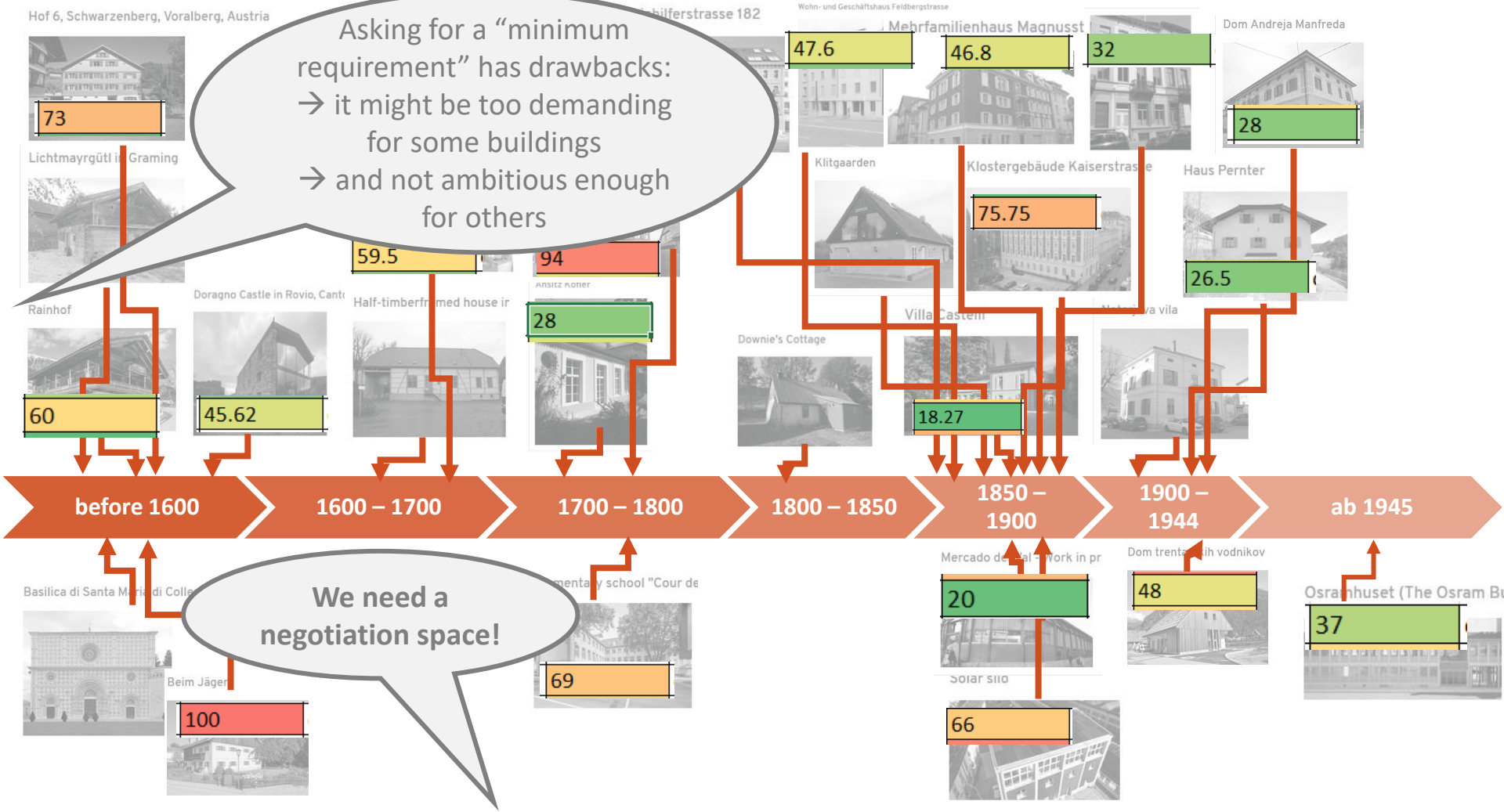
Mercado de Val Work in pr

Solar silo



Dom tr tarskih vodnikov

Osramhuset (The Osram Bu

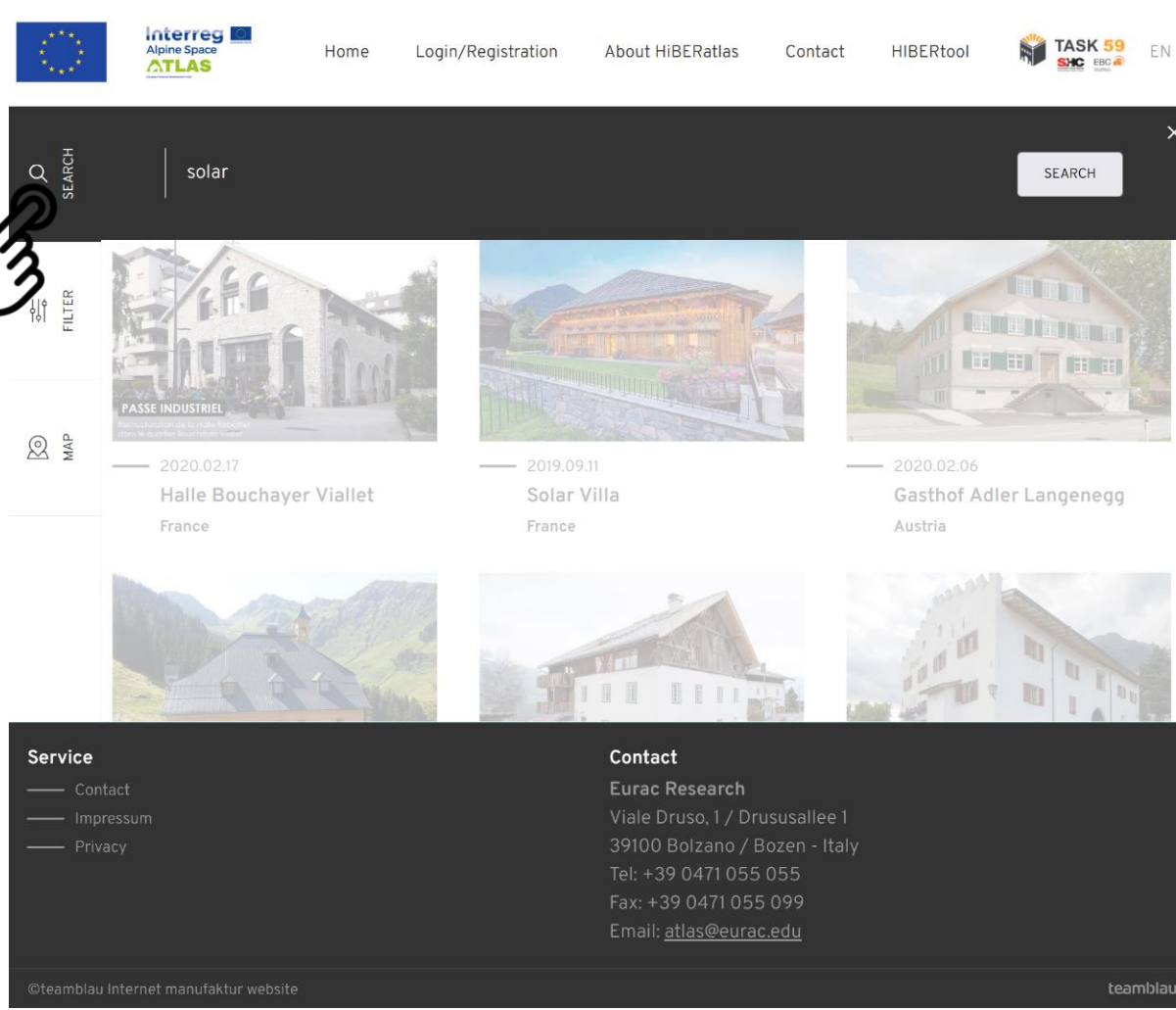

Asking for a “minimum requirement” has drawbacks:
→ it might be too demanding for some buildings
→ and not ambitious enough for others
Hof 6, Schwarzenberg, Voralberg, Austria
73
Lichtmayrgütl in Graming
Rainhof
60
Doragno Castle in Rovio, Cant
45.62
59.5
Half-timberfr med house ir
94
Ansitz Rotter
28
Wohn- und Geschäftshaus Feldbergstrasse
47.6
Mehrfamilienhaus Magnusst
46.8
32
Dom Andreja Manfreda
28
Klitgaarden
Klostergebäude Kaiserstra e
75.75
Haus Pernter
26.5
Downie's Cottage
Villa Castelli
18.27
before 1600
1600 – 1700
1700 – 1800
1800 – 1850
1850 – 1900
1900 – 1944
ab 1945
We need a negotiation space!
Basilica di Santa M ri di Colle
Beim Jäger
100
mentary school "Cour de
69
Mercado de al - Work in pr
20
Solar silo
66
Dom trenta ih vodnikov
48
Osramhuset (The Osram Bu
37

HOW can you use it?

Allowing focusing only on those buildings that are most relevant.

According to:

- Geographical area
- Building use
- Construction period
- Typology
- Construction material
- Solutions applied



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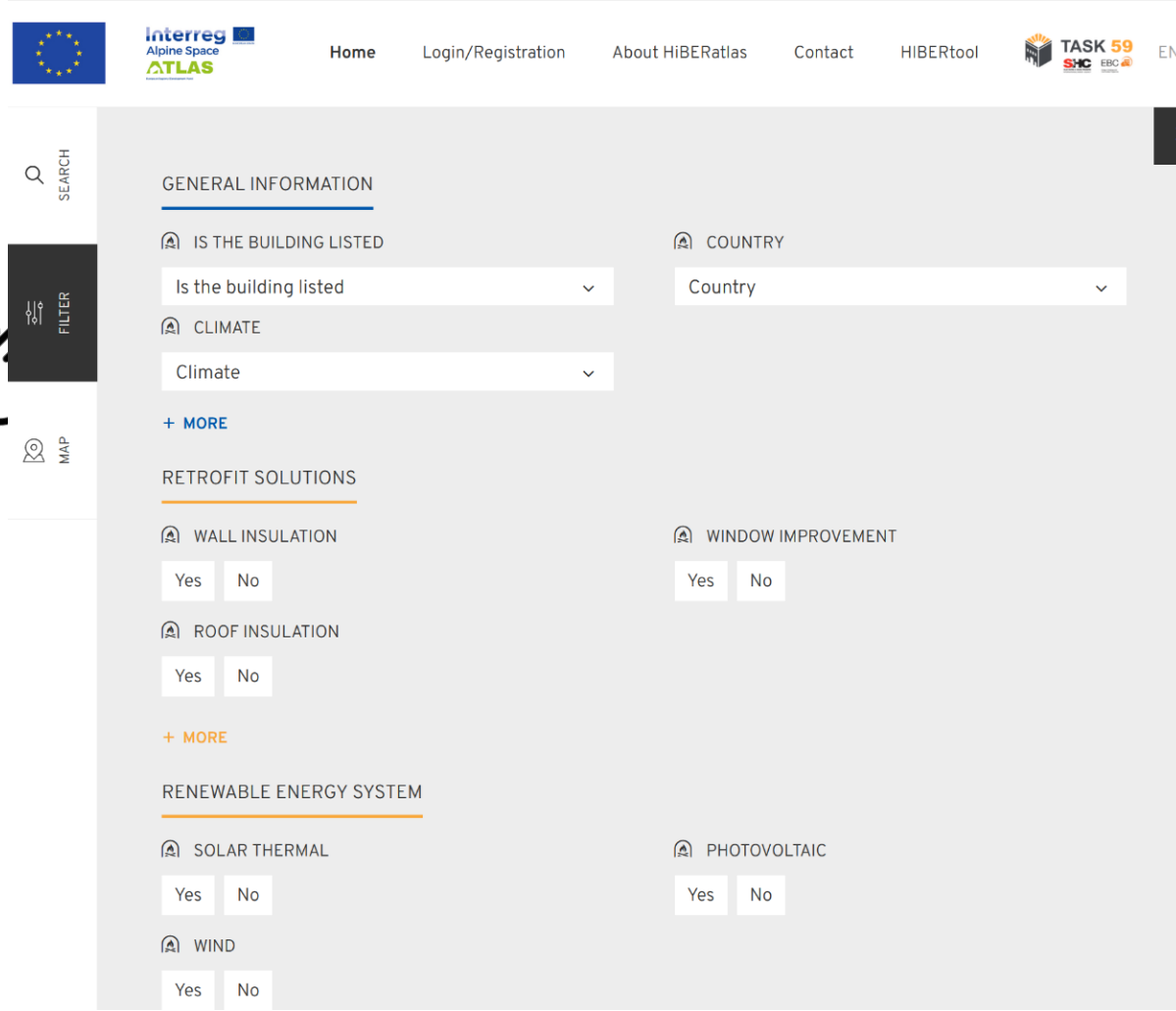

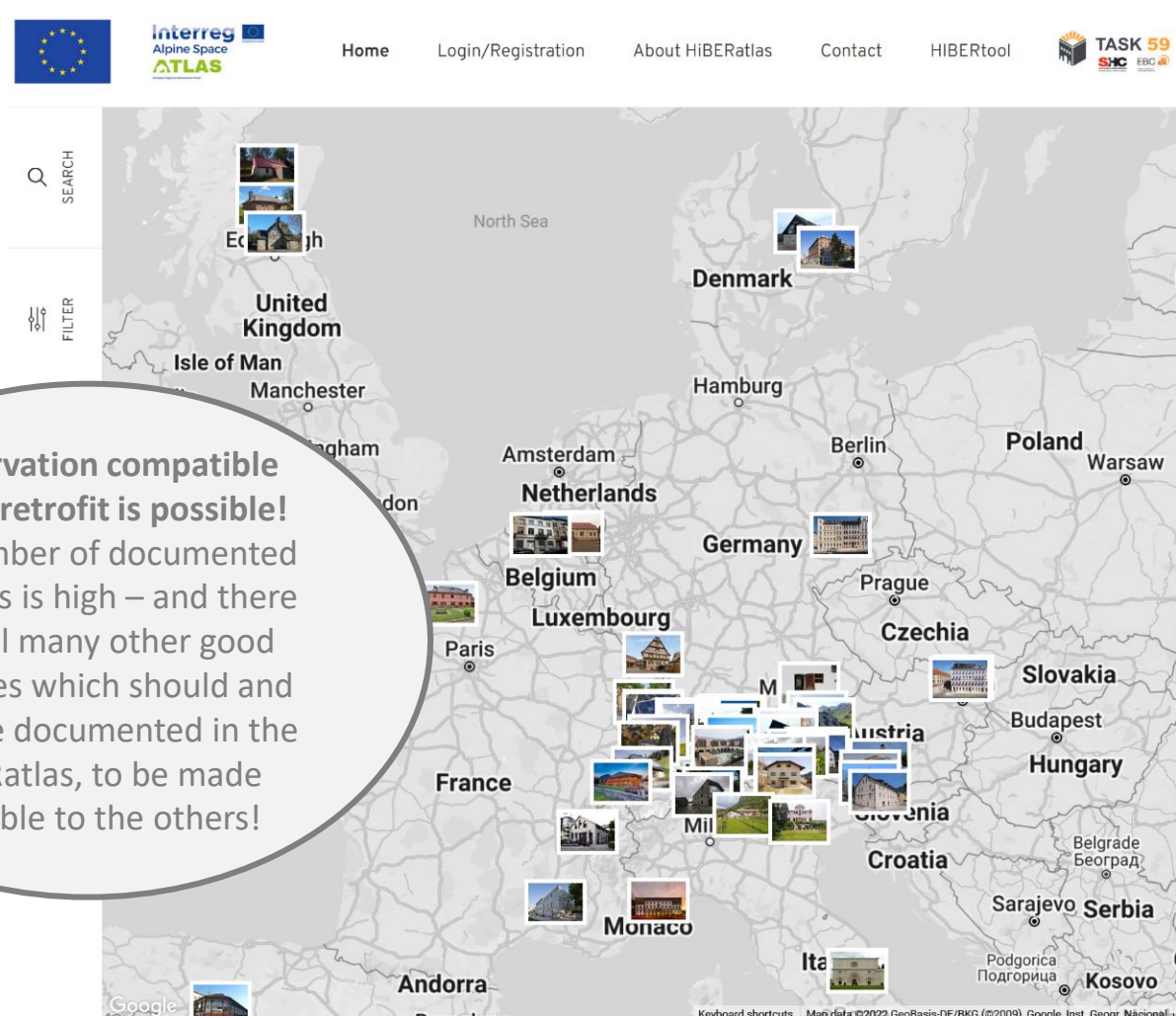

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Conservation compatible energy retrofit is possible!

The number of documented buildings is high – and there are still many other good examples which should and could be documented in the HiBERatlas, to be made available to the others!

WHO is documenting?

This is a **joint development** of two research projects:

- The European Interreg Alpine Space project "**ATLAS**"
- The International Energy Agency (IEA) project "**IEA-SHC Task 59**".

Initially, the partners of both projects were contributing with evaluated case studies. In a **second stance, owners and designers** of suitable example are invited to participate.

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 59

Case Studies Assessment Report June 2021

IEA SHC TASK 59 | Renovating Historic Buildings Towards Zero Energy

2.1.1 Short description of the case studies

A multi-purpose used convent building in the heart of Vienna has been refurbished with particular attention to monument preservation and to a new solution for renovating Viennese-type box windows. The goal was to present a sustainable system solution with the energetic refurbishment of the existing building and the highly efficient loft conversion according to the requirements of the monument protection.

Klostergebäude Kaiserstrasse Vienna, AT | Building Period: 1850 - 1899 Renovation: 2013 | Use: Residential (urban) Protection level: listed | Contact: e7 energy innovation & engineering

The renovation of the Mayrhof in Trins combines several best-practice solutions in one project. In particular, the use of a newly developed façade system and an extension using a house-in-house concept allow architecture and building physics aspects to harmonize with each other.

Farm house Trins Trins, AT | Building Period: 1600 - 1700 Renovation: 2019 | Use: Residential (rural) Protection level: not listed | Contact: University of Innsbruck

The former farm house and later on home of the painter Angelika Kaufmann was almost 400 years old, when the architect and new owner Thomas Monsorno decided to restore the building and play with it's given qualities. He kept the outward appearance and changed its interiors into a spaceship full of places to experience, with its different light and shades - it is a playground and an oasis in the same.

Hof 6, Schwarzenberg Vorarlberg, AT | Building Period: 1600 - 1700 Renovation: 2013 | Use: Residential (rural) Protection level: listed | Contact: Energieinstitut Vorarlberg

Exemplary sustainable renovation of a historic mountain hut at 1,482 meters above sea level in Aurach near Kitzbühel. The renovation resulted in a significant increase in the levels of comfort in a mountain hut exposed to severe weather conditions. The building is used all year round after renovation.

Kelchalm – Bochumer Hütte Tirol, AT | Building Period: 1800 - 1849 Renovation: 2013 | Use: Hotel/Restaurant Protection level: not listed | Contact: University of Innsbruck

Modernization of a Gründerzeit building with the use of an aerogel insulating plaster. In addition to the restored façade, the exterior of the new attic storey is initially noticeable. he building received two major awards: the 1st prize of the 33rd Vienna Urban Renewal Prize by the National Guild Construction Vienna, and the State Prize for Architecture and Sustainability 2019 by the Federal Ministry for Sustainability and Tourism.

Mariahilferstrasse 182 Vienna, AT | Building Period: 1850 - 1899 Renovation: 2013 | Use: Residential (urban) Protection level: not listed | Contact: e7 energy innovation & engineering

4.2.3 Ventilation

4.2.3.1 Overview of ventilation solutions

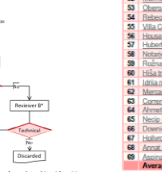
Table 14: Overview – ventilation solutions

No	Case study	Country	Building type	Intervention [to be completed]	Heat recovery
1	Klostergebäude Kaiserstrasse	AT	resturban	Semi-centralised MVHR, distribution with exist shafts	yes
2	Farm house Trins	AT	resrural	centralised MVHR with cascade system	yes
3	Hof 6,	AT	resrural		
4	Kelchalm - Bochumer	AT	hotel	decentralised MVHR for laundry rooms	yes
5	Mariahilferstrasse 182	AT	resurban	centralised MVHR with bypass	yes
6	House Maurer,	AT	resrural		
7	House Breuer,	AT	resrural	centralised MVHR	yes
8	Music school in Velden	AT	education	2 centralised (from attic and using existing chimneys)& 1 decentralised systems	yes
9	Hof Neuhäusl	AT	resrural	centralised MVHR	yes
10	Community Hall Zwischenwasser	AT	offices	centralised MVHR with cascade system	yes
11	Freihof Sulz	AT	hotel	centralised MVHR	yes
12	Oeconomy building Josef Weiss	AT	resurban	centralised MVHR for kitchen, restaurant & dining room	yes
13	Glatta Haus	AT	hotel	centralised MVHR with humidity control	yes
14	Rhine Valley House	AT	resrural		
15	Baur Residence,	AT	resrural		
16	Kasperhof	AT	resrural		
17	Maison Rubens	BE	resurban	centralised MVHR using chimneys	yes
18	Half-timberframed house in Alken,	BE	resrural	centralised MVHR	yes
19	Dongio Castle, Rovio (CH)	CH	resrural	centralised MVHR	yes
20	Solar silo	CH	offices	natural ventilation, manual via windows	no
21	Wohn- & Geschäfts-haus Feldbergstrasse	CH	resurban	centralised MVHR	yes
22	Mehrfamilienhaus Magnusstrasse	CH	resurban	centralised MVHR	yes
23	St. Franziskus Church	CH	other		
24	Kindergarten and apartments (PEB)	CH	resurban	decentralised MVHR, night cooling	yes
25	Single family home Luisenstrasse - Bern	CH	resurban	centralised MVHR with screed in built-in cupboards	yes
26	Single Family House -	CH	resrural		
27	Glaserhaus in	CH	resrural	natural ventilation via windows)	no
28	PalaCinema Locarno	CH	other	centralised MVHR, differentiated use sector	yes
29	Casa Rossa Chemnitz	DE	resurban	Exhaust ventilation	no
30	Rathaus Bergrheinfeld	DE	offices	Centralised MVHR	yes
31	Farmhouse Straub	DE	resrural		
32	Early work Sep Ruf	DE	resrural		
33	Ackerbürgerhäuschen	DE	resrural	centralised MVHR	yes
34	Rittethof	DE	resrural	centralised MVHR for part of the building	yes

1.2 Quality assurance (review process) (Franziska)

Ensuring the quality of the best-practices displayed in the database is crucial to help eradicating any concern about professionals' expertise. The implementation of a review process that can assess the validity of the projects and, most importantly, the way they are documented becomes necessary. The ultimate goal of the review process is not to reject proposed examples but to ensure their robustness and to improve the way they are presented. The review model takes inspiration from the academic peer-review process. Every best-practice gathered during the project was and will be assessed by the experts participating in the Task 59 following this methodology to test the feasibility of such review process. At the end of the Task 59 project, the lessons learned will be used to adapt and improve the reviewing model.

Figure 1: Review process in Task59



After checking the completeness of the information provided, the best-practice is assigned to at least two members with different expertise: Heritage or Technical. If a case study is rejected by one of the reviewers, this is submitted to an alternative reviewer for a second opinion. A second rejection will mean that the project should not be included in the database.

For the review a template was developed, that was tailored to heritage and technical focus. It was asked for an overall evaluation according to Heritage Compatibility and Technical feasibility. Furthermore, there is the possibility to mention other positive aspects of the project, like economic and environmental aspects, robustness and others.

Table 1 Extract of the review template, first part with key information

1.) Overall evaluation (the overall evaluation should be completed for all aspects 1.1 – 1.3 by all reviewers regardless of their expertise):			
1.1) What is your overall assessment of the project regarding Heritage Compatibility? Please select one of the categories below and write a short explanation			
Recommended as role model	Recommended with limitations	Not recommended	Please justify your selection shortly! Further explanations can be found below.
O	O	O	

This key- information part of the template is followed by questions which are supposed to be answered more in detail, asking mainly for the completeness and comprehensibility of the documentations.

It turned out that most projects were rated yellow, what means the projects seemed suitable for the database, but the documentation had to be at least partially completed. Only one project received a red rating in the first review from the Heritage expert. After a second review, however, this project was also given a yellow rating and asked to provide additional information. Only one of the evaluated projects received a green rating in both aspects, heritage and technical, with the first review.

42	Rainhof	IT	steady state	0		60.0	0	
43	Villa Castelli	IT	steady state	0	230.2	18.3	0	32.4
44	Ansitz Kofler	IT	steady state	0		30.0	0	
45	Rocca di Collemaggio	IT	NA	0		3.1	0	191.5 3.1
46	House Perrier	IT	NA	1		26.5		
47	Kohlerhaus	IT		1		68.3	1	16.9
48	Ruckenzauerhof	IT		0	360.0	110.0	0	
49	Aussergrubhof	IT		0		107.0	1	42.2
50	Obergasserhof	IT		0	230.0	135.0	1	260.0 181.0
51	Platzbonhof	IT	steady state	0		74.0	1	39.0
52	Maerhof	IT	NA	1	283.0	66.0	1	283.0 57.0
53	Obersasserhof	IT		0		99.0	1	36.2
54	Rebecco Farm	IT		1		89.3	1	
55	Villa Cappellazza	IT		1	338.0	319.0	1	361.9
56	House Monsder	IT		0	365.0	21.0	1	365.0 45.0
57	Huberhof	IT			151.0	129.0		
58	Notranja vila	SL	steady state	1		28.0	1	31.0
59	Rožna ulica 15, Idrija	SL		0		44.0		97.0
60	Hiša trentarskih vodnikov	SL	steady state	1		48.0		24.0
61	Idrija mercury smelting plant	SL		0				
62	Mercado del Val, Valladolid	SP	dynamic	0	61.7	20.0	0	1300.2 326.9
63	Compra 119	SP		0				
64	Ahmet Aga Mansion	TK		1		67.2	0	67.2
65	Necip Pasa Library	TK		1			0	
66	Downie's Cottage	UK	steady state	1		412.0	1	412.0 412.0
67	Hallsmead Park Lodge	UK		1			1	518.0 274.0
68	Arnot Road	UK		1		295.0	1	295.0
69	Aspinall Courthouse	USA	dynamic	0		76.8	1	134.4 66.2
	Average			0.6	214.4	68.2	0.6	362.7

A summary of the energy use (for space heating) of the entire sample before and after the retrofits is presented in Figure 69. The results in the first plot on the left show graphically a significant reduction in the demand of energy for space heating, but also a much more concentrated distribution of results. When looking at the histograms of both subsamples (before -middle- and after -right-), further detailed information can be accessed. After the renovation, most of the cases documented have a energy demand between 25 and 75 kWh/m²y.

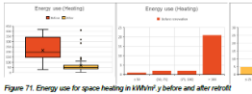


Figure 71. Energy use for space heating in kWh/m² y before and after retrofit

These results are obviously heavily influenced by the climatic conditions. In order to minimise this uncertainty a detailed analysis of a subsample with homogeneous climatic conditions was performed. Of the documented cases, the climate Cfb (Temperate oceanic climate; coldest month averaging above 0 °C, all months with average temperatures below 22 °C, and at least four months averaging above 10 °C) is by far the most representative (38 out of 69). The plots in Figure 70show the same analysis for the subsample. The distribution of results of the case studies in climate Cfb is almost identical to that of the entire sample, with a great majority of cases above 100kWh/m²y before the renovation and between 25 and 75 kWh/m²y afterwards.

Figure 52: Ventilation with heat recovery by main use in absolute numbers (left) and share (mid) as well as b both considering main and secondary use (right)

35 buildings with MVHR correspond to slightly more than half of all the documented good practice buildings. Th fact that looking specifically at listed buildings, 47% have been equipped with a ventilation with heat recovery, induces, that it might be slightly but not considerably more difficult to integrate a ventilation system in a listed building. The analysis looking at whether buildings are situated in conservation areas or are both – listed and ir conservation areas – shows the same trend.

Figure 53: Ventilation with heat recovery by main use in absolute numbers (left) and share (mid) as well as by both considering main and secondary use (right)

Ventilation systems have more often be considered in retrofits of urban than rural residential buildings: the number of documented ventilation systems is with 12 each equivalent, but since overall less urban residential buildings have been documented, the share is with of 2 out of 3 retrofits with ventilation system highest there. This value is only topped, when looking explicitly at buildings with any kind of educational use: 2 out 3 with it as main use have ventilation system, including those with a secondary educational use the numbers rise to 4 out – this shows a clear sensibility for indoor air quality in these cases.

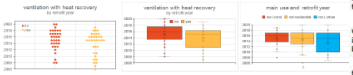


Figure 54: Year of retrofit – by ventilation with heat recovery (left) and main use (right)

The hypothesis, that recent retrofits might more often include MVHR since experience on how to implement it r rising is not supported by the collected data: the whisker plot of retrofits with and without MVHR actually shows that thos with MVHR are on average "older". This could, however, also be due to the fact that there is dominan of rural residential restrofits in the documented recent cases, which as has been shown above are less likely to equipped with MVHR.

Figure 30: Mairhof. All windows were replaced.

Figure 31: Obergasserhof. Single-leaf and double-glazed new windows.

Figure 32: Platzbonhof. Triple-glazed windows improved energy efficiency.

Figure 33: Aussergrubhof. Larch wood double-glazed windows.

Figure 34: Ruckenzauerhof. New windows selected in close cooperation with monument office.

Figure 35: Mercado del Val. The new glazed façade increased daylighting levels.

In the remaining 24 solutions, e.g. Ansitz Kofler, Bauernhof Trins, Maison Rubens, Half-timberframed house in Alken, Obergerhof, Timber-Framed house in Alsace and Rainhof all new windows were handcrafted to match the originals as far as possible. This meant typically that the frame would be an exact replica of the original except for the fact that it was adjusted to allow for another type of glazing, i.e. double- or triple-layer low-energy glazing instead of the typical single-layer glazing. The change of the glazing reduces heat losses significantly making the windows perform more or less like today's standard.

In the west façade of Ansitz Kofler, where the wall was insulated from the outside, the ancient openings were reconstructed. In order to allow for the most efficient position of the new window in a line with the insulation layer, the sub-frame had to be placed just "outside" the original stonewall. In order to avoid thermal bridges, the roller-shutter casings were installed on the wall in the insulation layer and the sub-frame was completely covered by the mineral wool panels. In order to achieve an airtight connection between sub-frame and the main frame of the window, jointing tape was applied.

In Bauernhof Trins, the windows were completely replaced. The new wooden windows in the local style were pre-installed in the custom-made wooden wall elements. The optimized position of the window frames in the insulation layer increases thermal comfort and reduces the risk of condensation through minimized thermal bridges.

For Maison Rubens, the windows were replaced with new ones of oak wood. The new windows are identical to the original and has the original shape. Most of the windows have been replaced and only the ones on the front façade at first floor were kept because they already had double-glazing.

In the Half-timberframed house in Alken, the windows were in a very bad state. There were windows (remains) from the 17th, 18th and even 20th century. In some places the windows were also missing. The remaining wooden joinery in the half-timbered house has been completely replaced by typologically appropriate new joinery. The new windows have double-glazing and in order to accommodate this, the profile thickness has been adjusted slightly.

In Oberbergerhof, most of the windows have been replaced. The bifora windows (mullioned windows with two lights) from the late renaissance were preserved in the middle room on the second floor. The windows in the apartment were renewed, while four new windows were added to the roof on the top floor. In the knight's hall, the old, historical windows have been preserved and not changed. When replacing the windows, special care was taken to ensure that the view of the courtyard was not changed. Therefore, it was only possible to provide the

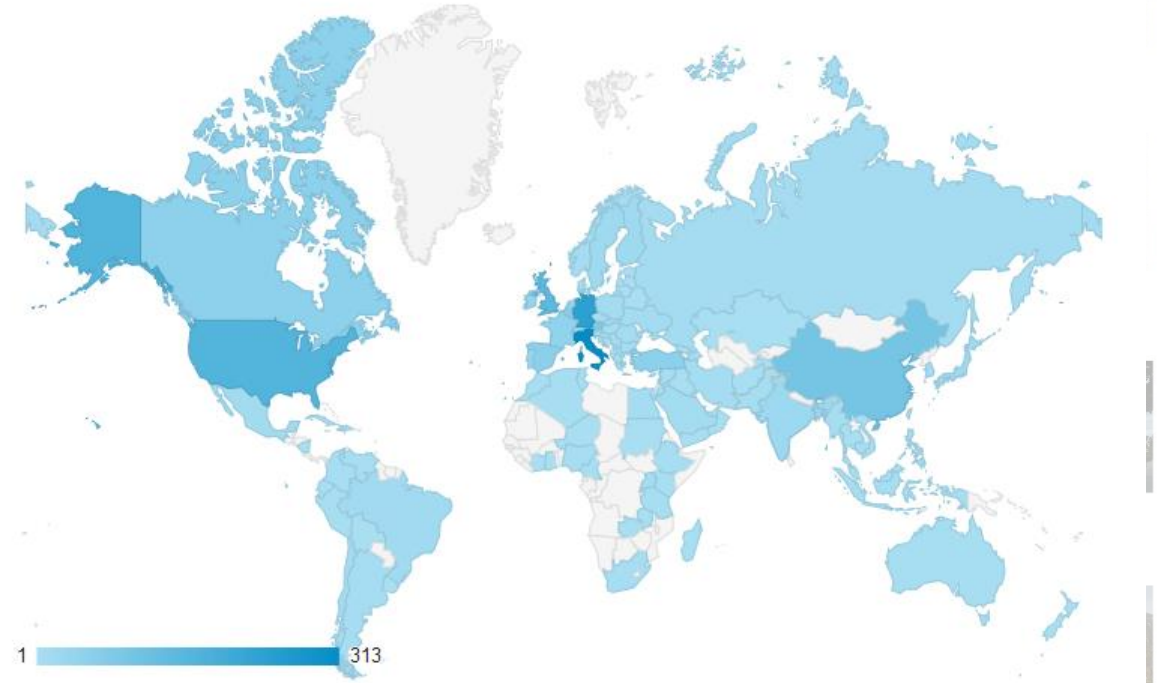
Historic Building Energy Retrofit Atlas

2020.07.13
Kasperhof
Austria

2020.10.16
Villa Capodivacca
Italy

2020.01.14
Musikschule Velden
Austria

2020.03.16
Community Hall Zwischenwasser
Austria



2019.07.03
Mercado del Val, Valladolid (Spain)
Spain

2019.12.10
Platzbon
Italy

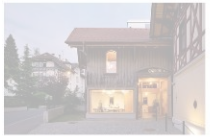
2019.11.27
Oberbergerhof
Italy

2019.07.26
Rožna ulica 15, Idrija
Slovenia

2019.08.22
Hiša trentarskih vodnikov
Slovenia

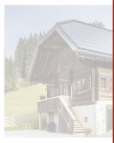
2020.01.10
St. Franziskus Church - Ebmatingen, Switzerland
Switzerland

2019.08.06
Maison Rubens
Belgium



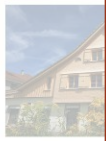
2020.04.16
Oeconomy building Josef Weiss
Austria

2019.05.07
Notarjeva vila
Slovenia



2020.05.22
Single Family H
Switzerland

2019.12.12
Annat Road
United Kingdom



2020.06.18
Baur Residen
Austria

2019.10.29
Kohlerhaus
Italy

Historic Building Energy Retrofit Atlas

2020.07.13
Kasperhof
Austria

2020.03.18
House of the Alpilles regional natural park
France

2019.12.12
Ansitz Mairhof
Italy

2019.03.29
Ansitz Kofler
Italy

2020.11.03
Casa Rossa Chemnitz
Germany

2020.04.28
Rebecco Farm
Italy

2020.01.10
St. Franziskus Church - Ebmatingen, Switzerland
Switzerland

2020.05.22
Single Family H
Switzerland
Switzerland

2020.10.16
Villa Capodivacca
Italy

2020.05.06
Sankt Christoph
Germany

2020.04.30
Giatla house
Austria

2020.11.03
PalaCinema Locarno - Locarno, Switzerland

2020.07.22
Glaserhaus - Affoltern im Emmental, Switzerland
Switzerland

2019.10.08
Idrija mercury smelting plant
Slovenia

2019.08.06
Maison Rubens
Belgium

2019.12.12
Annat Road
United Kingdom

2020.01.14
Musikschule Velden
Austria

2019.09.05
Mariahilferstrasse
Austria

2019.04.05
Klostergebäude Kaiserstrasse
Austria

2020.03.27
Single family House - Bern, Switzerland
Switzerland

2019.04.08
Klitgaarden
Denmark

2020.05.05
Rhine Valley House Irgang
Austria

2020.04.16
Oeconomy building Josef Weiss
Austria

2020.06.18
Baur Residen
Austria

2020.03.16
Community Hall Zwischenwasser
Austria

2019.07.03
Mercado del Val, Valladolid (Spain)
Spain

2019.12.10
Platzbon
Italy

2019.11.27
Oberbergerhof
Italy

2019.07.26
Rožna ulica 15, Idrija
Slovenia

2019.08.22
Hiša trentarskih vodnikov
Slovenia

2019.05.07
Notarjeva vila
Slovenia

2019.10.29
Kohlerhaus
Italy


one of the greatest challenges
the continent faces is converting the historic buildings in Europe's centuries-old cities for a sustainable future
European climate commissioner and EU executive vice-president
Frans Timmermans
We will set up a new European Bauhaus – a co-creation space where architects, artists, students, engineers, designers work together to make that happen
Ursula von der Leyen, State of the Union Adress 2020
3encult
dwellings e.g. in Europe
< 1919
14.3%
1919-1945
12.1%
26.4%
< 1945
30 million
25 million
55 million
65 million
55 million
120 million
dwellings %
dwellings n°
people

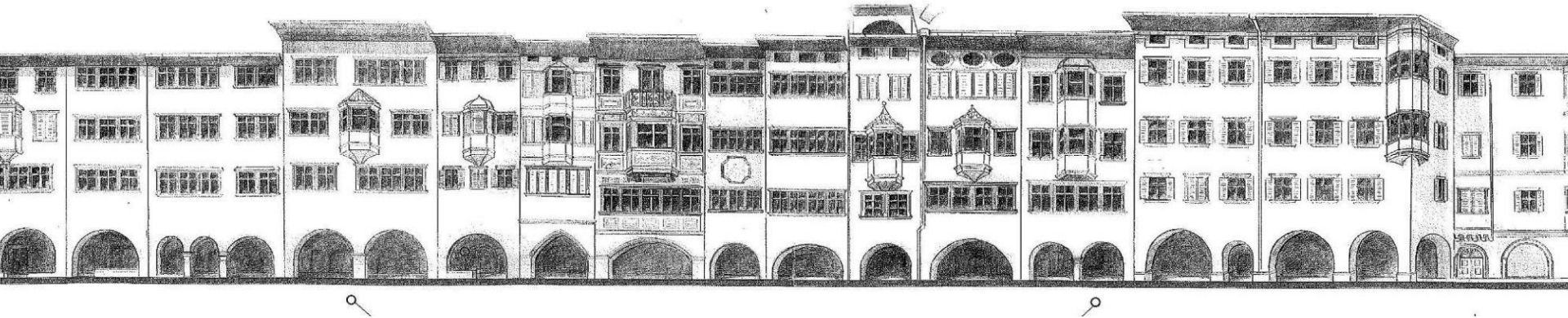
eurac research

THANK YOU FOR YOUR ATTENTION!

Alexandra Troi

alexandra.troi@eurac.edu

7th April 2022, Graz.
ISEC – International Sustainable Energy Conference



Discussion

Wrap-up

Céline Carré

Saint Gobain – President of EuroACE

EuroACE
Energy Efficient Buildings

Thank you!

EuroACE
Energy Efficient Buildings