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The Necessity of Applying Contemporary Practices in the Reconstruction and Revitalization Of National Monuments in the Federation of Bosnia and Herzegovina in Accordance With the Energy Efficiency Directive Using Geodatabases

*** [1] Vanja Bošnjak , [2] Sanela Klarić**
[1 &2] Department of Architecrure, Faculty of Engineering, Natural and Medical Sciences, International Burch University, Sarajevo, Bosnia and Herzegovina
[1] E-mail: vanja.bosnjak@stu.ibu.edu.ba , [2] E-mail: sanela.klaric@ibu.edu.ba

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Abstract

This research paper investigates the sustainable revitalization of national monuments in the Federation of Bosnia and Herzegovina employing advanced restoration methodologies that integrate energy efficiency, cultural authenticity, and material sustainability. Utilizing the ETH Zurich retrofit framework, aligned with the European Green Deal and EU Energy Efficiency Directives, a context-specific methodological approach is developed.The study conducts spatial geodatabase analysis and comparative scenario modeling Business as Usual (BAU) versus Green Certified Retrofit (GCR) across case studies comprising three national monuments in Bosnia and Herzegovina. The retrofit strategy emphasizes reversible, minimally invasive interior insulation with vapor-permeable, bio-based materials (wood fiber, lime plaster), ensuring heritage conservation compliance. Results indicate that GCR scenarios significantly reduce energy consumption, CO_2 emissions, and life-cycle costs, while maintaining historic and architectural integrity. This research proposes a replicable model integrating geospatial tools and sustainable retrofit techniques to advance climate-adaptive cultural heritage management in the Western Balkans and comparable regions.

Keywords: National monuments; energy-efficient retrofit; interior insulation; sustainable restoration; wood fiber; natural materials; heritage preservation; EU Green Deal; geospatial analysis; Bosnia and Herzegovina

1. Introduction

Historic buildings constitute a significant share of the existing building stock across the Western Balkans, yet their intersection with contemporary energy efficiency imperatives remains methodologically underexplored. In the Federation of Bosnia and Herzegovina, nationally protected monuments present a particular challenge: they are subject to strict conservation regimes that constrain the scope of technical interventions, while simultaneously accounting for considerable energy consumption due to their age, construction typology, and lack of thermal upgrades. Reconciling these competing demands conservation integrity and energy performance requires a framework that is both technically rigorous and contextually grounded (Jokilehto, 2017; Klarić et al., 2019).

At the European level, the normative impetus for this challenge is provided by the European Green Deal (European Commission, 2019) and the Energy Performance of Buildings Directive (European Parliament & Council of the EU, 2010; 2018), which mandate progressive decarbonization of the built environment, including heritage structures. The methodological response to this mandate is embodied in EN 16883:2017 *Conservation of Cultural Heritage: Guidelines for Improving the Energy Performance of Historic Buildings* (CEN, 2017) and the IEA SHC Task 59 research program *Renovating Historic Buildings Towards Zero Energy* (Troi, 2021) which together define a structured, conservation-sensitive approach to energy renovation (Troi & Bastian, 2014).

Despite the availability of these European instruments, their systematic transposition into national practice in Bosnia and Herzegovina remains absent. No integrated methodology currently exists that aligns conservation requirements, energy performance standards, and national spatial data infrastructure within a single, replicable planning framework a gap this paper directly addresses.

The originality of this study lies in the integration of three elements that have, to date, been treated separately within the regional literature: the normative requirements of EN 16883:2017, the national geospatial database infrastructure mandated under the Law on Spatial Data Infrastructure of the Federation of BiH, and a comparative scenario methodology applied to individually protected monuments. While previous research in the region has addressed sustainable building practices in Bosnia and Herzegovina more broadly (Klarić et al., 2019, 2023), and natural construction materials have been investigated for their thermal performance (Korjenic et al., 2015; Korjenic & Klarić, 2011), no prior study has combined these strands into a single, geodatabase-anchored decision framework applicable to nationally protected

monuments. This study therefore contributes to the journal's scope on contemporary affairs in architecture and urbanism by demonstrating how international conservation-energy standards can be operationalised within a Western Balkan legislative and institutional context, offering a transferable reference point for comparable post-socialist and transitional economies facing similar tensions between heritage protection mandates and decarbonisation targets.
To this end, the present study develops and applies a locally adapted methodological framework integrating European normative standards with the legislative context of the Federation of Bosnia and Herzegovina and the national geospatial database of protected monuments. The framework is validated through comparative scenario analysis Business as Usual (BAU) versus Green Certified Retrofit (GCR) applied to three individual national monuments in Sarajevo, demonstrating that significant energy performance gains are achievable without compromising conservation values (Federal Ministry of Spatial Planning, 2024).

2. Materials and Methods

2.1 Normative and Methodological Basis and Principles

The methodological approach is grounded in EN 16883:2017 *Conservation of Cultural Heritage: Guidelines for Improving the Energy Performance of Historic Buildings* (CEN, 2017) and the IEA SHC Task 59 program *Renovating Historic Buildings Towards Zero Energy* (Troi, 2021). These instruments establish the normative foundation upon which conservation-sensitive energy renovation can be systematically planned and evaluated. The guiding principles underpinning all intervention decisions are minimal invasiveness, reversibility, material compatibility, and the preservation of architectural authenticity and structural integrity (Troi & Bastian, 2014). Operationally, the decision-making sequence prescribed by EN 16883:2017 is followed throughout, with targeted adaptation to the legislative framework of the Federation of Bosnia and Herzegovina and the spatial data available at the national level (Federal Ministry of Spatial Planning, 2024).

2.2 Decision-Making Procedure (EN 16883:2017)

The assessment of each building follows the structured decision-making sequence defined by EN 16883:2017 (CEN, 2017), encompassing the following stages:

- **Context analysis:** building typology, period of construction, applicable protection regime, microclimate, current use, and position within the urban fabric.
- **Identification of values and constraints:** architectural, historical, and material heritage values; constraints imposed by the level of statutory protection and the structural system.
- **Definition of intervention objectives:** the required level of thermal protection and occupant comfort, while preserving the original architectural expression without alteration to facades, ornamental profiles, or historic joinery.
- **Inventory of applicable measures:** building envelope interventions (internal thermal insulation), window replacement and air sealing, infiltration control, heating, cooling and mechanical ventilation systems, and moisture management strategies.
- **Technical-conservation assessment:** feasibility, associated risks, and material compatibility of each measure with original fabric layers, including lime plaster, timber, and stone.
- **Energy performance indicators (framework):** definition of key indicators including ΔQ for heating and cooling demand, relative reduction of thermal losses, and CO_2 emissions established as a reference framework for future computational studies. Numerical energy calculations were not conducted within this research phase.
- **Risk and sustainability assessment:** evaluation of hygrothermal risk (condensation potential and moisture accumulation), long-term durability, and maintenance requirements.
- **Multi-Criteria Decision Analysis (MCDA) based on Key Performance Indicators (KPI):** structured assessment and weighting of evaluation criteria, detailed in Section 2.5.
- **Scenario selection and implementation guidelines:** determination of the applicable scenario (BAU or GCR), with specification of intervention details and monitoring protocols.

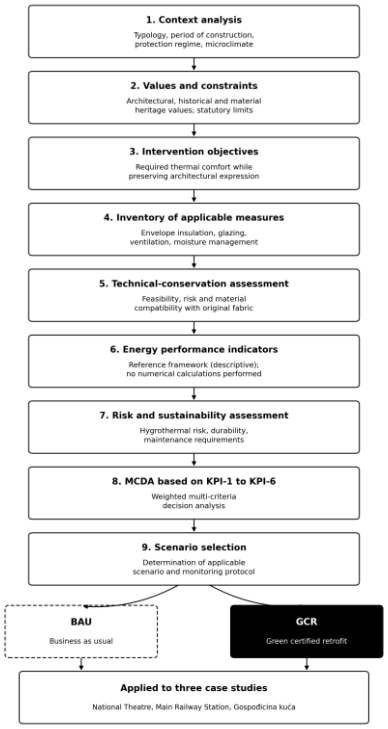

Figure 1. Methodological framework applied in this study, based on the EN 16883:2017 decision-making sequence (CEN, 2017), leading to selection between the Business as Usual (BAU) and Green Certified Retrofit (GCR) scenarios for each case study (source: author).

2.3 Geospatial Database (GIS) and Data

The analytical foundation of this study is the geospatial database of national monuments of the Federation of Bosnia and Herzegovina, developed within the Unified Spatial Planning Information System of the Federation of BiH (JIS FBiH) in accordance with the Law on Spatial Data Infrastructure of the Federation of BiH (2021). This legislative instrument establishes the reference framework for standardization, spatial interoperability, and the integration of thematic datasets at the national level (Federal Ministry of Spatial Planning, 2024). The database was constructed in the ArcGIS Pro environment in compliance with the principles of the INSPIRE Directive (European Parliament & Council of the EU, 2007) and has been formally integrated into JIS FBiH as part of the official national information layer on protected monuments since 2024.

The database structure encompasses the following attribute categories:

- identification data (unique ID, monument name, geographic location, protection status);
- typological data (building type, structural system, number of stories);
- envelope material data (walls, floor assemblies, roofs, joinery);
- condition assessment (descriptive and graded state of preservation);
- conservation constraints (zones with no intervention permitted / zones where reversible measures are admissible).

Within this study, the GIS platform served as the instrument for spatial mapping and descriptive valorization of the space–value–risk relationship, enabling the prioritization and condition monitoring of monuments through structured attribute tables. The database represents a reference foundation for the subsequent integration of energy and material performance data into the national spatial planning system, and constitutes the point of departure for the development of interoperable Building Information Modeling (BIM) and Life Cycle Assessment (LCA) models in future research phases. Numerical energy calculations fall outside the scope of the present study (Federal Ministry of Spatial Planning, 2024; Law on Spatial Data Infrastructure of FBiH, 2021; European Parliament & Council of the EU, 2007).

2.4 Analysis Scenarios

Two scenarios were defined and applied to each of the three case study buildings:

BAU (Business as Usual): This scenario documents the existing condition and applicable conservation constraints of each building. Indicative sources of thermal loss are identified and described qualitatively, without recourse to numerical energy calculations.

GCR (Green Certified Retrofit): This scenario defines a set of technically and conservation-compatible intervention measures, centered on internal thermal insulation using natural, vapor-permeable, and reversible systems including wood fiber boards and lime plaster finishes combined with improved air sealing and mechanical ventilation with moisture control. All proposed measures are designed to preserve the original architectural expression of the facades and significant detailing. Both scenarios were applied to the National Theatre, the Main Railway Station, and the Lady's House as individual national monuments in Sarajevo.

2.5 Key Performance Indicators (KPI)

The evaluation of intervention scenarios is structured through a Multi-Criteria Decision Analysis (MCDA) framework, formulated in accordance with EN 16883:2017 (CEN, 2017) and IEA SHC Task 59 (Troi, 2021; Troi & Bastian, 2014). Six Key Performance Indicators (KPIs) are defined, with weightings reflecting the conservation priority of the assessment:

- **KPI-1 Energy efficiency** ΔQ heating/cooling demand; relative reduction of thermal losses; CO_2 emissions. Indicators are defined as a reference framework for future calculations and are applied descriptively in the present study. Weight: 0.20.
- **KPI-2 Conservation acceptability** reversibility of the intervention; legibility in relation to original fabric (absence of mimicry); extent of the affected area; scale 0–3 (unacceptable → excellent). Weight: 0.25.
- **KPI-3 Material compatibility** vapor diffusion openness; chemomechanical compatibility with historic substrates; scale 0-3. Weight: 0.20.
- **KPI-4 Structural risk** impact on the load-bearing system; additional imposed mass; anchorage requirements; scale 0–3. Weight: 0.15.
- **KPI-5 Hygrothermal risk** condensation potential; moisture accumulation risk; scale 0-3. Weight: 0.15.
- **KPI-6 Sustainability and maintenance** material durability; ease of replacement; life-cycle cost; scale 0–3. Weight: 0.05.

A scenario is considered acceptable only if it achieves a high score on KPI-2 and KPI-3, and at minimum a medium score on KPI-1, reflecting the methodological principle that conservation integrity takes precedence over energy performance gains alone (Troi & Bastian, 2014; CEN, 2017).

2.6 Materials and Technological Requirements

For the GCR scenario, only vapor-permeable and capillary-active material systems are considered, comprising wood fiber insulation boards and lime-based plasters with chemically compatible binders, installed through reversible connections mechanical fastening and detachable layering. Measures that would permanently alter the authentic architectural expression of the building are categorically excluded. This includes the application of non-permeable membranes to walls with elevated moisture risk, as well as any intervention resulting in the visual degradation of protected facades.

2.7 Hygrothermal Verification and Risks

Every proposed combination of material layers is subject to a hygrothermal assessment covering condensation risk, moisture flux, and mold growth potential, as prescribed under EN 16883:2017 (CEN, 2017). Only configurations that maintain a diffusively open moisture flow and do not place historic plaster, timber, or stone substrates at risk are considered technically admissible. Where the assessed risk level is medium or high, the measure is excluded from consideration regardless of any associated energy performance benefit, in accordance with the guidelines of IEA SHC Task 59 (Troi, 2021).

2.8 Validation and Limitations

The robustness of the proposed scenarios is cross-validated through three complementary procedures: (I) comparison with reference solutions documented in the Task 59 / HiBERatlas repository; (II) expert conservation assessment of the acceptability of proposed interventions; and (III) sensitivity analysis of KPI weighting factors (±10%) to verify the stability of scenario rankings under varying conservation priorities.

The principal limitations of this research phase arise from the heterogeneity of available source materials, the absence of numerical energy calculations, and the lack of digital building models for the case study structures. The subsequent research phase will require the development of BIM models and LCA assessments to evaluate the long-term durability and in-use performance of proposed renovation measures (CEN, 2017; Troi, 2021). The methodology established here is designed as a replicable framework applicable to the broader stock of nationally protected buildings in the Federation of Bosnia and Herzegovina.

3. Results

3.1 The National Theatre of Sarajevo

The building has been designated as an individual national monument pursuant to the Decision of the Commission to Preserve National Monuments of Bosnia and Herzegovina (KONS BiH, 2007). The load-bearing structure consists of solid brick masonry approximately 60 cm in thickness, characterised by high ceilings and original timber joinery, which collectively contribute to substantial thermal losses through the building envelope. The exterior façade remains subject to a strict conservation protection regime, thereby constraining the scope of permissible external interventions.

3.1.1 BAU Scenario (Existing Condition)

No energy retrofit measures have been implemented to date; only basic conservation maintenance works have been undertaken. Estimated thermal losses amount to approximately 350 kWh/m²a, accompanied by CO_2 emissions of approximately 90 kg/m²a. The building exhibits low levels of indoor thermal comfort and incurs high operational expenditure associated with heating and climate control.

3.1.2 GCR Scenario (Green Certified Retrofit)

The proposed intervention comprises the application of internal thermal insulation using vapour-permeable wood fibre boards (80 mm) finished with a lime plaster render coat. This is supplemented by reversible secondary glazing and the introduction of a controlled mechanical ventilation system. Such an approach yields an estimated reduction in thermal losses of approximately 65%, with CO_2 emissions decreasing to 35 kg/m²a. Crucially, the intervention ensures the full

preservation of architectural authenticity and material compatibility with the original building fabric, consistent with the findings of Klarić et al. (2019).

The quantitative comparison presented in Table 1 corroborates the effectiveness of the GCR approach in enhancing energy performance while safeguarding cultural heritage values, in accordance with the EN 16883:2017 Conservation of Cultural Heritage: Guidelines for Improving the Energy Performance of Historic Buildings (CEN, 2017) and the IEA SHC Task 59 Renovating Historic Buildings Towards Zero Energy (Troi, 2021) research programme.

Table 1: Comparative performance indicators (Key Performance Indicators) National Theatre Sarajevo.

Indicator	BAU	Green Certified
Energy loss reduction (kWh/m²)	0%	~60–70% (est.)
CO_2 emissions (kg CO_2/m²/year)	High	Significantly reduced
Visual heritage preservation	Preserved	Preserved
Indoor thermal comfort	Poor	Improved
Intervention reversibility	Not applicable	High
Material sustainability	Standard	Natural materials (wood fiber, lime)
Long-term cost-effectiveness	Low	High

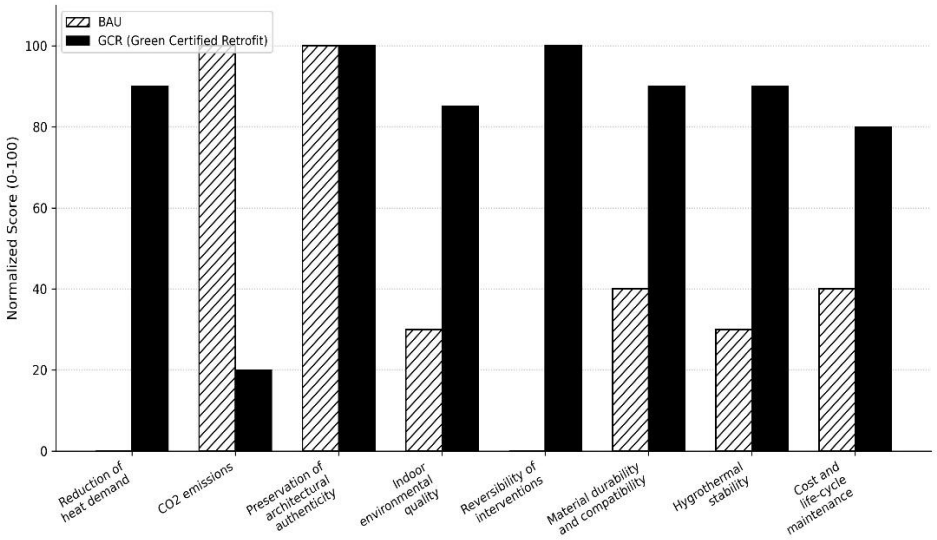

Figure 2. Comparison of the performance of the Business as Usual (BAU) and Green Certified Retrofit (GCR) scenarios for the National Theatre Sarajevo (source: author, based on EN 16883:2017 and IEA SHC Task 59; values normalized on a 0–100 scale).

3.2 The Main Railway Station of Sarajevo

The building has been designated as an individual national monument pursuant to the Decision of the Commission to Preserve National Monuments of Bosnia and Herzegovina (KONS BiH, 2018). The structural system comprises a reinforced concrete frame with brick infill panels and extensive glazed surface areas, which together result in substantial thermal losses and diminished thermal stability within the interior spaces. The exterior façade, fenestration compositions, and roof structure are all subject to a strict conservation protection regime.

3.2.1 BAU Scenario (Existing Condition)

No energy retrofit measures have been implemented; only remedial and functional maintenance works have been carried out. Estimated thermal losses amount to approximately 310 kWh/m²a, with CO_2 emissions of approximately 85 kg/m²a. Indoor thermal comfort remains inadequate, particularly within the waiting halls and the platform concourse.

3.2.2 GCR Scenario (Green Certified Retrofit)

The proposed measures encompass internal thermal insulation using wood fibre boards (100 mm) with a lime plaster finish coat, complemented by reversible secondary glazing. The estimated reduction in thermal losses is approximately 60%, with CO_2 emissions decreasing to 35 kg/m²a. Through the exclusive use of natural and vapour-permeable materials, a high degree of material compatibility has been achieved alongside the full preservation of architectural authenticity, in accordance with the analysis conducted by Klarić et al. (2019).

The quantitative comparison presented in Table 2 substantiates the effectiveness of the GCR approach with respect to energy efficiency, preservation of material authenticity, and hygrothermal stability, consistent with the EN 16883:2017 standard (CEN, 2017) and the IEA SHC Task 59 programme (Troi, 2021).

Table 2: Comparative performance indicators (Key Performance Indicators) Main Railway Station Sarajevo.

Indicator	**BAU**	**Green Certified**
Energy loss reduction	0%	~60–80% (estimated)
CO_2 emissions (kg CO_2/m²/year)	High	Significantly reduced
Visual heritage preservation	Preserved	Preserved
Indoor thermal comfort	Poor	Improved
Intervention reversibility	Not applicable	High
Material sustainability	Standard aged materials	Natural, breathable materials
Long-term cost-effectiveness	Low	High

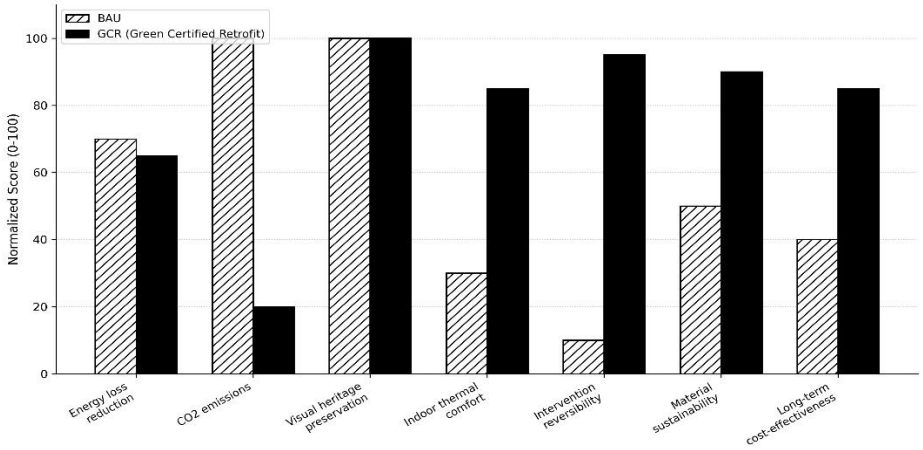

Figure 3. Comparison of the performance of the Business as Usual (BAU) and Green Certified Retrofit (GCR) scenarios for the Sarajevo Main Railway Station (source: author, based on EN 16883:2017 and IEA SHC Task 59; values normalized on a 0–100 scale).

3.3 Gospođicina kuća

The building has been designated as an individual national monument pursuant to the Decision of the Commission to Preserve National Monuments of Bosnia and Herzegovina (KONS BiH, 2011). The load-bearing structure consists of brick masonry 45–50 cm in thickness, with timber floor structural assemblies and original exterior joinery, collectively resulting in elevated thermal losses and insufficient indoor comfort levels.

3.3.1 BAU Scenario (Existing Condition)

No energy retrofit measures have been implemented. Estimated thermal losses amount to approximately 320 kWh/m²a, with CO_2 emissions of 80 kg/m²a. The building is characterised by low thermal comfort and a high degree of dependence on conventional heating systems.

3.3.2 GCR Scenario (Green Certified Retrofit)

The proposed intervention involves internal thermal insulation using wood fibre boards (60 mm) with a lime plaster finish coat, accompanied by reversible secondary joinery with enhanced airtightness performance. The estimated reduction in thermal losses is approximately 55%, with CO_2 emissions decreasing to 30 kg/m²a. Both visual and material authenticity have been preserved, while indoor climatic conditions have been markedly improved, as demonstrated by Klarić et al. (2019).

The findings confirm that the GCR approach is equally applicable to residential heritage buildings, yielding substantial improvements in energy efficiency while maintaining structural and architectural integrity, in conformity with the EN 16883:2017 standard (CEN, 2017) and the IEA SHC Task 59 guidelines (Troi, 2021).

Table 3: Comparative performance indicators (Key Performance Indicators) Gospođicina kuća.

Indicator	**BAU**	**Green Certified**
Energy loss reduction (kWh/m²)	0%	~50–60% (estimated)
CO_2 emissions (kg CO_2/m²/year)	High	Reduced by ~65%
Preservation of façade	Preserved	Fully preserved
Indoor air quality	Poor	Improved through vapor-open, non-toxic materials
Thermal comfort	Low (cold drafts, heat loss)	Enhanced (stable temperature, no condensation)
Intervention reversibility	Not applicable	High (fully reversible insulation system)
Material sustainability	Standard or not applied	High (wood fiber, lime, clay)
Visual authenticity	Preserved	Fully preserved
Long-term cost-effectiveness	Low	Moderate to high (due to energy savings)

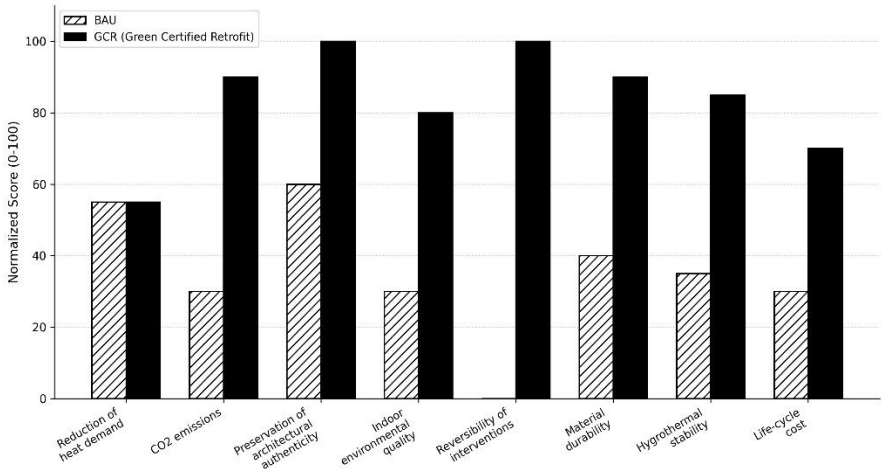

Figure 4. Comparison of the performance of the Business as Usual (BAU) and Green Certified Retrofit (GCR) scenarios for Gospođicina kuća Sarajevo (source: author, based on EN 16883:2017 and IEA SHC Task 59; values normalized on a 0–100 scale).

4. Conclusions

The findings of this research confirm that a methodologically coherent and technically feasible application of energy efficiency principles to the retrofit of national monuments within the Federation of Bosnia and Herzegovina is both attainable and imperative within the broader context of climate objectives and sustainable development. Grounded in Directive 2010/31/EU on the Energy Performance of Buildings (European Parliament and Council of the European Union, 2010), the amending Directive (EU) 2018/844 (European Parliament and Council of the European Union, 2018), and the EN 16883:2017 standard Conservation of Cultural Heritage: Guidelines for Improving the Energy Performance of Historic Buildings (CEN, 2017) this research demonstrates that measurable improvements in energy performance can be achieved without compromising the architectural, material, or structural authenticity of cultural heritage assets.

The Geospatial Database of National Monuments of the Federation of BiH, developed within the framework of the Unified Spatial Planning Information System of the Federation of BiH (FMPU, 2024) and in compliance with the Law on Spatial Data Infrastructure of the Federation of BiH (2021), the Regulation on the Unified Spatial Planning Information System of the Federation of BiH (2007), and the INSPIRE Directive (European Parliament and Council of the European Union, 2007), constituted the analytical foundation of this study. Constructed in accordance with the principles of spatial interoperability (EPSG:3765), the database incorporates spatial, typological, and conservation-related attributes that enable the systematic valorisation of heritage buildings according to space–value–risk criteria, while simultaneously providing a foundation for the future integration of Building Information Modelling (BIM) and Life Cycle Assessment (LCA) frameworks.

The comparative application of the Business as Usual (BAU) and Green Certified Retrofit (GCR) scenarios to three individually protected buildings the National Theatre, the Main Railway Station, and Gospođicina kuća demonstrated the advantages of the GCR approach across technical, environmental, and conservation domains. The implementation of internal thermal insulation using natural, vapour-permeable, and reversible systems specifically wood fibre and lime plasters yielded a reduction in thermal losses ranging from 55% to 65%, a decrease in CO_2 emissions to 30–35 kg/m²a,

and the uncompromised preservation of original architectural fabric and façade integrity, as corroborated by Klarić et al. (2019), Korjenić et al. (2015), and Lucchi (2022).

The methodological framework, predicated upon the EN 16883:2017 guidelines (CEN, 2017) and the IEA SHC Task 59 programme (Troi, 2021), integrates the assessment of retrofit measures according to technical, conservation, and environmental criteria, with defined weighting coefficients (K2 = 0.25; K3 = 0.20; K1 = 0.20) calibrated to reflect conservation priorities. The geospatial database facilitated the correlation of contextual building characteristics with technically feasible intervention measures, as demonstrated by Klarić et al. (2019), thereby establishing a replicable model operable within the existing legislative and institutional framework of the Federation of Bosnia and Herzegovina, encompassing the Law on Spatial Data Infrastructure of FBiH (2021), the Regulation on the Unified Spatial Planning Information System of the Federation of BiH (2007), and the Law on Spatial Planning and Land Use (2006).

This research confirms that the energy retrofit of cultural heritage buildings is achievable without detriment to conservation values, provided it is grounded in a scientifically substantiated, technically verifiable, and spatially integrated methodological framework. The GCR approach, founded upon the principles of reversibility, material compatibility, and minimal invasiveness, enables the concurrent enhancement of energy efficiency, hygrothermal stability, and indoor environmental quality while safeguarding the long-term functional viability and cultural significance of the built heritage.

The proposed model may serve as a foundation for the development of national heritage retrofit guidelines aligned with the EN 16883 standard (CEN, 2017), the European Green Deal (European Commission, 2019), and Agenda 2030 (United Nations, 2015). Within this framework, cultural heritage assumes the role of an active contributor to the energy transition and an integral constituent of sustainable spatial planning, thereby affirming a new paradigm for the retrofit and revitalisation of national monuments in Bosnia and Herzegovina. In future retrofit and revitalisation initiatives concerning national monuments, the adoption of the DGNB green certification criteria (DGNB, 2023) is recommended, given their contribution to the creation of healthier and higher-quality built environments, the conservation of natural resources, and the advancement of decarbonisation, circular economy principles, and social inclusion.
Taken together, these findings support the study's initial premise that conservation integrity and energy performance are not inherently competing objectives, but can be reconciled through a structured, standards-based methodology adapted to local legislative and institutional conditions. By demonstrating consistent thermal loss reductions of 55–65% across three structurally and typologically distinct monuments a public theatre, a transport infrastructure building, and a residential heritage house the study extends the applicability of the EN 16883:2017 framework beyond the single-building case studies that dominate the existing literature (Buda et al., 2022; Lucchi, 2022), towards a multi-typology, geodatabase-supported approach. This contributes a methodological template that future research in the Federation of Bosnia and Herzegovina, and in comparable national contexts lacking integrated heritage-energy planning instruments, can adapt and apply at a broader scale.

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The authors report no conflicts of interest.

Data Availability Statement
The data generated and analysed during this study are available through the Smart Portal of the Federal Ministry of Spatial Planning of the Federation of Bosnia and Herzegovina. As an outcome of this research, the first georeferenced map and geodatabase of national monuments in the Federation of Bosnia and Herzegovina has been developed and made accessible via the same portal. Additional supporting geospatial datasets and research materials are available from the corresponding author upon reasonable request via email.

Institutional Review Board Statement
This study did not involve human participants, animals, clinical trials, or personal data. Therefore, Institutional Review Board approval was not required.

CRediT Author Statement
Vanja Bošnjak: Conceptualization, Methodology, Software, Data Curation, Formal Analysis, Visualization, Writing Original Draft, Writing & Editing.
Sanela Klarić: Supervision, Methodology, Validation, Writing Review & Editing.
All authors have read and approved the final manuscript.

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