DOI: **10.5937/greenb26003Z**
Review paper

A BACKCASTING APPROACH TO BUILDING RENOVATION OBLIGATIONS IN SLOVENIA AND SERBIA

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Abstract

On 15 July 2026 the European Commission opened infringement procedures against all twenty-seven Member States for incomplete transposition of the recast Energy Performance of Buildings Directive, whose transposition deadline had passed on 29 May 2026. This paper takes that general failure of implementation as its origin and asks a question that is institutional rather than technical: for a binding obligation with a fixed date, what has to be true for a state to deliver it, and is it true? A reproducible capability-gap protocol is set out. Binding obligations are enumerated with their dates from primary legal sources; for each, the delivery preconditions are identified; each precondition is tested against measured national indicators; and every gap is classified as a measurement, legal or capacity gap. The protocol requires only public data and is replicable for any Member State. Applied to Slovenia, it finds a country reporting a renovation rate but not the stock of which it is a rate, nor the primary energy metric in which the Article 9(2) obligation is expressed. Of the fifteen draft renovation plans assessed by the Joint Research Centre in July 2026, Slovenia is the only one omitting both the residential renovation trajectory and the non-residential performance thresholds. The co-owner consent threshold governing deep renovation is unchanged and is named as a barrier in the state's own renovation strategy. Close to half the construction workforce hold foreign nationality. A comparison with Serbia shows the carbon border adjustment mechanism substituting for the acquis as the operative decarbonisation pressure in a candidate country. The paper finds the binding constraint to be institutional rather than technological. In architecture and construction only legislation, and the standards it makes binding, are obligations; everything else is read by practice as a wish list.

Key words: *building renovation, Energy Performance of Buildings Directive, capability gap, condominium ownership, carbon border adjustment mechanism*

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1. INTRODUCTION

On 15 July 2026 the European Commission sent letters of formal notice to all 27 Member States for failing to transpose fully the recast Energy Performance of Buildings Directive (EPBD) [1] into national law [2]. The transposition deadline had expired on 29 May 2026. No Member State met it. At the same date only sixteen of twenty-seven had filed even a draft national building renovation plan, and the Joint Research Centre (JRC), assessing the first tranche of those plans, found projected primary energy reductions to 2050 ranging from 24 % to 73 % [3].

A universal failure is analytically more interesting than a national one. If every Member State missed the same deadline, the explanation is unlikely to lie in the will or diligence of any administration; it is more plausibly structural. This paper asks what was missing.

The question posed is institutional rather than technical: for a binding obligation with a fixed date of application, what has to be true for a Member State to be capable of delivering it, and is it true? **This paper makes no forecast; it is an ordered reading of what has already been reported.** Its inputs are obligations that already exist in law and carry a date; its output is a statement about whether the preconditions for meeting them are in place. This distinguishes it from the scenario-based foresight that dominates the literature on building-stock decarbonisation, which asks what a state may face rather than what it has already undertaken.

Four contributions are claimed: a capability-gap protocol replicable for any Member State from public, dated sources; the finding that Slovenia reports an annual renovation rate but not the stock of which it is a rate, nor the primary energy metric in which the Article 9(2) obligation is expressed, while the one obligation that is unambiguously measured has been met in a single year out of eleven; the finding that the co-owner consent threshold governing deep renovation remains unchanged although the state's own renovation strategy identifies it as a barrier; and the comparative observation that for a candidate country the carbon border adjustment mechanism substitutes for the acquis as the non-deferrable pressure on material decarbonisation.

2. THE BINDING CALENDAR

Obligations bearing on the European building stock are frequently reported in a form that conflates three kinds of instrument: **level 1** binds and applies now; **level 2** binds but applies at a future date; and **level 3** is programmatic, reserves the substantive decision to the Member State, or remains in draft. Table 1 sets out the three levels and their contents. The separation is not presentational.

At least five widely repeated claims concern level 3. The most persistent, and the one most often put to designers by clients, is that fossil-fuel boilers will be prohibited by 2040. There is no such prohibition: Article 13 of and Annex II to the EPBD impose a duty to set out policies with a view to a phase-out, and the only binding provision is the prohibition on financial incentives for stand-alone boilers, applicable since 1 January 2025. Each such claim arises from reading a level 3 instrument as though it were level 1.

Digital product passports are not mandatory: the Construction Products Regulation [4] establishes the legal architecture and the registry of unique identifiers opened on 19 July 2026, but no construction product carries an obligation until the corresponding delegated act, expected for cement, building limes and hydraulic binders around the fourth quarter of 2027 [8]. Limit values on life-cycle global warming potential are not set at Union level: Delegated Regulation (EU) 2026/52 [5] harmonises the calculation, while the values remain national competence, roadmapped by 1 January 2027 and applying from 2030. The class-based minimum standards for individual dwellings that appeared in the 2021 proposal were removed from the adopted text: Article 9(2) sets a stock average and Article 9(1) a threshold calibrated to each Member State's own 2020 non-residential stock by floor area, neither being a requirement for any individual building.

Table 1. Obligations bearing on the building stock, classified by legal force. Dates are dates of application, not of adoption.

Instrument	Obligation	Applies from	Note
Level 1 — binding and already applying			
EPBD, Art. 17(15)	No public incentives for stand-alone fossil-fuel boilers	1 Jan 2025	In force
EPBD	Transposition into national law	29 May 2026	Missed by all 27
Del. Reg. (EU) 2026/52	Union framework for calculating life-cycle GWP	24 May 2026	EN 15978; Level(s) 1.2
Reg. (EU) 2023/956 (CBAM)	Definitive regime; 2.5 % factor on embedded emissions	1 Jan 2026	Cement, steel, aluminium
Reg. (EU) 2021/1119, as amended	−90 % net GHG emissions by 2040 against 1990	Adopted 5 Mar 2026	≥ 85 pp domestic
Level 2 — binding, applying at a future date			
EPBD, Annex III	National roadmap for GWP limit values	1 Jan 2027	Roadmap, not values
EPBD, Art. 7	New buildings owned by public bodies zero-emission	1 Jan 2028	Ownership, not use
EPBD, Annex III	Life-cycle GWP disclosed on the EPC above 1 000 m²	1 Jan 2028	Disclosure, no cap
EPBD, Art. 7	All new buildings zero-emission; GWP disclosure extended	1 Jan 2030	NZEB applies until then
EPBD, Art. 9(1)	Worst-performing 16 % of non-residential floor area above a national threshold; 26 % by 2033	2030 / 2033	A threshold, not a mandate
EPBD, Art. 9(2)	Residential stock average primary energy −16 %, then −20 to −22 % against 2020	2030 / 2035	≥ 55 % from the worst 43 %
Dir. 2003/87/EC, Art. 10a(1a)	CBAM factor to 48.5 %, then 100 %	2030 / 2034	Inflection 2029→2030

Level 3 — programmatic, national competence, or in draft; frequently misreported as binding			
EPBD, Art. 13, Annex II	Phase-out of fossil-fuel boilers by 2040	—	A planning duty, not a ban
EPBD, Annex III	Limit values on life-cycle GWP	from 2030	National competence
ZURE-1 (Slovenia)	Transposition of the EED and the recast EPBD	—	Unadopted at Sep 2026

Sources for Table 1. Level 1 and level 2 entries are taken from the Official Journal of the European Union: the recast EPBD [1]; Delegated Regulation (EU) 2026/52 [5]; the Construction Products Regulation [4] and its working plan [8]; the carbon border adjustment mechanism and the emissions trading directive [6]; and the amended European Climate Law [7]. The transposition status is from the Commission's infringement package of 15 July 2026 [2]. The 3 % public-sector renovation duty referred to elsewhere in the paper is set by the Energy Efficiency Directive [10]. The level 3 entry for ZURE-1 refers to the draft Slovenian act in public consultation since October 2024.

3. METHOD

We used regulatory backcasting approach combined with an institutional capability assessment. Its inputs are obligations that already exist in law and carry a date of application; its output is a statement about whether the preconditions for meeting them are in place. General steps visioning, baseline, capability assessment and pathways as final possible outcome were tailored for specific theme of the paper. The protocol has given four steps.

Step 1 — Enumeration. Every obligation bearing on the building stock is extracted from primary legal sources with its date of application. Two inclusion criteria apply: the obligation must be legally binding with defined date. Programmatic provisions, those reserving the substantive decision to the Member State, and those still in draft are excluded and listed separately in level 3 of Table 1 — several are reported as binding in the professional literature, and treating them as such would misstate both obligation and gap.

Step 2 — Delivery preconditions. Four recur: transposition into an instrument binding on the permitting authority and therefore on the designer; an observation system capable of producing the indicator in which the obligation is expressed; a decision-making mechanism able to authorise works at the level of the individual building; and implementation capacity — labour, skills, finance, administrative process. A precondition is admitted only where the obligation cannot be met without it.

Step 3 — Testing. Each precondition is confronted with measured national data from official sources. Where the required indicator cannot be computed from any published national source, is recorded as a result of the assessment rather than a limitation of it: an obligation expressed as a proportional change in an unobserved quantity is not merely hard to meet but hard to demonstrate having met.

Step 4 — Classification. A **measurement gap** exists where the indicator in which the obligation is expressed cannot be computed; a **legal gap** where a statutory provision or consent threshold conditions the works irrespective of technical and financial feasibility;

a **capacity gap** where the obligation is measurable and lawful but exceeds available labour, skills, finance or administrative throughput. The categories are ordered by remedy rather than severity — they identify who would have to act — and are not mutually exclusive.

Every input is public and dated and the classification criteria are stated, so the assessment is reproducible for any Member State. That transferability, rather than the Slovenian result itself, is the methodological contribution claimed here.

Limitations. Taken example of two countries (Slovenia and Serbia) are not a sample; the findings are generalised analytically, through the mechanism identified. The Slovenian and Serbian demographic series derive from methodologically distinct projection exercises — Serbia lies outside EUROPOP [18] — and establish direction and order of magnitude only. The classification in step 4 involves **a judgement**, which is why the criteria are stated explicitly: a reader may reclassify a gap, and the reasoning remains inspectable. Serbia is treated as a structural comparison rather than a parallel case study, no measured national renovation rate being published for it.

4. SLOVENIA: DELIVERY CAPACITY

Slovenia is an informative case: a small Member State with an otherwise largely transposed acquis; an overwhelmingly owner-occupied residential stock, which sharpens the ownership question; and a draft renovation plan independently assessed, which makes the measurement question answerable from public documents rather than by inference.

4.1. The measurement gap

Article 9(2) of the recast EPBD requires each Member State to reduce the average primary energy use of its residential stock by at least 16 % by 2030 and 20–22 % by 2035 against 2020, achieving at least 55 % of the 2030 reduction through renovation of the worst-performing 43 % [1]. The obligation is expressed in three quantities: a primary energy baseline, a trajectory from it, and an identification of the worst-performing tail. Slovenia submitted its draft renovation plan on 8 January 2026; the Joint Research Centre assessed it with fourteen others in July 2026 and classified it as partially complete [3].

All three are absent. The plan reports no primary energy consumption for the residential stock, the non-residential stock or the total, for 2020 or any subsequent year, and sets no primary energy target for 2030, 2040 or 2050; the indicator checklist marks primary energy use and targets ‘No’, noting that the figures are expected later, once the primary energy factors have been updated, and the factors themselves are recorded as not available. The Article 9(2) trajectory is likewise not provided and is described as still under development. The worst-performing buildings have not been defined: thresholds are to be set per building type, which requires a shift from the existing heat-demand classification to one based on total primary energy. As an interim indication, Slovenia estimates that 15–20 % of buildings exceed 300 kWh/(m²·y) [3].

What the plan does report is a renovation rate. Slovenia states annual rates of approximately 2 % at stock level across 2020–2050 — rising in the non-residential

sector from 2.1 % to 2.9 % and falling in the residential sector from 2.2 % to 1.5 % — against a baseline floor area of 66.5 million m² residential and 23.8 million m² non-residential, and a cumulative renovated area of 66.5 million m² over the period. The renovation-rate indicator is marked 'Yes'. The difficulty is that it is not a rate of anything the plan establishes. The stock overview omits the number of buildings entirely, marked 'No' with the explanation that a detailed structure will be developed later, and the assessment finds the reported floor-area values inconsistent with the stock baseline, concluding that it is not clear whether the targeted renovation will contribute to the plan's own energy and emission targets. Its judgement on calibration is explicit: because neither the residential trajectory nor the non-residential thresholds were provided, it is not possible to assess whether the annual renovation targets are calibrated to them [3].

This is the measurement gap in its precise form, and it is sharper than the familiar observation that renovation activity is poorly monitored across Europe [9]. **Slovenia reports a rate; it does not report the stock of which it is a rate, nor the metric in which the obligation is expressed.** A percentage has been supplied where a quantity was required.

The condition is long-standing. Recorded renovation of roofs, façades and windows in the Slovenian real-estate register falls from 2.4–5.6 % in 2000 to approximately zero by 2014, a collapse attributed to the cessation of owner self-reporting after the 2007 property census rather than to any change in physical activity [13]. The register was never an observation system; it was a self-declaration system that stopped receiving declarations.

Two qualifications are owed. First, Slovenia is not alone, and the argument does not depend on its being exceptional: of the fifteen draft plans in the first tranche, six — Bulgaria, France, Cyprus, Austria, Slovenia and Sweden — lack the Article 9(2) residential trajectory, and three — Germany, the Netherlands and Slovenia — lack the Article 9(1) non-residential thresholds. Slovenia is, however, the only one recording both as not available, and the only one for which the primary energy factors are recorded the same way. Second, these are draft plans; the final plans were due on 31 December 2026, and the missing elements may by then have been supplied. The finding concerns readiness four years before the obligations apply, not a prediction that they will not be met.

The contrast with the one obligation in the Slovenian building sector that is unambiguously measured completes the point. Under the Energy Efficiency Directive [10] the narrow public sector must renovate 3 % of its floor area annually. Here the state is owner, client and regulator at once, the stock is enumerated, and performance is reported by the government's own monitoring programme. Over 2014–2024 the target was met in a single year, 2018; cumulative delivery stands at 91 146 m², or 31 % of the cumulative target; in 2024, 16 709 m² were renovated against a requirement of 28 254 m² [12]. **The absence of measurement elsewhere cannot therefore be read as concealing better performance: where the quantity is observed, the obligation is not met.**

Table 2. Capability gaps for Slovenia, classified by step 4 of the protocol.

Obligation	Delivery precondition	Status in Slovenia	Gap
EPBD Art. 7 — ZEB from 2028 / 2030	Transposition into an instrument binding on the permitting authority	ZURE-1 in draft since October 2024, unadopted; infringement opened 15 July 2026	Legal
EPBD Art. 9(2) — residential −16 % by 2030	Primary energy baseline and targets for the stock	Not provided for any year; checklist marks primary energy use and targets 'No'; to be calculated later	Measurement
EPBD Art. 9(2)	Trajectory for progressive renovation	Not provided; recorded as still under development	Measurement
EPBD Art. 9(2) — 55 % from the worst 43 %	Definition of worst-performing buildings	Partial. Thresholds to be set per building type; requires a shift from heat demand to total primary energy	Measurement
EPBD Art. 9(1) — non-residential	National maximum energy performance thresholds	Not provided; recorded as not yet determined	Measurement
EPBD Annex II — stock overview	Enumeration of the building stock	Number of buildings marked 'No'; floor-area values inconsistent with the stock baseline	Measurement
EPBD Art. 9(2) applied to multi-apartment buildings	A consent mechanism able to authorise works at building level	SZ-1 Art. 29: above 75 % of ownership shares; unanimity where works alter common parts, change use, or are financed against the reserve fund	Legal
EED — 3 % annual public-sector renovation	Administrative and financial throughput	Met in one year of eleven; 91 146 m² delivered, 31 % of the cumulative 2014–2024 target	Capacity
Plan target of ≈2 % annual stock renovation	Labour and skills	37 805 of 76 957 construction workers are foreign nationals; skilled-labour shortage named the largest constraint by close to half of firms	Capacity
Investment need of €4.1 bn to 2030	Identified financing	€3.2 bn identified; no sources identified for the €11.5 bn to 2040 or €19.4 bn to 2050	Capacity

4.2. The legal gap

Where the measurement gap concerns whether compliance can be demonstrated, the legal gap concerns whether the works can be authorised at all. In Slovenia the relevant provision is not in building or energy legislation but in housing and property law.

The Housing Act [14] establishes a three-step ladder of co-owner consent for multi-apartment buildings. Ordinary management — operation and maintenance — requires more than one half of the ownership shares. Acts exceeding ordinary management, expressly including construction works requiring a building permit, require more than three quarters. Unanimity is required where the works alter the ratio between common and individual parts, restrict or change use, or are financed by borrowing against the reserve fund. These provisions displace the general rule of the Property Code [15], under which such acts would require the consent of all co-owners in any event.

The significant point is not that the threshold exists but that the state has identified it and not moved it. Slovenia's own long-term renovation strategy names fragmented ownership as a barrier and states explicitly that where energy renovation forms part of a wider renovation, a unanimous decision is required [11]. The 2025 amendment to the Housing Act nevertheless left Articles 25 and 29 untouched; the draft ZURE-1 does not address consent thresholds; and no bill amending them was pending as at September 2026.

Two European precedents exist and neither has been evaluated. Lithuania lowered the threshold for homeowner associations to a simple majority; France, under its 2015 energy transition legislation, permits decisions on energy-efficiency measures by a majority of those present at the general assembly rather than an absolute majority of shares [16]. Whether either produced a measurable change in renovation activity appears untested. Given that roughly 48 % of EU residents live in apartments, this is a conspicuous evidential gap.

The threshold bites harder in Slovenia than the European average would suggest, because the tenure structure concentrates decision rights in owners rather than landlords: 74.8 % of the Slovenian population lived in owner-occupied dwellings in 2024, against an EU-27 average of 68.4 % [18]. Roughly 15 000 multi-apartment buildings are subject to mandatory professional management. Each is a separate decision-making body whose consent is required before deep renovation can proceed, and the Article 9(2) obligation is weighted precisely towards the part of the stock where those bodies are most numerous and least well resourced.

4.3. The capacity gap

The third precondition is the ability to carry out the work. Slovenia's draft plan targets an annual renovation rate of approximately 2 % of the stock, against a European average estimated at roughly 1 %, of which deep renovation accounts for 0.2 % [9]. Meeting it would require close to a doubling of activity sustained for a quarter of a century.

The workforce available to do so is already constrained. In 2025 an average of 76 957 persons were work-active in Slovenian construction, a decline of 1.4 % on the previous year, of whom 37 805 — close to 49 % — were foreign nationals. Shortage of qualified workers was the single most frequently cited constraint, named on average by nearly half of firms, with the skills gaps identified as project management, building information modelling, digital technologies, sustainable construction and energy efficiency [17].

Demography compounds rather than causes this, though not in the way usually asserted. The projections do not show a collapsing pipeline of young entrants: Slovenia's 19–24 cohort contracts by only some 3 % to 2046, because the current student cohort was already born in the fertility trough of the early 2000s. What changes is the ratio between those able to build and the stock requiring renovation and maintenance — the old-age dependency ratio rises from 35.9 in 2026 to 50.9 in 2046, crossing fifty in 2045, against an EU-27 figure of 48.8 [18].

Financing shows the same shape, and is taken up in Section 4.4.

4.4. Financing after the Recovery and Resilience Facility

The capacity constraint is sharpest in the instrument that has carried most Slovenian building renovation over the past five years, and which closed while this paper was being written. The Recovery and Resilience Facility required all milestones and targets to be completed by 31 August 2026, final payment requests to reach the Commission by 30 September 2026, and all payments to be executed by 31 December 2026; amounts not paid by that date are decommitted rather than reprogrammed [19]. Slovenia devoted one component of its national plan, C1.K2 Sustainable renovation of buildings, to the subject, with a final allocation of €86.65 million — €64.15 million in grants and €22.50 million in loans [20].

Two observations follow, and neither is a finding of failure. Slovenia met the targets. The four physical targets under the component — 59 574 m² and 21 398 m² of deep renovation, 29 392 m² and 8 965 m² of technical building system upgrades — were recorded as fulfilled in the July 2026 implementation report, and the technical-system strand overshot, delivering roughly 55 000 m² against a target of 38 357 m² [20].

The observations concern scale and scope. Scale: the 80 972 m² of deep renovation is 0.09 % of the 90.3 million m² stock reported in the draft renovation plan, and €86.65 million is about 2 % of the €4.1 billion that the same plan identifies as needed by 2030 [3]. Scope: the component was confined to publicly owned buildings. The single strand addressed to multi-apartment residential buildings was worth €5 million, at a co-financing rate of €250 per square metre, restricted to publicly owned buildings with four or more dwellings and conditional on a 30 % reduction in primary energy use.

The most telling evidence is what became of money that could not be spent on construction. **In the sixth and final amendment to the plan, agreed on 10 July 2026, seven weeks before the deadline, twelve investments were reduced and the savings directed to a contribution to a European joint undertaking for artificial-intelligence computing, worth €71.65 million [20].** An instrument that absorbs funds by transfer can clear a deadline; renovation, which requires procurement, site works and

commissioning, cannot be compressed into seven weeks. Building renovation was not cut. It could not be scaled up either — which is the capacity gap in its most concrete form.

What follows the Facility is smaller. The draft Social Climate Plan for 2026–2032 proposes €475.9 million in total, of which €239.5 million is allocated to buildings and directed at energy-poor and low-income households [21]. That is roughly 2.8 times the Facility's renovation envelope spread over more than twice the period, against an investment need of €4.1 billion by 2030 and €19.4 billion by 2050, for which the draft plan identifies €3.2 billion to 2030 and nothing thereafter [3].

The second amendment to the plan makes the mechanism explicit. Grants for C1.K2 were cut from €66.05 million to €63.55 million, and the official summary gives the reason without circumlocution: because of a lack of interest from potential applicants, the milestone "Completed energy and sustainable renovation of residential buildings in public ownership" was removed and the €2.5 million earmarked for it redirected to a district-heating measure, itself restructured after receiving far fewer applications than expected [20]. The sum is small against the plan as a whole; what was removed is not. It was the only milestone in the component addressed to residential buildings, and it was withdrawn for want of applicants rather than for want of money. This is a demand-side failure, and it is the clearest available evidence that the binding constraint on renovation in Slovenia is not the availability of funds.

5. SERBIA: THE CANDIDATE-COUNTRY POSITION

Serbia is treated as a structural comparison rather than a parallel case study, for the reason given in Section 3: no measured national renovation rate is published. What can be compared is the mechanism by which decarbonisation pressure reaches the building sector.

Serbia opened Cluster 4, covering energy and environment, in December 2021; neither Chapter 15 nor Chapter 27 has been provisionally closed, and the 2025 enlargement assessment finds the country moderately prepared on energy and recommends that it finalise the implementing legislation on the energy performance of buildings [22]. Its integrated national energy and climate plan sets renovation rates of approximately 1 % annually for residential buildings, 3 % for public buildings and 2.3 % for other non-residential buildings [23]. These are targets; achieved rates are not published.

The decisive difference lies elsewhere. **For a Member State, decarbonisation pressure arrives through transposition, and transposition can be deferred — as all twenty-seven have demonstrated. For a candidate country outside the emissions trading system but exporting into the single market, it arrives through a price at the border, which cannot be deferred by any domestic decision.** The carbon border adjustment mechanism entered its definitive regime on 1 January 2026 [6]. Its immediate effect is slight: the factor applied to embedded emissions is 2.5 % in 2026. The inflection falls between 2029 and 2030, when the factor rises from 22.5 % to

48.5 % as free allocation under the emissions trading system is withdrawn, reaching 100 % in 2034. Cement, iron and steel, and aluminium are covered.

This is the one genuinely non-deferrable instrument examined here. Every other obligation depends for its effect on an act of national implementation that may be late, partial or absent. The border price does not.

The order of magnitude can be indicated, with the caution that the available figures are estimates rather than official statistics. Published analysis of the Smederevo steelworks puts its emissions intensity at approximately 2.3 tCO_2 per tonne of hot-rolled coil, some 68 % above the CBAM benchmark, with around 55 % of output directed to EU markets. These are single-author estimates published outside the peer-reviewed literature and are reported here as such.

6. THE HORIZON MISMATCH: REGULATION AND CLIMATE PROJECTION

The obligations in Table 1 are dated between 2025 and 2040 and are expressed in two quantities: primary energy and greenhouse gas emissions. The climate they are meant to address is projected on a different timetable and in different quantities. Table 3 sets the two national projections side by side.

Table 3. National climate projections for the end of the twenty-first century. Slovenian values are changes against 1981–2010 from a multi-model regional ensemble at 12 km resolution [24]; Serbian values are changes against 1986–2005 from a nine-member EURO-CORDEX ensemble [25], [26].

Indicator	Slovenia	Serbia
Mean annual temperature, RCP4.5	+2.0 °C	+1.9 °C
Mean annual temperature, RCP8.5	+4.1 °C (range 3.0–5.1)	+4.4 °C
Summer temperature, RCP8.5	above the annual mean	+4.5 °C
Hot days above 30 °C, RCP8.5	up to +60 in the lowlands	not reported
Days above 35 °C, RCP8.5	not reported	+30 to +50
Tropical nights, RCP8.5	up to +60 in some regions	not reported
Summer precipitation, RCP8.5	winter increase; summer signal weaker	−40 % in southern Serbia
Heatwaves	longer and more frequent under every indicator	duration rising sharply
National assessment issued by	Environment Agency (ARSO)	none; university ensemble, published via UNDP

Two features matter more than the individual figures. The indices governing building design move further than the mean: Slovenian hot days rise by 5 to 10 in the lowlands as early as 2011–2040 [24]. And the spatial signal matters for a conference held in Niš: warming is more pronounced and water availability more reduced in central

and southern Serbia than in the north [26]. Niš recorded 49 tropical days a year and an absolute maximum of 44.2 °C in the 1981–2010 normal [28].

Three mismatches follow, and each is a design problem before it is a policy one.

The first is a mismatch of horizon. The regulatory calendar ends at 2040; the projections are indexed to 2041–2070 and 2071–2100. A building completed to the zero-emission standard in 2030, with a service life of fifty to a hundred years, will spend almost all of it inside the periods the projections describe, and not one of the obligations in Table 1 is expressed for those periods.

The second is a mismatch of quantity. The obligations measure primary energy and global warming potential. Neither measures whether a building remains habitable in a heatwave, and a building can satisfy both while overheating. The one Serbian study to quantify this found that under 3.8 °C of warming, heating degree days fall by 35.7 % while cooling degree days rise from 113 to 566, close to a fivefold increase in primary cooling energy [29]. A framework that rewards reductions in annual demand can therefore be satisfied by a building whose summer performance is deteriorating, because for most of the projection period the heating saving is the larger number.

The third is a mismatch of assessment capacity, and it belongs with the gaps in Table 2. Slovenian designers can consult a state-issued, index-level projection; Serbian designers have a journal article, a UNDP report and a web atlas, and a Third National Communication that reproduces headline figures without index-level detail [27]. The two countries share a projection domain, so this is not a difference in climate but in the institutional infrastructure for turning projection into design practice. It is a measurement gap in the sense of Section 3, one step earlier in the chain.

The consequence for design is concrete. The loads that will decide whether a building performs in 2060 are not the loads it is sized for in 2026. Shading, thermal mass, night ventilation and orientation answer projected summer conditions, and they are not what the instruments in Table 1 credit; those credit installed efficiency and disclosed carbon. Where the two coincide, regulation carries the design. Where they diverge, the designer is on their own.

7. DISCUSSION

The three gap types are not of equal standing in the case examined. **The binding constraint on delivery is institutional, not technological or financial.** No finding in Section 4 turns on the unavailability of a construction technique, a material, or a demonstrated retrofit solution. The measurement gap is a question of statistical infrastructure; the legal gap is a question of a consent threshold in housing law; the capacity gap is a question of who is trained and employed. Each has a known remedy, and none of the remedies belongs to the disciplines represented at a building conference.

That observation cuts two ways, and the second is the more important. A profession that treats measurement, property law and workforce as somebody else's brief will find that they are nobody's. The designer occupies the only position at which all three

constraints meet a specific building on a specific plot with a specific set of owners — the point at which a renovation either is or is not authorised, financed and built.

As analysis show *six of the fifteen assessed plans omit the Article 9(2) trajectory, so this is a European rather than a Slovenian condition. It is also worth considering that the disclosure obligations, and in particular the life-cycle global warming potential carried on the energy performance certificate from 2028, may prove more consequential in practice than the performance obligations, because a figure printed on a certificate is enforced by the property market rather than by an inspector. The mission being green and simultaneously following complete legal framework in architecture and constructing is a steep way. Nevertheless, construction is in the field of natural sciences architecture is in-between human science and natural science. Our daily basis at the building site is to shape a common decision among available resources (material, financial and human), cognitive capabilities of involved people and reasoning genius loci. Including those inputs in the matrix of directives and binding regulations follow toward almost to common direction involved team. This direction is not granted to be parallel with goals given from in direction from top to bottom.*

8. CONCLUSIONS

This paper set out a capability-gap protocol for assessing whether a Member State is positioned to deliver obligations that already exist in law and carry a date. The protocol requires only public, dated sources, states its classification criteria explicitly, and is replicable for any Member State.

Applied to Slovenia, it finds a country reporting an annual renovation rate but not the stock of which it is a rate, nor the primary energy metric in which the Article 9(2) obligation is expressed; the only one of fifteen assessed draft plans omitting both the residential trajectory and the non-residential thresholds; an unambiguously measured obligation met in a single year out of eleven, at 31 % of cumulative target; a consent threshold left unchanged although the state's own strategy names it as a barrier; and close to half the construction workforce holding foreign nationality. The comparison with Serbia identifies the carbon border adjustment mechanism as the single instrument examined here whose effect cannot be deferred by a national act.

Two recommendations follow directly. First, reporting obligations on renovation should be attached to a document with established compliance — the energy performance certificate, the building permit, or the subsidy procedure — rather than to voluntary declaration in a property register, which has already been shown not to work. Second, the Lithuanian and French reforms of co-owner consent thresholds should be evaluated before further jurisdictions decide whether to follow them.

The Slovenia–Serbia comparison is not a benchmark test; the intention was to separate the wheat from the chaff. Regulatory backcasting is not the only possible pathway, but the results it yields open a constructive discussion and invite researchers to actively contribute and reshape possible outcomes of this conference.

ACKNOWLEDGMENT

This paper is an outcome of the author's Erasmus+ Staff Mobility for Teaching programme at Faculty of Civil Engineering and Architecture – University of Niš during the summer of 2026. The author would like to express sincere gratitude to Prof. Dr. Marko Nikolić and Prof. Dr. Mirko Stanimirović for their exceptional hospitality and the valuable academic opportunities provided in Niš.

Table of abbreviations

Abbr.	Meaning	Abbr.	Meaning
CBAM	Carbon border adjustment mechanism	NBRP	National building renovation plan
CDD	Cooling degree days	NOO	Načrt za okrevanje in odpornost — Slovenia's recovery and resilience plan
C1.K2	Trajnostna prenova stavb — building renovation component of Slovenia's NOO	NZEB	Nearly zero-energy building
EED	Energy Efficiency Directive	OPS21	Ocena podnebnih sprememb v Sloveniji do konca 21. stoletja
EPBD	Energy Performance of Buildings Directive	RCP	Representative concentration pathway
EPC	Energy performance certificate	RRF	Recovery and Resilience Facility
ETS	Emissions Trading System	SPZ	Stvarnopravni zakonik — Property Code, Slovenia
EURO-CORDEX	European branch of the Coordinated Regional Climate Downscaling Experiment	SZ-1	Stanovanjski zakon — Housing Act, Slovenia
EUROPOP	Eurostat population projections	TNC	Third National Communication to the UNFCCC
GHG	Greenhouse gas	UNDP	United Nations Development Programme
GWP	Global warming potential	UNFCCC	United Nations Framework Convention on Climate Change
HDD	Heating degree days	URSOO	Urad RS za okrevanje in odpornost — Office for Recovery and Resilience
INECP	Integrated National Energy and Climate Plan (Serbia)	ZEB	Zero-emission building
JRC	Joint Research Centre of the European Commission	ZURE-1	Zakon o učinkoviti rabi energije — draft Energy Efficiency Act, Slovenia
MEPS	Minimum energy performance standards		

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