

Gaps in the 19th issue of National Building Regulations of Iran (NBRI) through the LEED Lens and its Enhancement Strategies

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Abstract .

Iran's building sector accounts for approximately 40% of the country's total energy consumption, with per-capita building energy use exceeding five times the global average. The 19th issue of the National Building Regulations of Iran (NBRI), first enacted in 1991 and subsequently amended, represents the sole mandatory regulatory instrument for building energy conservation in the country. However, growing evidence indicates that the implementation of Issue 19 has not delivered the projected 30–50% energy savings. This study examines the structural and substantive gaps in the energy criteria of Issue 19 by benchmarking it against the Leadership in Energy and Environmental Design (LEED) rating system, which allocates approximately 33% of its total points to the Energy and Atmosphere category. Through a systematic comparative analysis, six critical gaps are identified: (1) the absence of mandatory commissioning and verification procedures, (2) the lack of renewable energy production requirements, (3) no provision for building-level energy metering and monitoring, (4) the prescriptive rather than performance-based compliance framework, (5) the omission of demand response and grid interaction mechanisms, and (6) insufficient attention to refrigerant management and greenhouse gas accounting. For each identified gap, evidence-based enhancement strategies are proposed that account for Iran's socio-economic context—including subsidized energy pricing, limited access to green building technology, and the absence of a national building sustainability assessment framework. The findings contribute to the ongoing discourse on aligning Iran's regulatory instruments with internationally recognized sustainability benchmarks and provide actionable recommendations for the next revision cycle of Issue 19.

Keywords: 19th issue of National Building Regulations of Iran, LEED, renewable energy, refrigerant management, greenhouse gas accounting



1. Introduction

The building sector stands as one of the most significant consumers of energy worldwide, accounting for roughly one-third of global final energy consumption and approximately one-third of global carbon emissions (Ramin & Karimi, 2020). In Iran, this proportion is even more pronounced: buildings consume around 37–42% of the nation's total energy, depending on the source and year of assessment (Riazi & Hosseyni, 2011) & (Carlucci et al., 2024). The energy intensity of Iran's building stock far outpaces that of comparable nations—per-capita building energy consumption in Iran exceeds the global average by a factor of more than five (Heidari et al., 2018). Natural gas satisfies the majority of household energy demands at 46%, followed by electricity at 28% and oil products at 20% (Carlucci et al., 2024). This disproportionate energy consumption, coupled with Iran's heavy reliance on fossil fuels, has made the regulatory governance of building energy performance a matter of pressing national concern.

Iran's primary regulatory response to building energy inefficiency has been the 19th issue of its National Building Regulations (NBRI), commonly referred to as Issue 19 or Chapter 19. First enacted in 1991 and amended in 2000 and 2014, Issue 19 sets mandatory requirements for energy conservation in new construction (Ramin & Karimi, 2020). Upon its introduction, it was projected that Issue 19 could reduce building energy consumption by 30–50% (Edalat et al., 2016). Yet three decades after its initial passage, the evidence tells a different story: actual energy savings have fallen far short of projections, and Iran's building energy performance remains among the weakest in the Middle East and North Africa region (Carlucci et al., 2024) & (Fatourechi et al., 2022).

The root causes of this shortfall are manifold. Prior research has identified barriers to implementation, including low energy prices resulting from subsidies, insufficient trained personnel for code enforcement, and a lack of specific codes for different building typologies (Edalat et al., 2016) & (Fatourechi et al., 2022). However, an equally important but less thoroughly examined dimension concerns the substance of the regulations themselves: the extent to which Issue 19's energy criteria align with what international best practice demands. Green building certification systems—particularly the Leadership in Energy and Environmental Design (LEED) framework developed by the U.S. Green Building Council—have established widely recognized benchmarks for building energy performance that go well beyond prescriptive envelope requirements (Amiri et al., 2020). LEED allocates approximately 33 of its 110 total points to the Energy and Atmosphere (EA) category, making it the single highest-weighted category in the rating system (Amiri et al., 2020). This emphasis reflects a broad consensus in the



international building sustainability community that energy performance warrants the greatest attention in green building assessment.

This study positions LEED as an analytical lens through which to examine the gaps in Issue 19's energy criteria. Rather than arguing that Iran should adopt LEED wholesale—which would be neither feasible nor desirable given the country's distinct socio-economic and climatic conditions—the study uses LEED's Energy and Atmosphere framework as a benchmarking instrument to identify what Issue 19 lacks and where enhancement is most urgently needed. The central research question is: What are the specific gaps in the energy criteria of the 19th issue of NBRI when benchmarked against LEED's Energy and Atmosphere category, and what strategies can feasibly enhance Issue 19 in the Iranian context?

2. Literature Review

2.1 Iran's Building Energy Landscape

Iran's building energy situation is shaped by several structural factors. The country holds some of the world's largest proven deposits of oil and natural gas, and subsidization policies—alongside the availability of vast energy resources—have driven an alarming rise in energy consumption with little consideration given to energy efficiency (Carlucci et al., 2024). Iran's energy intensity exceeds that of the MENA region and low-income countries and is nearly twice as high as that of the European Union (Carlucci et al., 2024). The 2010 subsidy reform aimed to address energy overconsumption by raising prices, but while it reduced electricity consumption in the short term, the effect was not sustainable in the long term (Fatourehchi et al., 2022).

From a regulatory standpoint, the most relevant national instruments include Issue 19 of the NBRI, the Iranian National Standard (INS) for energy performance in buildings (ISIRI 14253 for residential and ISIRI 14254 for non-residential buildings), and the energy labeling instructions that assign grades (A through G) based on annual energy consumption relative to reference buildings (Ramin & Karimi, 2020). Of these, Issue 19 is the only mandatory code that addresses energy conservation directly in building design and construction (Darabpour et al., 2018). The INS standards, while providing valuable benchmarks for per-square-meter energy consumption, are non-compulsory and carry no recommendations for envelope design (Ramin & Karimi, 2020).

2.2 The 19th Issue of NBRI: Scope and Limitations

Issue 19 covers the following building elements: minimum thermal resistance for external walls; minimum thermal resistance and solar heat gain coefficient (SHGC) for fenestrations; requirements for the mechanical room, heating, cooling, ventilation, and hot water equipment including minimum efficiency, piping and duct insulation, control



requirements, maximum ventilation rate, and sealing quality; and lighting system and electrical appliance requirements (Ramin & Karimi, 2020). Two compliance paths are available: the prescriptive method, which specifies minimum thermal resistance values for individual envelope components and is restricted to buildings with a floor area below 2000 m² and up to nine stories; and the performance method, which defines a "reference heat transfer coefficient" as the maximum allowable heat transfer rate from all envelope components combined (Ramin & Karimi, 2020).

Several studies have documented the limitations of Issue 19. Kari and Fayaz (2006) evaluated the Iranian thermal building code and concluded that, while the new version had a significant impact on envelope heat transfer reduction, improvements were needed to bring the code closer to international standards (Kari & Fayaz, 2006). Ramin and Karimi (2020) compared Chapter 19 envelope requirements with ASHRAE Standard 90.2 and found that Iranian standards for external walls are comparable, but ASHRAE requires higher minimum thermal resistance for ceilings (Ramin & Karimi, 2020). Danesh Edalat et al. (2016) identified implementation barriers including lack of specific codes for residential building types, low energy prices, and absence of a performance-based assessment system (Edalat et al., 2016) & (Fatourechi et al., 2022). Riazi and Hosseini (2011) noted that by 2010, Code 19 and renewable energy policy had been implemented by only 20% and 38% respectively, necessitating more efficient strategies (Riazi & Hosseini, 2011).

2.3 LEED's Energy and Atmosphere Framework

LEED's Energy and Atmosphere (EA) category in its v4.1 version comprises three prerequisites and seven credit categories, collectively worth up to 33 points out of 110 (Amiri et al., 2020). The three prerequisites—Fundamental Commissioning and Verification, Minimum Energy Performance, and Building-Level Energy Metering—must be fulfilled before any points can be earned. The credit categories include Enhanced Commissioning (up to 6 points), Optimize Energy Performance (up to 18 points, representing the single largest credit in LEED), Advanced Energy Metering (up to 1 point), Demand Response (up to 2 points), Renewable Energy Production (up to 6 points), Enhanced Refrigerant Management (up to 1 point), and Green Power and Carbon Offsets (up to 2 points) (Amiri et al., 2020).

The structure of LEED's EA category reflects a fundamentally different philosophy from Issue 19. Where Issue 19 is primarily prescriptive—specifying minimum thermal properties for envelope components—LEED adopts a performance-based approach that rewards buildings for exceeding minimum thresholds and provides multiple pathways for compliance (Amiri et al., 2020). Furthermore, LEED addresses dimensions that are entirely absent from Issue 19, including commissioning and verification, on-site



renewable energy, demand response integration, advanced metering, refrigerant management, and carbon offset strategies.

2.4 Previous Comparative Studies

Omran and Marsono (2016) benchmarked Issue 19 against both LEED and BREEAM, finding that the Iranian regulations and the international tools have various differences in their approaches toward the sustainable built environment and energy usage in buildings (Omran & Marsono, 2016). Their study was among the first to systematically position Issue 19 within the international green building assessment landscape. Mahdavinnejad et al. (2019) evaluated and compared LEED, BREEAM, and NBRI from a sustainability perspective using the MCDM TOPSIS method. Their findings revealed that NBRI receives the lowest spending in almost every case compared to LEED and BREEAM, and they identified several criteria within the LEED and BREEAM energy sections that are neglected in Issue 19 (Mahdavinnejad et al., 2020). YektaHashkvaei and Ahmadnejad (2024) compared the benchmarks of Chapter 19 with international standards, producing a checklist of shared and divergent criteria (YektaHashkvaei & Ahmadnejad, 2024). Mohammadi et al. (2023) compared the Iranian National Standard with LEED in the field of energy performance using office buildings in Tehran as a case study (Mohammadi et al., 2023). Amiri et al. (2020) conducted a case study on the economic and technical considerations of pursuing LEED certification in Iran, finding that a typical residential building in its current state earns only 29 out of 110 LEED points, with significant shortfalls in the EA category (Amiri et al., 2020).

While these studies have documented broad differences between Issue 19 and international standards, the present study aims to provide a more granular, gap-specific analysis using LEED's EA category as a structured benchmarking framework, followed by context-sensitive enhancement strategies.

3. Methodology

This study employs a comparative benchmarking methodology to identify gaps between Issue 19's energy criteria and LEED's Energy and Atmosphere category. The analytical framework proceeds in three stages.

Stage 1: Structural Mapping. A side-by-side mapping was constructed between the energy-related criteria of Issue 19 and the EA prerequisites and credits of LEED v4.1 for Building Design and Construction (BD+C). Each criterion in Issue 19 was classified according to the corresponding EA element in LEED, or marked as having no LEED counterpart. Likewise, each LEED EA element was classified as having a partial counterpart, a full counterpart, or no counterpart in Issue 19.



Stage 2: Gap Identification. Gaps were defined as LEED EA elements that have no counterpart or only a partial counterpart in Issue 19. For each identified gap, the nature and extent of the discrepancy was characterized through reference to both the regulatory text of Issue 19 and the LEED v4.1 reference guide, supplemented by evidence from the literature on building energy performance in Iran.

Stage 3: Strategy Formulation. For each gap, enhancement strategies were developed that consider Iran's specific contextual constraints: heavily subsidized energy prices, limited availability of green building products and skilled professionals, the absence of a national building sustainability assessment method, the diversity of climatic zones across the country, and the existing institutional infrastructure for code enforcement. Strategies were evaluated against three criteria: regulatory feasibility (can they be incorporated into Issue 19's existing legal framework?), technical practicality (are the required technologies and expertise available or acquirable within a reasonable timeframe?), and impact potential (what magnitude of energy performance improvement can be expected?).

4. Results: Identified Gaps

The systematic comparison reveals six critical gaps in Issue 19 relative to LEED's EA framework.

4.1 Gap 1: Absence of Commissioning and Verification

LEED requires fundamental commissioning as a mandatory prerequisite (EA Prerequisite 1: Fundamental Commissioning and Verification) and offers up to 6 additional points for enhanced commissioning (EA Credit 1: Enhanced Commissioning) (Amiri et al., 2020). Commissioning ensures that building energy systems are installed, calibrated, and performing according to the owner's requirements, design intent, and construction documents. It encompasses the verification of HVAC systems, lighting controls, building envelope performance, and renewable energy installations—extending from the design phase through at least ten months of post-occupancy operation.

Issue 19 contains no requirement for commissioning, testing, or verification of building energy systems. Once a building permit is issued based on design documents that comply with the prescriptive or performance path, there is no systematic mechanism to verify that the as-built building actually performs as designed. This gap is particularly consequential because even well-designed buildings can significantly underperform due to installation errors, control system misconfigurations, or construction quality deficiencies. The absence of commissioning means that the energy savings projected at the design stage—which form the basis for regulatory compliance—are never confirmed in practice (Edalat et al., 2016).



4.2 Gap 2: No Renewable Energy Requirements

LEED's EA Credit 5 (Renewable Energy Production) awards up to 6 points for on-site renewable energy generation, such as solar photovoltaic, solar thermal, wind, or geothermal systems (Amiri et al., 2020). While not mandatory, the availability of significant credit points creates a strong incentive for project teams to incorporate renewable energy.

Issue 19 makes no reference to renewable energy whatsoever. There are no requirements for on-site renewable energy production, no incentive mechanisms for incorporating solar hot water or photovoltaic systems, and no connection to Iran's broader renewable energy policies. This omission is especially notable given that Iran possesses exceptional solar irradiation potential—particularly in its central and southern regions—and that 81% of building experts surveyed have identified high potential for renewable energy production as the greatest opportunity for green building in the country (Rajabi et al., 2021). The absence of renewable energy criteria in Issue 19 means that the regulatory framework provides no mechanism to translate this natural advantage into built-environment outcomes.

4.3 Gap 3: No Building-Level Energy Metering

LEED mandates building-level energy metering as a prerequisite (EA Prerequisite 3: Building-Level Energy Metering) and offers an additional point for advanced energy metering (EA Credit 3: Advanced Energy Metering) that covers energy end-uses such as lighting, plug loads, HVAC, and domestic hot water (Amiri et al., 2020). Metering enables ongoing performance tracking, identification of operational inefficiencies, and data-driven energy management.

Issue 19 does not require building-level or sub-level energy metering. While individual residential units in Iran typically have electricity and natural gas meters for billing purposes, there is no requirement for whole-building energy monitoring that would allow performance tracking against design projections. This gap creates a fundamental accountability deficit: without metering, it is impossible to determine whether buildings that comply with Issue 19 at the design stage actually achieve the intended energy performance during operation (Fatourehchi et al., 2022). The lack of post-occupancy performance data also prevents evidence-based refinement of the code itself.

4.4 Gap 4: Prescriptive Rather Than Performance-Based Compliance

LEED's EA Credit 2 (Optimize Energy Performance) awards up to 18 points—the single largest credit in the entire rating system—based on the percentage improvement in energy performance over the baseline building, as defined by ASHRAE Standard 90.1 (Amiri et al., 2020). This performance-based approach allows design teams to choose whatever



combination of envelope, mechanical, and lighting strategies best meets the project's performance target, enabling innovation and cost optimization.

While Issue 19 offers both prescriptive and performance compliance paths, the performance path is constrained in scope and application. The prescriptive method—specifying minimum thermal resistance values for individual components—is restricted to buildings with floor areas below 2000 m² and up to nine stories (Ramin & Karimi, 2020). The performance method uses a "reference heat transfer coefficient" that aggregates envelope heat transfer but does not address whole-building energy consumption modeling. Critically, Issue 19 does not require whole-building energy simulation as a compliance mechanism. Without simulation-based performance assessment, there is no way to evaluate the interactive effects of envelope improvements, HVAC efficiency, lighting design, and occupant behavior on total building energy consumption (Hosseini et al., 2023).

4.5 Gap 5: No Demand Response or Grid Interaction

LEED's EA Credit 4 (Demand Response) awards up to 2 points for participation in demand response programs or the installation of infrastructure that enables future participation (Amiri et al., 2020). Demand response mechanisms allow buildings to reduce or shift energy consumption during peak demand periods, improving grid reliability and reducing the need for additional generation capacity.

Issue 19 contains no provisions for demand response, energy storage, or grid-interactive building systems. This gap is increasingly relevant as Iran faces electricity supply challenges, including summer peak demand that strains generation capacity—Tehran experienced 111 unhealthy air quality days in 2015, partly attributable to power generation emissions (Ramin & Karimi, 2020). Buildings that can reduce or shift their demand could contribute meaningfully to grid stability and reduce the need for expensive and polluting peaking generation plants.

4.6 Gap 6: No Refrigerant Management or Greenhouse Gas Accounting

LEED requires fundamental refrigerant management as a prerequisite (EA Prerequisite 4: Fundamental Refrigerant Management) and offers additional credit (EA Credit 6: Enhanced Refrigerant Management) for the use of refrigerants with low ozone depletion potential and low global warming potential (Amiri et al., 2020). Furthermore, LEED's EA Credit 7 (Green Power and Carbon Offsets) incentivizes the purchase of renewable energy certificates or carbon offsets to address the building's operational greenhouse gas emissions.

Issue 19 does not address refrigerant selection, ozone depletion potential, or the global warming potential of HVAC refrigerants. There is also no framework for greenhouse gas



emission accounting or carbon offsetting associated with building energy consumption. Given that buildings in Iran are responsible for approximately 26.4% of national CO₂ emissions (Heidari et al., 2018), the absence of any regulatory mechanism to track or reduce the carbon intensity of building operations represents a significant gap.

5. Results: Identified Gaps

The identified gaps represent structural deficiencies in Issue 19 that limit its capacity to drive meaningful improvements in building energy performance. However, proposing enhancements requires careful consideration of Iran's contextual realities, including subsidized energy prices that reduce the financial incentive for efficiency investments, limited domestic production of advanced building technologies, insufficient numbers of trained commissioning agents and energy modelers, a fragmented institutional landscape with overlapping jurisdictions, and the absence of a national building sustainability assessment method (Malek & Grierson, 2016) & (Darabpour et al., 2018). The following strategies are designed to be feasible within these constraints.

5.1 Introducing Mandatory Commissioning for Large Buildings

A phased approach to commissioning is recommended. In the short term, mandatory commissioning requirements should be added to Issue 19 for buildings above a defined threshold—initially set at 2000 m² of floor area, consistent with the existing boundary between the prescriptive and performance compliance paths. The commissioning scope should cover HVAC systems, building automation controls, and envelope air leakage testing. In the medium term, the threshold should be progressively lowered as the pool of trained commissioning agents expands. The development of a national commissioning certification program—potentially administered by the Iranian Fuel Conservation Organization (IFCO) or the Iran Energy Efficiency Organization (SABA)—would be essential to support this requirement (Carlucci et al., 2024).

5.2 Establishing Renewable Energy Tiers

Rather than mandating a fixed renewable energy percentage—which would be impractical given Iran's varying climatic conditions and the current cost of photovoltaic systems—a tiered approach is recommended. Three tiers could be established: Tier 1 (encouraged) for buildings that incorporate solar hot water systems, which are already relatively common and cost-effective in Iran; Tier 2 (recommended) for buildings that install building-integrated photovoltaic systems covering a minimum percentage of roof area; and Tier 3 (aspirational) for buildings that achieve a defined percentage of total energy from on-site renewable sources. Compliance with each tier could be rewarded through incentives such as expedited permitting, additional allowable floor area ratio, or reduced permit fees—mechanisms that have been identified as effective motivators in the



Iranian context where low energy prices diminish the economic case for efficiency investment (Amiri et al., 2020).

5.3 Implementing Mandatory Building Energy Metering

Building-level energy metering should become a mandatory requirement for all new buildings. For residential buildings, this could build upon the existing per-unit electricity and gas metering infrastructure by requiring aggregation to the whole-building level. For commercial and public buildings, sub-metering of major end-uses (HVAC, lighting, plug loads) should be required above a defined floor area threshold. The metering data should be linked to the national energy labeling system (ISIRI 14253/14254) to create a feedback loop that allows post-occupancy performance to be compared against design projections and code benchmarks (Ramin & Karimi, 2020). This strategy directly addresses the accountability deficit identified in Gap 3 and provides the evidence base for future code refinement.

5.4 Transitioning to Whole-Building Energy Performance Assessment

The most transformative enhancement would be to replace Issue 19's component-based compliance framework with a whole-building energy performance assessment. This would require the adoption of building energy simulation as the primary compliance mechanism, with a minimum percentage improvement over a defined baseline building. To support this transition, it is recommended that Iran develop a national reference building methodology—analogue to ASHRAE 90.1's appendix G—that defines baseline envelope, mechanical, and lighting characteristics for different building types and climate zones. The existing "reference heat transfer coefficient" concept in Issue 19 could serve as a starting point but would need to be expanded to encompass total energy use intensity, not just envelope heat transfer. Given the limited availability of energy simulation expertise in Iran, this transition should be phased, beginning with large commercial and public buildings and gradually extending to smaller buildings as professional capacity grows (Hosseini et al., 2023).

5.5 Incorporating Demand Response Readiness

While full demand response programs require utility-scale infrastructure that is not yet widely available in Iran, Issue 19 can incorporate demand response readiness requirements at minimal cost. Specifically, new buildings above a defined threshold should be required to install communication infrastructure (smart thermostats, programmable building automation systems) that enables future participation in demand response programs. This "wiring for readiness" approach imposes minimal upfront cost but ensures that buildings can participate in demand response programs when and where they become available. The particularly acute summer peak demand in major Iranian



cities—where rolling blackouts are not uncommon—makes this strategy especially timely (Ramin & Karimi, 2020).

5.6 Adding Refrigerant and Carbon Accounting Provisions

Issue 19 should be amended to include minimum requirements for refrigerant selection in HVAC systems, specifying maximum allowable global warming potential values for refrigerants used in new construction. A carbon accounting appendix should be added that provides a methodology for estimating the operational greenhouse gas emissions of buildings based on their energy consumption and the carbon intensity of Iran's electricity grid. While mandatory carbon offsetting would be premature, the availability of an accounting framework would lay the groundwork for future carbon-reduction policies and would facilitate alignment with Iran's commitments under the Paris Agreement (Carlucci et al., 2024).

6. Conclusion

This study has employed LEED's Energy and Atmosphere framework as a benchmarking lens to identify six critical gaps in the 19th issue of Iran's National Building Regulations: the absence of commissioning and verification, no renewable energy requirements, no building-level energy metering, a prescriptive rather than performance-based compliance framework, no demand response or grid interaction provisions, and no refrigerant management or greenhouse gas accounting. Each gap represents a dimension of building energy performance that is well-established in international practice but entirely absent from Iran's regulatory framework.

The enhancement strategies proposed for each gap are designed to be context-sensitive, accounting for Iran's subsidized energy economy, limited green building infrastructure, and the institutional challenges of code enforcement. A phased implementation approach—beginning with the most feasible measures (metering, demand response readiness, refrigerant requirements) and progressing toward more transformative changes (mandatory commissioning, whole-building performance assessment, renewable energy tiers)—offers the most realistic path forward.

Several limitations of this study should be acknowledged. The comparison is limited to LEED's EA category and does not address other LEED categories (Water Efficiency, Materials and Resources, Indoor Environmental Quality, etc.) that also intersect with Issue 19's scope. The proposed enhancement strategies are conceptual and would require detailed regulatory drafting, stakeholder consultation, and cost-benefit analysis before adoption. Future research should focus on quantifying the energy savings potential of each proposed enhancement through simulation-based case studies of representative Iranian building typologies across different climate zones.



Ultimately, the pace and scale of Iran's building energy transition will depend not only on regulatory reform but also on broader energy pricing reform, professional capacity building, and the development of a national building sustainability assessment framework (Malek & Grierson, 2016) & (Niksefat & Taghizade, 2020). Issue 19 has served as an important first step for more than three decades, but its next revision must address the structural gaps identified in this study if it is to meet the challenges of a rapidly urbanizing, energy-intensive nation in an era of climate urgency.

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