



## Formulating Energy-Oriented Urban Design Principles with an Emphasis on the LEED-ND Approach (Case Study: Valiasr Neighborhood, Tabriz)<sup>1</sup>

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### Abstract

**BACKGROUND AND OBJECTIVE:** Cities account for approximately three-quarters of global primary energy consumption and nearly 60% of worldwide greenhouse gas emissions. According to the International Energy Agency, around 15% of the global population lives in energy poverty, marking the onset of the first global energy crisis. Given the worldwide significance of energy issues and the limitations and necessity of resource conservation, energy has become one of the most critical challenges of our era. One of the major challenges lies in the lack of effective planning and design for new neighborhoods, along with the continued use of outdated comprehensive and detailed planning models. In response to these issues, new approaches grounded in sustainable development principles have been proposed. One of the key methods for assessing sustainability involves indicator-based analyses derived from environmental certification systems. Among these, the LEED-ND rating system has gained popularity among planners and designers as a market-driven approach to promoting sustainability through urban design. This framework provides a comprehensive methodology for designing and evaluating urban spaces, prioritizing sustainability, resilience, and social well-being. Accordingly, this study aims to evaluate the sustainability status of the VALIASR NEIGHBORHOOD in the metropolis of Tabriz based on LEED-ND criteria and to formulate effective urban design principles tailored to the local conditions of this neighborhood.

**METHODOLOGY:** This study is quantitative in nature, applied in terms of its objective, and descriptive in character. Data collection was conducted through both documentary (library) research and field surveys. For the analysis, the LEED-ND model was employed as the evaluation framework. In this research, 16 criteria and indicators were selected to assess the sustainability of the neighborhood.

**FINDINGS AND CONCLUSION:** The findings of the study indicate that the neighborhood falls within the Silver certification level. Given the scarcity of energy resources, population growth, and rising energy consumption, the neighborhood requires the development of urban design principles to move closer to achieving sustainability goals. The results demonstrate that the neighborhood achieved full scores in the indicators related to steep slope protection, mixed-use neighborhood centers, access to recreational facilities, tree-lined and shaded streets, and neighborhood schools. These indicators must be preserved and enhanced. For the remaining indicators, further measures are required to obtain the necessary points and improve overall sustainability performance.

**Keywords:** Energy, Urban Design, LEED-ND Approach, Valiasr Neighborhood, Tabriz

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## Extended Abstract

### Introduction:

The Industrial Revolution in the 19th century marked the beginning of the global urbanization. According to a United Nations report, more than 64% of the world's population currently lives in urban areas, and this figure is projected to rise to 68% by 2050 (Castrejon-Esparza et al., 2025). Cities consume approximately three-quarters of the world's primary energy and account for nearly 60% of global greenhouse gas emissions (Shi, Fonseca, & Schlueter, 2017). According to the International Energy Agency, around 15% of the worldwide population currently experiences energy poverty, indicating the onset of the first global energy crisis ((IEA), 2017). Therefore, the rapid growth of industries, the increasing density of urbanization, and the rising dependence on energy resources have created numerous challenges for sustainable energy management at the global level (Faghihinia, Hami, & Saadatjou, 2025). Given the worldwide significance of energy issues, along with the limitations of resources and the need to preserve them, energy has become one of the most critical challenges of our time. This situation has not only led countries to face energy shortages but has also exposed them to various climatic problems such as climate change and the intensification of urban heat islands. Since cities are among the primary consumers of energy, they can therefore be considered a key solution in addressing and mitigating energy resource threats (Rezaei Jahromi, 2014). The sustainable use of resources has been identified as one of the main goals of urban renewal programs and policies at the beginning of the 21st century (Pedro, Silva, & Duarte Pinheiro, 2018). The increasing energy consumption in cities has led to two major issues: (1) the expansion of environmental pollution, and (2) the depletion of non-renewable energy resources, which are nearing exhaustion (Mofidi Shamirani, 2008). On the other hand, the development of renewable energy sources is still insufficient to fully replace conventional fossil fuels (Ying L et al., 2019). Consequently, as the global population continues to shift toward urban living, the decline in environmental quality, uncontrolled urban sprawl, and social segregation have become growing challenges for planning and design professionals (Cease et al., 2019). In the contemporary era, widespread transformations in technology, industry, and lifestyle have triggered profound economic, social, environmental, and physical changes in urban fabrics and neighborhoods, especially in developing countries. These changes have reduced neighborhoods' effectiveness in meeting residents' needs and led to the emergence of new urban neighborhood patterns characterized by the dominance of private vehicles, high-rise buildings, fragmented urban forms, a weakened sense of community, and increased consumption of energy and fossil fuels. A key challenge lies in the lack of effective planning and design for new neighborhoods, coupled with continued reliance on traditional comprehensive and detailed planning models. In response to these challenges, new approaches based on the principles of sustainable development have been proposed (Pasian Khamri, 2017). Sustainable urban development requires attention to four key dimensions: environmental, social, economic, and cultural. Since the 1970s, the global need for adopting sustainable behaviors and actions has been widely emphasized. One of the primary methods for evaluating sustainability is through analyses based on indicators derived from environmental certification systems. In this regard, considerable efforts have been made to assess the sustainability of urban development, leading to the formulation of various indicators. These indicators serve as tools to observe, measure, and evaluate urban characteristics. As a result, experts have developed diverse methodological frameworks for assessing urban sustainability, which have contributed to international initiatives in creating environmental and sustainability indicators (Carolina Hyczy de Siqueira et al., 2020). Among urban planners and designers, the LEED-ND rating system has gained increasing popularity as a market-based approach for promoting

sustainability through design. If a project meets the prerequisites and earns the necessary points to reach specified thresholds, it can be certified under LEED-ND. The LEED-ND rating system is expected to enhance energy efficiency in projects, revitalize existing urban areas, reduce land consumption, minimize automobile dependency, promote walkability, improve air quality, reduce polluted stormwater runoff, and foster the development of more sustainable and livable communities for people of all income levels (Garde, 2009). This framework offers a comprehensive approach to designing and evaluating urban spaces, prioritizing sustainability, resilience, and social well-being (Rizk Hegazy et al., 2024). Architects, urban designers, and land-use planners are also aware that urban design can play a pivotal role in addressing the challenges faced by urban communities, including the trend of uncontrolled urban sprawl and the rise in physical inactivity (A. Zuniga-Teran et al., 2016).

Given the intensifying environmental challenges such as increasing energy consumption and the impacts of climate change particularly in emerging urban contexts revisiting urban design and planning models has become an undeniable necessity. Valiasr Neighborhood in the metropolis of Tabriz, as a prominent example of rapid urban development, is facing multiple threats, including energy loss and the decline of environmental quality. While many urban neighborhoods lack cohesive frameworks for sustainability assessment, the utilization of internationally recognized systems like LEED-ND can provide a scientific basis for analyzing existing conditions and deriving design strategies rooted in the principles of sustainable development. Accordingly, this study aims to assess the sustainability status of the Valiasr Neighborhood in Tabriz based on LEED-ND criteria and to develop effective urban design principles tailored to the local context of this neighborhood. Based on this, the main research question is formulated as follows:

- What is the current state of sustainability in Valiasr Neighborhood of Tabriz according to LEED-ND criteria, and based on this, what urban design principles can be proposed to achieve more sustainable development?

### **Methodology:**

The present study evaluates the sustainability status of the Valiasr Neighborhood in the metropolis of Tabriz. Accordingly, this research is quantitative in nature, applied in terms of purpose, and descriptive in terms of methodology. Following the assessment of sustainability and the corresponding scores, recommendations are proposed to enhance sustainability and develop urban design principles for the study area. Data for the analysis were collected through library research, field surveys, and existing data from the approved 2016 Geographic Information System (GIS) of the city of Tabriz. The analytical framework employed is the LEED-ND model, in which 16 criteria and indicators were selected for assessment. Once the relevant indicators and criteria were determined, the collected data were analyzed using ArcGIS software, and the results were subsequently reviewed and interpreted according to the LEED-ND documentation. Valiasr Neighborhood also features a planned urban fabric and has achieved full scores in indicators such as mixed-use neighborhood centers, access to recreational facilities, tree-lined and shaded streets, and neighborhood schools.

### **Results and Discussion:**

Given that the study area did not achieve satisfactory or full scores in the indicators related to access to public and urban spaces, reduction of the urban heat island effect, and the orientation of neighborhood buildings relative to the sun, there is a clear need for targeted policymaking and planning to improve the quality of urban spaces and enhance energy efficiency. By localizing indicators such as green building certification, building energy efficiency, indoor water efficiency, landscape water use efficiency, on-site renewable energy resources, energy infrastructure efficiency, and the presence of certified LEED professionals, it is possible to

promote environmental sustainability and achieve significant economic cost savings. Valiasr Neighborhood also features a planned urban fabric and has achieved full scores in indicators such as mixed-use neighborhood centers, access to recreational facilities, tree-lined and shaded streets, and neighborhood schools. The development of urban design regulations and principles related to indicators such as the presence of a cycling network and bicycle storage kiosks, street networks, public transportation facilities, and transportation demand management can enhance the energy efficiency and sustainability of the neighborhood.

### **Conclusion:**

Based on the results obtained, the sustainability level of the Valiasr Neighborhood has been classified as Silver. Certain indicators such as steep slope protection, mixed-use neighborhood centers, access to recreational facilities, tree-lined and shaded streets, and neighborhood schools have received full scores, indicating the presence of sustainable design potential within the existing urban structure. However, these strengths must be preserved and reinforced in future interventions. Conversely, indicators such as the cycling network, public transportation, travel demand management, and urban heat island reduction scored zero or poorly, necessitating targeted interventions in these areas. Without such actions, and considering the ongoing population growth and energy consumption trends, the neighborhood's sustainability level is likely to decline, hindering the achievement of sustainable development goals. Therefore, it is imperative to enhance the evaluated criteria and indicators. In the following section, urban design principles will be formulated, accompanied by specific strategies and recommendations for each indicator that has the potential for improvement.

### **Declarations**

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