Sustainable Solutions in Structural Engineering and Construction
*Edited by* Chantawarangul, K., Suanpaga, W., Yazdani, S., Vimonsatit, V., and Singh, A.

ISBN: 978-0-9960437-0-0

# ASSESSMENT OF LEED REQUIREMENTS FOR ENERGY AND ATMOSPHERE FOR DEVELOPING A LOCAL CERTIFICATION SYSTEM

RUVEYDA KOMURLU[1], ASLI PELIN GURGUN[2], and DAVID ARDITI[3]

[1] *Dept of Architecture, Kocaeli University, Kocaeli, Turkey*
[2] *Dept of Civil Engineering, Yildiz Technical University, Istanbul, Turkey*
[3] *Construction Engineering & Management Program, Illinois Institute of Technology, Chicago, USA*

Building construction is a major industry that uses a considerable amount of energy and causes extensive atmospheric pollution. Around 30-40% of energy consumption as well as 15% of greenhouse gas emissions originate from construction activities. As a result, sustainability is of special importance, from the extraction of construction materials to building operation and maintenance. Given the increasing demand for energy worldwide, energy efficiency and renewable energy sources have special importance for a sustainable future. Green building certification systems, with their increasing importance and popularity in developing and developed countries, pursue higher goals for energy efficiency and pollution prevention. Leadership in Energy and Environmental Design (LEED) is the preferred rating system in the world. LEED assigns 32% of the available rating points to the energy and atmosphere category. The subject country of this study, Turkey, is developing local certification systems based on the characteristics of the Turkish construction industry. The leading study, Turkish National Green Building Certification - Homes (TNGBC-H), has not been introduced yet as it is still being developed. This study focuses on the codes and standards that will possibly be used in these certification systems, such as the Code for Building Energy Performance prepared by the Turkish Ministry of Environment and Urbanization, and the Turkish standards related to energy and atmosphere. This paper compares the standards and regulations referred to by LEED and TNGBC-H and makes suggestions for a coherent and efficient future certification system in Turkey.

*Keywords:* Sustainability, Green building certification systems, Turkish national green building certification – homes, Standards.

## 1 INTRODUCTION

Energy consumption is the most significant environmental impact of buildings over their life cycles. Buildings consume 30-40% of all primary energy worldwide (UNEP 2007). According to the International Energy Agency (IEA 2007), the construction industry consumes 47% of the energy produced, whereas its closest competitor, the industrial sector, uses only 28%. Therefore, the improvement of energy efficiency in buildings has become essential to ensure an adequate energy supply in the future (Gonzalez et al. 2011).

In LEED 2009 NC, it is possible to earn a maximum of 35 points associated with the six credits listed under the "energy and atmosphere" (EA) category, which constitutes 32% of the maximum total points (110 points) that one can score in LEED evaluations. Despite LEED's expanding global use, it should be noted that the energy and atmosphere requirements have been prepared for the U.S. construction environment. LEED refers to U.S. energy codes and standards that do not exist in other countries, resulting in difficulties in the implementation of these credits in other countries after accounting for a few regional priorities (Komurlu et al. 2013).

The objective of this study is to review and discuss the "energy and atmosphere" category of LEED relative to its adaptation and contribution to a possible country-specific system in Turkey. Turkey has guidelines and codes that regulate the use of energy, but although different parties are working on developing certification systems, there is no local certification system in place yet.

## 2 COMPARISON OF LEED 2009 NC AND TURKISH NATIONAL GREEN BUILDING RATING SYSTEM – HOMES (TNGBRT-H)

Since the Turkish National Green Building Certification – Homes is in the very early stages of preparation, the methods and standards for the credits have not been introduced yet. However, the Code for Building Energy Performance prepared by the Ministry of Environment and Urbanization sets an appropriate basis. The code, the latest revision of which has been introduced in 2011, has been prepared using ASHRAE standards and European Commission directives, and sets a high and contemporary level for energy efficiency. The code is highly developed, quite sophisticated and generally meets most contemporary energy standards (Komurlu et al. 2012).

This study evaluates the credits proposed in the Turkish National Green Building Certification - Homes with regards to the above-mentioned codes and the standards that are available and/or are in use in Turkey, compared to LEED 2009 NC and the standards to which it refers (Table 1). Some of the Turkish standards currently used, such as TS EN 378 "Standard for Refrigerating Systems and Heat pumps - Safety and Environmental Requirements", or TS 825 "Thermal Insulation Requirements for Buildings", may also be of value to the Turkish Green Building Certification System. The law for the Protection of the Consumer, introduced by the Turkish Ministry of Science, Industry and Technology, may be used for the project owner's protection relative to energy issues. Finally, the Ministry of Energy and Natural Resources has introduced a law on the Use of Renewable Energy Resources in Electricity Production, which has great importance not only for building certification, but also for energy policy (Komurlu et al. 2012).

It should be noted that there are big gaps in the implementation of these policies. Regarding the standards in use, it is quite possible to earn points from credits equivalent to LEED 2009 NC, except in EA Credits 2 and 6, which focus on renewable energy. Although there is a great potential about renewable energy sources in Turkey, as stated by the Ministry of Energy and Natural Resources (MENR 2012), currently the production of renewable energy is quite limited. In addition, LEED 2009 NC requires that the renewable energy resource should be verified by a third party, recognized by the Turkish Ministry of Energy and Natural Resources and the certification institution. However, an energy source verification entity does not exist in Turkey. As a result, the

renewable energy sources' qualifications are unknown. The second option, buying Renewable Energy Certificates to prove that the energy bought from a party is renewable, is rarely applicable because of the relatively low amount of renewable energy provided to the market. In summary, because of the limited production of renewable energy, there are serious problems about the application of this credit in Turkey (Komurlu et al. 2012).

"EA Credit 1 Optimize Energy Performance" refers to the ASHRAE Advanced Energy Design Guide which sets climate zones for the U.S., and recommends separate actions for these different zones (LEED 2009 NC) similar to the regional priorities category of LEED 2009 NC. Although there is a wide range of climates in Turkey, from hot-dry to warm-humid, there is no standard that classifies these and lists the proper actions. Thus a matching approach is needed to ensure the applicability of Turkish standards and certification credits (Komurlu et al. 2012).

According to Karabulut et al. (2011), fourteen Turkish universities have started courses on renewable energy in Master's and Ph.D. programs, especially in colleges of engineering, focusing on solar, wind, geothermal and hydraulic energy. The study of energy-efficient buildings has a long history in major universities in Turkey. Examples are described by Korkmaz et al. (2009), and Komurlu (2009). As consciousness about sustainability spreads among the society, the interest and initiative in both academia and industry soars as evidenced by the activities of the Chamber of Architects (2009), and the Turkish Green Building Council (CEDBIK, 2014).

The main issue for the Turkish National Green Building Certification - Homes is that the standards and laws mentioned are quite general in nature and do not include application or implementation methods. Additionally, laws are mandatory, thus compliance with the law is expected but does not satisfy the credit point assignments for certification. Establishing independent verification entities, encouraging educational institutions to teach and research sustainability-related issues, and recognizing the different conditions in different regions, are critical for a viable certification system in Turkey. Resolving these issues should greatly satisfy the expectations of not only local stakeholders, but also of international investors and building occupants.

## 3 CONCLUSION

By introducing the Code for Building Energy Performance, Turkey has made a significant step in the direction of energy conservation not only for certification but for the construction industry as a whole. In addition to the Turkish National Green Building Certification – Homes, introduced by the Turkish Green Building Council, a major academic institution is currently developing SEEB-TR (Sustainable Energy Efficient Buildings - Turkey).

The Code for Building Energy Performance has been a major step for sustainability in construction regarding the operation phase of the building life cycle. Additionally, as referred to in the Table 1, the code may function as a baseline for any certification effort. Nevertheless, there is an important lack of standards for sustainable practices

Table 1. Comparison of Standards Used in LEED 2009 NC and Turkish Green Building Certification – Homes.

| **LEED 2009 NC** | | | **Turkish National Green Building Certification - Homes** | | |
|---|---|---|---|---|---|
| **Energy and Atmosphere** | | | **Energy Use** | | |
| **EA Prerequisites and Credits** | **Pt.** | **Referenced Standards** | **Requisites and Credits** | **Pt.** | **Proposed Standards** |
| EA Prerequisite 1 - Fundamental Commissioning of Building Energy Systems | - | N/A | Operational Setup | - | The Ministry of Environment and Urbanization, the Code for Building Energy Performance |
| EA Prerequisite 2 - Minimum Energy Performance | - | ANSI/ASHRAE/IESNA Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential | - | - | The Ministry of Environment and Urbanization, the Code for Building Energy Performance |
| | | ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 | | | |
| | | ASHRAE Advanced Energy Design Guide for Small Warehouses and Self Storage Buildings 2008 | | | |
| | | ASHRAE Advanced Energy Design Guide for K-12 School Buildings | | | |
| | | New Building Institute, Advanced Buildings Core Performance Guide | | | |
| | | Energy Star Program, Target Finder Rating Tool | | | |
| EA Prerequisite 3 - Fundamental Refrigerant Management | - | U.S. EPA Clean Air Act, Title VI, Section 608, Complies with the Section Refrigerant Recycling Rule | - | - | The Ministry of Environment and Urbanization, the Code for Building Energy Performance |
| | | | | | Turkish Standard TS EN 378 "Standard for Refrigerating Systems and Heat pumps - Safety and Environmental Requirements" |
| | | | | | The European Commission Directive 97/23/EC |
| EA Credit 1 - Optimize Energy Performance | 0-19 | ANSI/ASHRAE/IESNA Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential | Energy Efficiency | - | The Ministry of Environment and Urbanization, the Code for Building Energy Performance |
| | | ASHRAE Advanced Energy Design Guide for Small Office Buildings 2006 | | | Turkish Standard TS 825 - Thermal Insulation Requirements for Buildings" |
| | | ASHRAE Advanced Energy Design Guide for Retail Buildings 2006 | | | |
| | | ASHRAE Advanced Energy Design Guide for Small Warehouses and Self Storage Buildings 2008 | | | |
| | | ASHRAE Advanced Energy Design Guide for K-12 School Buildings | | | |

<table>
<tr><td></td><td></td><td>New Building Institute, Advanced Buildings Core Performance Guide<table><tr><td>Improvement New Bldg.</td><td>Improvement Exist. Bldg.</td><td>Pt.</td></tr><tr><td>12% - 14%</td><td>8% - 44%</td><td>1 - 19</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>EA Credit 2 - On-site Renewable Energy</td><td>7</td><td>ANSI/ASHRAE/IESNA Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential<table><tr><td>Renewable Energy Percentage</td><td>Pt.</td><td>Renewable Energy Percentage</td><td>Pt.</td></tr><tr><td>1%</td><td>1</td><td>9%</td><td>5</td></tr><tr><td>3%</td><td>2</td><td>11%</td><td>6</td></tr><tr><td>5%</td><td>3</td><td>13%</td><td>7</td></tr><tr><td>7%</td><td>4</td><td></td><td></td></tr></table></td><td>Renewable Energy Use</td><td>-</td><td>The Ministry of Energy and Natural Resources, Law About the Change for the Use of Renewable Energy Resources in Electricity Production</td></tr>
<tr><td>EA Credit 3 - Enhanced Commissioning</td><td>2</td><td>U.S. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air</td><td>Operational Setup</td><td>-</td><td>The Ministry of Science, Industry and Technology, "Law for the Protection of the Consumer"</td></tr>
<tr><td rowspan="3">EA Credit 4 - Enhanced Refrigerant Management</td><td rowspan="3">2</td><td rowspan="3">N/A</td><td rowspan="3">-</td><td rowspan="3">-</td><td>The Ministry of Environment and Urbanization, the Code for Building Energy Performance</td></tr>
<tr><td>Turkish Standard TS EN 378 "Standard for Refrigerating Systems and Heat pumps - Safety and Environmental Requirements"</td></tr>
<tr><td>The European Commission Directive 97/23/EC</td></tr>
<tr><td rowspan="2">EA Credit 5 - Measurement and Verification</td><td rowspan="2">3</td><td rowspan="2">International Performance Measurement and Verification Protocol, Volume III, EVO 30000.1-2006, Concepts and Options for Determining Energy Savings in New Construction</td><td rowspan="2">Energy Efficiency Verification</td><td rowspan="2">-</td><td>The Ministry of Environment and Urbanization, the Code for Building Energy Performance</td></tr>
<tr><td>ANSI/ASHRAE/IESNA Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential</td></tr>
<tr><td>EA Credit 6 - Green Power</td><td>2</td><td>Center for Resource Solutions, Green-e Product Certification Requirements</td><td>Green Energy</td><td>-</td><td>N/A</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>Exterior Lighting</td><td>-</td><td>N/A</td></tr>
<tr><td>Energy Efficient Appliances</td><td>-</td><td>N/A</td></tr>
<tr><td>Elevators</td><td>-</td><td>N/A</td></tr>
<tr><td>Total Points</td><td>16</td><td></td><td>Total Points</td><td>-</td><td></td></tr>
</table>

including material production and transportation, installation, testing and commissioning. The cooperative efforts of the Ministry of Environment and Urbanization, the Ministry of Science, Technology and Industry, the Turkish Standards Institute, academic institutions, and professional organizations are highly required.

This study draws attention to the standards about energy and atmosphere that are needed for the effective implementation of sustainability measures in Turkey. The intent is not only to expose the standards-related problems in Turkey, but also to function as a guideline for the preparation of the ones needed. It is hoped that this study helps highlight potential bottlenecks in developing countries focusing on sustainability

## References

CEDBIK, Accessed March 9, Retrieved from cedbik.org/default.asp, 2014.

Chamber of Architects of Turkey Antalya Branch, accessed March 12, 2014, retrieved from www.antmimod.org.tr/oku.asp?blm=6&procid=356&dizid=442, 2009.

Gonzalez, A. B. R., Diaz,, J. J. V., Caamano, A.J., and Wilby, M.R., Towards a universal energy efficiency index for buildings. Energy and Buildings, 40, .980-987, 2007.

IEA (International Energy Agency), *Energy Balances of Non-OECD Countries*, 2007 Edition.

Karabulut, A., Gedik, E., Kecebas, A., and Alkan, M.A., An investigation on renewable energy education at the university level in Turkey, *Renewable Energy*, 36, 1293-1297, 2011.

Komurlu, R., Arditi, D., and Gurgun, A. P., Ass. of Indoor Environmental Quality for LEED Certification in Developing Countries, *ISEC-07, 7th Int. Structural Engrg. and Const. Conf.* Yazdani, S., and Singh, A. (eds.), 1691-1696, June 18-23, University of Hawaii, Honolulu, 2013.

Komurlu, R., Arditi, D., and Gurgun, A. P., Ass. of LEED Requirements for Energy and Atmosphere in Turkey, *10th Int. Congress on Advances in Civil Engineering*, 17-19 October, Middle East Technical University, Ankara, Turkey, 2012.

Komurlu, R., Sustainable Building Production and Examples in Turkey, *GMTR, Real Estate Turkey Journal, Depo Publisher*, Issue 8, 44-45, July-August, 2009.

Korkmaz, S., Erten, D., Syal, M., and Potbhare, V., A review of green building movement timelines in developed and developing countries to build an int. adoption framework, *5th Int. Conference on Const. in the 21th Century* (CITC-V), May 20-22. Istanbul, Turkey, 2009.

LEED 2009 NC, *LEED Ref. Guide for Green Bldg. Design and Const*., USGBC, USA, 2009.

MENR, The Ministry of Energy and Natural Resources, *The Renewable Energy*, retrieved from www.enerji.gov.tr/index.php?sf=webpages&b=yenilenebilirenerji, 2012.

UNEP, United Nations Environment Program, *Buildings and Climate Change, Status, Challenges and Opportunities*. Retrieved from www.unep.ch/etb/, 2007.