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ASSESSMENT OF THE GREEN BUILDING STATUS IN LEBANON

August 2022

ALMEE

ARZ
BUILDING RATING SYSTEM

LGBC
lebanon green building council
مجلس لبنان للأبنية الخضراء

Assessment of the Green Building Status in Lebanon

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CONTEXT

Environmental degradation is occurring on a global scale and Lebanon is not an exception. Environmental damage in Lebanon has reached critical levels. Problems in relation with poor air and water quality, inadequate treatment and disposal of hazardous waste, land contamination, and deforestation are among the most severe environmental threats that the country is currently facing and should begin to effectively deal with.

One of the challenges, as stipulated through sustainable development, is to meet the needs of the present generation without undermining the ability of future generations to meet their own needs. Sustainable construction, in particular, is a concept that is gaining importance in Lebanon. In this context, green buildings are an example of solutions that deliver high quality buildings which can minimize environmental impact and resources depletion while enhancing occupants' well-being. According to green buildings' specialists[1], Environmentally friendly buildings, as opposed to conventional ones, have a higher construction cost (More than 90% of the reported green cost fall within a range from −0.4% to 21%. Two studies found that green buildings cost less than their conventional counterparts[2]) but present lower operation cost (30-80%[3] operational costs savings) as a result of the efficient use of utilities in terms of energy and water consumption and a reduced waste production, while providing a healthier space. Due to its higher construction cost, choosing an environmentally friendly building is still not among the priorities of property buyers. Today, green buildings can be delivered at a price comparable to conventional buildings and investments can be recouped through operational cost savings and, with the right design features, can create a more productive workplace[3]. Similarly, constructors are increasingly aware of the additional requirements to certify their buildings as 'green'. Given that the production and construction concepts are still new to the Lebanese community, consultants, assessors, and NGOs have to play a major role in encouraging clients to turn green and raising the public awareness about the impact of sustainable development on their social and economic welfare. Once the Lebanese people are well informed about these advantages, it will only be a matter of time before more green projects are constructed and increase their share of the real estate market.

I. INTRODUCTION

For nearly two years now, Lebanon has been assailed by compounded crises—specifically, an economic and financial crisis, followed by COVID-19 and, lastly, the explosion at the Port of Beirut on August 4, 2020[4]. Today the dollar exchange rate has led to an increase in the prices of materials, their scarcity and the inability to import them. The banking sector, which has informally adopted strict capital controls, has ceased lending and is not attracting new deposits. The decrease in purchasing power, the social impact of which more than half the country's population is now likely below the poverty line as per the World Bank report, and the seizure of depositors' money in banks have affected the construction sector mostly new construction. This has unfortunately trickled down to the workforce with unemployment and immigration reaching high in the latest years. In the period between 2018 and 2019, the unemployment rate in Lebanon increased from 11.4% to 29.6%[5]. During the middle of the crisis, the same report by the Central Administration of Statistics showed that "nearly a third of the active labor force was unemployed" at the beginning of 2022. The current net migration rate for Lebanon in 2022 is -20.553 per 1000 population, a 24.28% increase from 2021. The net migration rate for Lebanon in 2021 was -16.538 per 1000 population, a 32.06% increase from 2020[6]. It has actually weakened some 70 professions directly related to the work of engineers and contractors at a time when there is dire need of reversing the faltering and traumatic economic cycle which underlies the political, financial and monetary problems as declared by the chairman of the Syndicate of Contractors of Public Works and Buildings[7].

[1] InternationalGBC.org
[2] Luay D., Kherun A., 2016; Energy and Buildings, ELSEVIER, "Green buildings cost premium: A review of empirical evidence"
[3] WorldGBC.org
[4] The World Bank Website retrieved in: https://www.worldbank.org/en/country/lebanon/overview#1
[5] Central Administration of Statistics in cooperation with the International Labor Organization report, 2022
[6] macrotrends.net
[7] Arab News: Interview with Maroun El Helou, the chairman of the Syndicate of Contractors of Public Works and Buildings

Furthermore, as per the World Bank report 2021, and "beyond the human tragedy, the impact of the Port of Beirut explosion has had implications at the national level, despite its geographical concentration. These add to Lebanon's long-term structural vulnerabilities, which include low-grade infrastructure—a dysfunctional electricity sector, water supply shortages, and inadequate solid waste and wastewater management—as well as weak public financial management, large macroeconomic imbalances, and deteriorating social indicators".

Green building, or sustainable design, in its basic definition, is the practice of increasing the efficiency through which buildings and their sites use energy, water, and materials, and of reducing impacts on human health and the environment for the entire lifecycle of a building. Across the world, governments and businesses are recognizing the value of a voluntary assessment (or mandatory in some countries) methodology for buildings that are eco-friendlier. That methodology is being called a "green building certification". These facts have prompted the creation of green building standards, certifications, and rating systems aimed at mitigating the impact of buildings on the natural environment through sustainable design.

In Lebanon, the concept may be relatively new; nonetheless, various green projects have already been implemented. In fact, Lebanon has been under reconstruction since 1990, after a decade and a half of civil war that devastated its infrastructure, economy, and environment. While unplanned areas (areas with arbitrary planning) constitute eighty-five percent of Lebanese territory[8], the majority of the new buildings and renovated buildings have been completed without taking into consideration energy efficiency measures: "80 percent of the buildings in Beirut are wrongly oriented and attract unwanted sunlight and heat, that prompt residents to turn on their air conditioners"[9], as reported by professional engineers.

Development decisions for Green Buildings before the actual crisis relied solely on financial incentives and the fluctuations of the real estate market.

[8] The General Directorate of Urban Planning: Arbitrary Practice Between the National Master Plan, General Master Plans, Exceptions, and Decisions

[9] Eng. Khaled El Rassi, Lecture LAU, 2010 retrieved in: https://www.lau.edu.lb/news-events/news/archive/green_buildings_and_electronic/

In the past, the government had fixed the electricity tariff based on the price of a barrel of oil being $20, up until the beginning of 2021[10] . In 2022, the cost of oil skyrocketed worldwide to $70 or $80 per barrel as a direct consequence of the Russian invasion of Ukraine. Lebanon felt the aftermath of such an increase, adding to the fact that the Lebanese government removed all fuel subsidies, causing further struggles. Thus, bringing forward and adopting energy efficient measures becomes a necessity taking into consideration their positive impact on the environment and public health. Moreover, facing increasing black-out periods and unaffordable generator bills, has favored an increased interest in alternatives and more sustainable energy sources. People are seen to be shifting to solar power, seeking independence from an unreliable governmental power grid.
This report aims at assessing the current fiscal incentives and regulatory framework available in Lebanon that promote green building rating systems and certifications, in the light of the estimated cost difference between green and non-green buildings.

II. APPROACH AND METHODOLOGY

The overall approach that describes the methodology of the assessment, that was conducted and reported by the team of experts, is detailed in the following paragraph. Assessing Green Buildings in Lebanon cannot be achieved without conducting thorough research on relevant documents as well as evaluating the several topics that will be detailed further in the report. Various stakeholders were identified in each area along with their current involvement in the advancement of policy, regulation and programs related to building performance.

- Existing Regulatory Instruments for Green Buildings in Lebanon including legislations, policies and incentives affecting energy efficiency, renewable energy, environment and green buildings. Particularly, a review of the Lebanese Building

[10] **Historical Fuel Prices in Lebanon, retrieved in www.thefuelprice.com**

Code highlighting the obligations mandated and the incentives offered by the construction law. The stakeholders' mapping of this topic showed that many actors played a major role in setting, preparing, financing, reviewing, approving, applying, monitoring and evaluating such regulations and policies and it is listed in Table 1. A list of questions was drafted for the interviews conducted (in-person and/or online) with the different stakeholders' representatives. Their feedback, clarifications and recommendations have been integrated in the assessment and mapping of the policy and regulatory roadmap for the promotion of green buildings in Lebanon.

- Existing Technical Instruments for Green Buildings, Energy Efficiency, Energy Performance and Renewable Energy in Lebanon including the Rating Systems, the Green Labels, the Standards, the MEPS…. A detailed review for the relevant documents about green building certifications in Lebanon including previous studies, existing green labeling certifications (ARZ 1.0, ARZ 2.0 GrassMED, EDGE, LEED, BREEAM, etc.) and the technical standardization, the criteria for green buildings was conducted in this part. Interviews were done (in-person and online) with the different actors tasked with the preparation, implementation and evaluation of such instruments. The list of stakeholders interviewed and their role in this area are detailed in the Table 1.

- A thorough review and assessment of the financial framework (past and ongoing) was elaborated and reported: (Banque Du Liban) BDL circulars, subsidized loans, financial institutions contributions (i.e. AFD, EBRD, IFC, etc.), other projects and initiatives. All stakeholders were approached for an interview, including representatives from BDL from which no response was received. Findings related to this sections are based on desktop research.

- The status of green building constructions and certification was evaluated in order to assess their sustainable achievements using several criteria from design, to construction implementation. This assessment was performed using two complementary methodologies. The first approach consisted of reviewing all the available information regarding the existing certified green buildings in Lebanon along with their implementation details. The second approach consisted of conducting surveys targeting various Lebanese parties deemed as key players in

escalating the concept of construction from short-term targets of economy/profit making to a global long-term sustainable development that ensures the welfare of the current and future generations. More precisely, two online surveys were conducted during this study. The first survey was addressed to consultants/assessors/developers; This survey gathered information utilized to identify the drivers and the barriers of the green building sector in Lebanon and their impact on the decision of obtaining a green building certification. The outcome of this survey would provide vital information for setting up relevant policies regarding green building certification. The second survey was addressed to managers/occupants who live/work in green buildings and gathered information about occupants' comfort, perception of building performance, and adaptive behavior. The stakeholders' mapping is listed in the table 1.

Table 1: The stakeholders mapping for Green Buildings in Lebanon

Stakeholder	Role
The Parliament Committee of Public Works, Transport, Energy and Water	Passing and ratifying the necessary laws needed to de-risk renewable energy, energy efficiency and green buildings implementation in Lebanon and removing any potential legal, institutional and constitutional barriers that might arise.
The Ministry of Energy and Water (MoEW)	Responsible for the national electricity utility (EDL) and overseeing Lebanon's energy sector, electricity papers, national action plans, setting necessary policies, regulations, decrees, decisions and the needed mechanisms to support the implementation of its approved plans and policy paper, in relation to meeting the Energy Efficiency (EE) and Renewable Energy (RE) targets.
The Ministry of Environment (MoE)	The host of Lebanon's UNFCCC climate focal point and overseeing the majority of climate change and environmental projects in Lebanon. The ministry is also the National Focal Point for the Montreal Protocol and activities carried out under the Montreal Protocol. The ministry is responsible for setting refrigerant quotas to local suppliers. The MoE coordinates all efforts related to Lebanon's commitments to internationally agreed targets

	such as the COP Paris Agreement. Additionally, the MOE is also concerned in supervising and monitoring all Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA) related to RE projects' implementation.
The Council for Development and Reconstruction (CDR)	The CDR is the central institution when one considers land-use planning initiatives led by the State. It was the conductor of the post-war reconstruction project. It directed the National Physical Master Plan for Lebanon.
The General Directorate of Urban Planning (GDUP)	Administrative unit of the Ministry of Public Work: the main official actor in the field of urban and land-use planning in Lebanon. They develop designs and systems for cities and villages (their scope of application - purpose - preparation - effects), implement designs and regulations for cities and villages, main decider in building permits…
Local Authorities (Federations and Municipalities)	The public authorities that have the role at local level, and as per the Municipal Law, of protecting and promoting the environment. The municipality, as an administrative control body to maintain public order, was granted by law, in accordance with the amendments related to development and reconstruction, a supervisory authority, either in its capacity of granting certificates or licenses, or a construction certificate, a certificate of conformity,…..
Electricité Du Liban (EDL)	The legal institution granted sole responsibility for the generation, transmission, and distribution of electrical energy in Lebanon. It is also responsible for implementing the net-metering mechanism and providing technical support.
Orders of Engineers and Architects (OEA)	The national organization hosting engineers and architects in Lebanon. The order regularly publishes reports and studies on energy performance in appliances and buildings and participate in the setting of standards and Criterion for the construction sector in Lebanon.

The Lebanese Center for Energy Conservation (LCEC)	A not-for-profit organization in charge of supporting the MoEW to set-up national strategies, implementing RE&EE initiatives. The LCEC acts as the technical arm of the MoEW in all issues related to renewable energy, energy efficiency and green buildings.
The Lebanese Customs Authority	The authority in charge of controlling the imports of appliances and materials. Providing data on imports and exports of equipment, materials for green buildings and refrigerants.
UNDP-CEDRO 5	An EU Co-funded, UNDP managed project in partnership with the Ministry of Energy and Water. It includes several sustainable energy projects that are designed to further mature the local market, including energy efficiency and renewable energy demonstration projects for private sector buildings and facilities and renewable energy implementations in public buildings in support of the direct implementation of the villages' Sustainable Energy and Environmental Action Plan (SEEACAP).
LIBNOR	Lebanon's regulatory body issuing and adopting standards and potentially labels for green buildings and appliances
The Industrial Research Institute (IRI)	National authority for the testing of industrial equipment and appliances, responsible for the implementation of HQE rating system (CEDRE in its Lebanese version)
Lebanon Green Building Council (LGBC)	An organization working to promote the sustainable building industry of an international level. Identifying and promoting procedures, methods and solutions for the design, planning, construction and utilization of both new buildings and major renovation of existing buildings that achieve the goal of sustainability. Certifying (ARZ 1.0 and ARZ 2.0) the buildings that achieve the fixed rating levels and meet the requirements of a sustainable built environment. Developing & promoting industry standards, educational

	programs and design practices, targeting professionals related to environmentally responsible buildings, individuals and teams, and at all phases. Conducting research and educational activities and engaging in lobbying efforts to promote green building practices and legislation.
Association Libanaise pour la Maitrise de l'Energie et pour l'Environnement (ALMEE)	Involved in a wide range of activities related to sustainable practices and other "green" issues at local and regional levels, committed to better handling of multiple issues and technologies associated with Energy and Environment, not just in Lebanon but also across the Mediterranean Basin and worldwide. Its overriding goal is to develop, increase and promote scientific methods and means contributing to better management of energy and related economic policies. Certifying (Grass and GrassMED) the buildings that achieve the fixed rating levels and meet the requirements of a sustainable built environment in Lebanon and the South-Mediterranean region.
Green Building Assessors and Experts in Lebanon (Eco-Consulting, Associated consulting Engineers, Quali consult, Green Power Generation, Energy Efficiency Group, Free Lancers…)	Assessors of the Certified Green Building Projects in Lebanon (sample for each label: LEED, BREAM, ARZ, HQE, EDGE…). Professionals who undertook the assessment process for the certification of the green buildings
Experts in Green Buildings	Engineers and researchers who promoted and developed green building projects and helped in developing the local green rating systems in Lebanon.
Universities and NGOs	Responsible for providing green education and spreading awareness in eco-friendly constructions.
Banque Du Liban (BDL)	Providing and supporting subsidized loans and green financing mechanisms for energy projects as well as setting the necessary initiatives for it, such as NEEREA.

Green Materials/Equipment Suppliers	Retailers and sellers of efficient appliances and green materials / equipment in both retail and wholesale
End Users	Households and other users buying and using green buildings/apartments/houses, efficient appliances, green materials and equipment.

One of the conclusions drawn in the present report highlights the **limitations** that prevent Green Building applications, including analysis of the financial environment, understanding of the legal, financial, technical and institutional **constraints and barriers**, and identification of **gaps/tasks** to solve and/or to overcome. **Lessons learned and expectations from the different interviewees** were detailed in the end of this deliverable that help therefore framing in an adequate manner the work to be conducted (**roadmap**) in deliverable 3 of the project.

III. Existing Regulatory Instruments for Green Buildings in Lebanon: Legislations, Policies and Building Code

Buildings are responsible for energy consumption and raw materials utilization. Particularly Green Buildings consist of conserving energy and materials by focusing on energy efficiency measures and technologies, renewable energy for heating and electricity production, passive effect of the envelope, building location and orientation, conserving natural resources, managing water, producing healthier indoor environment, using eco-friendly materials, producing less waste and integrating green sites. The findings present some existing insights for policy makers to improve building construction and occupancy through enhancing energy and environmental decisions, thus promoting Green Buildings applications. An overview of the existing regulatory framework related to each topic is detailed and evaluated in this paragraph. The various laws, decrees, ministerial decisions,

and other actions of the Lebanese Government, concerning the Green buildings are considered, as well as other fields aiming at the same objective of the latter, and falling under its criteria, namely the use of renewable energies, energy efficiency and environmental impact of buildings.

1. Green Building Regulations and Incentives (Building Code)

To date (May 2022), no specific regulations intended to set the green buildings criteria or to certify them or to encourage this type of construction, exist in Lebanon. However, through the Lebanese Council for Green Building (LGBC), created in 2008, the "ARZ rating system" was launched in 2011, in collaboration with the International Finance Corporation (IFC), an organization of the World Bank. The ARZ rating system is a certification system for green buildings adapted to the Lebanese context, which covers: orientation and design of the structure, materials, quality of the interior environment, optimization of operation and maintenance, and reducing waste and toxics. In any case, this certification system, as well as its new version (ARZ 2.0) of 2022, , have not been adopted by the State, probably due to a lack of consensus around this system, especially among architects and engineers, some of whom fear that the constraints (multiplication of certification conditions) it contains, will be used as a pretext to refuse building permits (if some of these conditions are not met), or that they do not give the opportunity to those who issue these permits to be more demanding in terms of bribes in order to agree to override these conditions required by ARZ 2.0. Rating systems applied in Lebanon will be detailed in section IV.

Accordingly, the ecological character of buildings in Lebanon is constantly being evaluated according to criteria requested by international certification systems, such as LEED or BREEAM, HQE or EDGE. Consequently, the regulations relating to green building do not appear in Lebanon in a document specific to the latter, but in the form of articles that have been taken from laws and decrees that regulate construction, the protection of environment… (the Lebanese construction law since its legalization in 2004 to the modifications done by laws and decrees in 2005, 2007 and 2022). These articles that are summarized in the following sections, relate to thermal insulation, the importation of equipment efficiency and favorable to the protection of the environment, the collection of rainwater, and the shading devices.

1.1. Rainwater Collection Tanks

Rainwater collection is not mandated in the Lebanese construction law, yet in paragraph **4 of article 13** of the Construction Code, **Law 646 of 11/12/2004**[11] which amends decree-law 148 of 16/9/1983 (building law), is mentioned among the conditions of obtaining the building permit, that the habitat "…must be connected to a public water distribution network, or [otherwise] build a **rainwater tank for domestic use**…". Therefore, the construction of a rainwater tank is not legislatively considered as an ecological condition for combating the waste of water resources, but as an alternative to the public water distribution network, in the event that it is lacking.

Recently, the **Law 262/2022** aims to incentivize new buildings to integrate renewable energy for their own green electricity production, yet it mandates to **collect rainwater** for domestic usage and treat sewage water.

1.2. Building Envelope

1.2.1. Double-wall, Roof and Thermal Insulation

The thermal insulation of the building consists in creating an envelope around the construction, in order to guarantee the occupants a comfortable temperature, without having to consume a lot of energy, which limits energy waste. Thus, thanks to the thermal insulation, the inhabitants are protected from the cold in winter, and benefit from a sufficiently cool temperature in summer. At the same time, thermal insulation reduces energy bills (therefore achieving savings), in addition to the emission of greenhouse gases. Thermal insulation is indicated in two paragraphs of **article 14 of the Building Code (Law 646 of 11/12/2004** which amends decree-law 148 of 16/9/1983 (building law), namely:

- **Paragraph 5** which stipulates that they "are not counted in the exploitation coefficient of the horizontal surface (% of the horizontal surface of the building in the area of the land), and in the factor of the overall exploitation (% of the built-up area of all floors in the land area) […], waterproofing and thermal insulation works, provided that their thickness does not exceed 50 cm, as well as the tile slope of the roof …". This is an incentive for thermal insulation voluntary but not mandatory.

[11] **Lebanese University, Legal Informatics Center: Building Law 2004 (www.ul.edu.lb)**

- Paragraph 7 according to which "the double walling for thermal insulation, in case it exists, it is not counted in the operating coefficient of the horizontal surface, and in the overall operating factor, provided that its thickness varies between 22 and 35 cm…".
It incentivizes building owners to integrate thermal insulation in a double wall (voluntary and not mandatory) which will give a protective layer that reduces the energy consumed for indoor air-conditioning without losing additional areas in the general surface investment factor. The implementation of the Law 646/2004 was explained in the **Decree N° 15874/2005**[12], more specifically for the roof insulation in the **articles 8 and 12**, and in the **Decree N° 617/2007**[13] **article 12**, considering the roof insulation as an extrusion when less than 50 cm, and the allowable dimensions of the double wall thermally insulated. These articles come to explain the application of the allowed extrusion, including roof insulation and external double walls and insulation. This article determines in addition that, in the event of benefiting from the above provisions, the glass in the external doors and windows shall be of a double type. However, nothing is indicated in the Lebanese legislation on the nature of the insulators (mineral, synthetic, natural, etc.) to be required.

1.2.2. Shading Devices

Extrusions are considered as external shading devices in a building that helps control the amount of sunlight admitted into a building thus reducing building peak heat gain and cooling requirements and improve the natural lighting quality of building interiors. **Articles 8 and 12** in the **Decree N° 15874/2005** determine and explain the parts of the building envelope that are considered as extrusions such as the solar canopies in the ground floor (allowed at least 30cm from the side walk limit-road side); the sun blockers, … (maximum allowed from the building envelope +60cm), … the sunscreens and curtains on sidewalks (maximum allowed +3m from the envelope and distanced at least 50 cm from sidewalk border or from tree trunk if exiting); … and the brick roofs (extrusion<1.05m). Those extrusions as per article 8 are the parts of the buildings whose area is not included in the calculation of the investment factors and the number of floors; skylights (transparent ceiling area) are considered only once in the calculation of the investment factor as per the article 12. This incentivizes the integration of shading devices in a building.

[12] **Lebanese University - Legal Informatics Center: The Applied Decree of Building Law 2005 (ul.edu.lb)**
[13] **http://legallaw.ul.edu.lb/LawArticles.aspx?LawArticleID=1065754&LawId=212422**

1.2.3. Daylight savings and Indoor Air Quality

The technical conditions to ensure the extent of the sighting are determined in **Article 9 of the Decree N° 15874/2005**. The extent of sighting ensures the daylight integration and the natural ventilation in a room. It is mandatory for every room except the one mentioned in **Article 9.3** where mechanical ventilation is required to improve the indoor air quality.

1.3. Solar Energy Incentives in the Construction Law

The Law 262/2022 incentivizes buildings to integrate photovoltaics for their self- green electricity generation by permitting an additional floor with a sloped roof that is not included in the general investment factor and the number of floors and heights allowed in the area with some required conditions. One of the conditions mandates a total bricked roof with at least 15% of the sloped surface covered with PV.

It is also necessary to mention that the Orders of Engineers in Lebanon announced a decision from many years ratified, some local authorities integrated this decision in a local municipal decision making it mandatory, such as, but not limited to the Municipality of Kornet Chehwan[14].

1.4. Environmental Protection in the Construction Law

Article 13 of the Construction Law 646/2004 clarifies that "[…] The stages of construction, occupancy, and demolition if necessary, must take into account the principles of environmental protection and the sustainability of its natural resources (water, air, land and living creatures) as defined by Law No. 444/2002 (Environmental Protection). While protecting the environment is one of the major goals of the Green Building concept it still needs to be further integrated in the Lebanese Construction Law.

[14] **Municipal Decision No 91/2010 – Kornet Chehwan**

1.5. Energy Efficiency Building Code

In general, and as per many testimonials of Lebanese engineers and experts, the construction in Lebanon has very low standards in terms of certain aspects such as how significant the waste of energy is. The Lebanon Building Code report of the Guidehouse (2021)[15] described the construction in Lebanon as constructed in a non-energy efficient way in its vast majority, which results in a poor energetic quality of the buildings.

As per the **BUILD_ME project (2016-2018),** there are several challenges linked to the enforcement and implementation of an Energy Efficiency Building Code (EEBC) and its success to promote efficiency in the building sector in Lebanon This was the subject of **BUILD_ME project (2019-2021)** that aimed at defining the regulatory and implementation gaps in reference to the implementation of the EEBC and provide concrete recommendations on how these gaps can be filled and pave the way for its effective implementation.

1.6. Sustainable Building definition as per the law

The article 66 of the General Budget Law 2019 defined the sustainable buildings as the ones that fit into specific environmental, social, organizational, and energy requirements push towards sustainable construction. However, it does not tackle technical specifications.

2. Renewable Energy Regulations and Incentives

In most countries, buildings represent 30 to 40% of total final energy consumption[16]. Buildings are the places where people spend most of their time and where they consume most of the electricity.

Green building networks have experience in communicating about the impacts of buildings, and in setting workable standards to reduce that impact. An increasing number of green

[15] **https://www.buildings-mena.com/files/LBBuildingcodereport.pdf**

[16] **www.iea.org**

building standards are now explicitly recommending that all purchased electricity should be renewable. The LEED Standard even goes further. LEED doesn't just refer to renewable energy, but to eco-labelled green electricity (Green-e, EKOenergy[17] label...), guaranteeing that the purchase has a higher positive impact. Actually, renewable electricity in a Green Building is an essential component considering the conservation of resources and an energy production without the incessant noise and pollution of the diesel private generators.

Apart from their satisfaction with an essential criterion of green building, namely "the positive house" or "the positive energy building" which produces more energy than it consumes, renewable energies represent today in Lebanon almost the only alternative or solution to its electricity crisis which dates back more than four decades.

In fact, Lebanon suffers from deprivation in its power supply, which has reflected negatively on the performance of its economy and the welfare of its people. Because of this, electricity supply is one of the major political challenges facing Lebanon over the coming decade.

Electricté Du Liban (EDL) was founded, by the **Decree N° 16878/1964,** as a public institution with an industrial and commercial mandate under the control of the Ministry of Energy and Water, and granted sole responsibility for the generation, transmission, and distribution of electrical energy in Lebanon. Thus, the electricity sector is monopolized by EDL that, currently, controls over 90% of the formal Lebanese electricity sector (including concession in North Lebanon). Other formal participants in the sector include hydroelectric power plants owned by the Litani River Authority (public company), concessions for hydroelectric power plants owned by Nahr Ibrahim and Nahr Al Bared (private companies) that sell their electrical production to EDL. In addition, there are distribution concessions in Zahle, Jbeil, Aley, and Bhamdoun. The country's energy supply has been inconsistent since the 1975-1990 civil war, but has drastically degenerated in the past two years as a result of an ever-deepening financial crisis.

The electrical capacity shortage has created an informal back-up self-generation system and plays a complementary role that is participating in assuring nearly 100% electrification together with EDL. This additional production comes from privately owned backup diesel generators that have been operating for years without any regulatory or legislative framework and that cost consumers billions of dollars per year. Due to a lack of reform and

[1717] **www.ekoenergy.org**

investment in this sector, the production of Electricité du Liban (EDL), presently, and even before the crises (economic, financial, monetary and banking) the country is going through, is still not able to meet 60% (1800 MW) of the country's demand, leaving the rest (1200 MW) to the private generators[18]. In 2019, generators powered 84% of households during rationing hours, representing an informal market of $2 billion a year. While the average price per kWh for an individual generator, is $0.20, and varies from $0.25 to $0.30 for a consumer subscribing to collective or neighborhood generators[19]. Indeed, these electricity prices are among the highest in the world. Similarly, for almost a year – second half of 2021 till the first half of 2022 (report date), the EDL has been providing only 2 to 4 hours of electricity per day, due to a lack of official foreign currency reserves to import the fuel needed to produce this energy, while the energy produced by the generators costs around $0.35.

Nevertheless, Lebanon is ranked among the countries rich in three sources of renewable energy (solar, wind and hydro). Similarly, the cost price of electricity produced through these energies is far lower than that paid by the Lebanese for electricity produced using fuel: solar energy costs $0.087 and $0.12 per kWh,[20]. However, although the exploitation of renewable energies is currently one of the few available resources that could assist in overcoming the electricity crisis, and meet a critical criterion of ecological buildings, the Lebanese Government efforts remain insufficient for almost 20 years now, which will be elaborated in the following sections. Thus, only 2% of the electricity produced is through renewable energies (solar, wind and hydraulic)[21].

2.1. The First Milestone of Privatization

In 2000, the Lebanese government began to prepare for the privatization of the energy sector. This included the signing of a contract with the French banking giant BNP Paribas in order for the latter to act as a financial advisor in matters of privatization. The bank was tasked with drawing up the short- to medium -term development strategy plans for the

[18] AYAT, Carole, Leveraging the banking crisis to finance electricity reform in Lebanon, Issam Farès Institute for public policy and international affairs, October 2021

[19] https://theconversation.com/lelectricite-un-implication-clef -of-the-lebanese-crisis-144217

[20] https://www.rouchenergies.fr/photovoltaique/ce-que-vous-devez-savoir/blog/combien-coute-l-electricite-solaire-photovoltaique.html

[21] International Energy Agency (IEA), 2019

privatization of the energy sector, proposing a legal and regulatory framework, thus helping to identify options for investment and scenarios for the implementation of the proposed plan. This is the **Law 228 dating from 31.05.2000** related to **"The regulation of privatization operations and the determination of the conditions and areas of its application"** that was adopted at that time**.** this law is discussed hereafter as it formed the basis or the legal reference for later Lebanese regulations, which advocated a privatization of the renewable energy sector. This law, which creates a **"High Privatization Council"**, attributes to it, in its **article 5**, powers, the most essential of which are: the proposal of the general privatization policy, and the means of its execution (paragraph A); the development of a timetable of the public bodies it intends to privatize (paragraph B); the valuation of the assets of these organizations, according to international financial and economic criteria (paragraph D) …
As for the principles or conditions which must hold the privatization operations, they are detailed in **article 8** of this law, as follows: to ensure competition in the activities where it is judicious (paragraph A); the protection of consumer interests with regard to prices and the quality of goods and services, through supervisory bodies, in areas where competition is present (paragraph B); the preservation of the rights of the national workforce working in the public body to be privatized (paragraph C); the protection of public money, through the evaluation of the assets of public bodies, according to international financial and economic criteria (paragraph D); give citizens the chance to participate in the capital of the privatized organization, to avoid the monopoly of shares (paragraph E)…
Note that this law makes no reference to the privatization of the renewable energy sector.

2.2. Privatization in the electricity sector

The privatization of any public sector/enterprise in Lebanon cannot be done without a robust / clear legal platform. For this purpose, Lebanese legislators passed Law 228 as a general privatization guide, and then went further by ratifying Law 462, which opened the way for privatization of the electricity sector. However, on the legal front, EDL is not considered currently ready for privatization irrespective of law number 462. It was expected that the adoption of law 462 would contribute to accelerating the process of privatization in which it states the need to establish a **"National Electricity Regulatory Authority" (NERA)** that hasn't been established yet. Without the NERA in place, there is not an authorized body who has the right to issue a license for an independent power producer.

This privatization was planned for the first time in Lebanon, through the **law of "regulation of the electricity sector" N0 462 of 02.09.2002**. The reasons / needs for this law appear in its preamble as follows:

- Electricity is a vital strategic good. Therefore, the private sector must participate in its production, transport, and distribution.
- Privatization would allow the electricity sector to self-finance its equipment, and gradually reduce the financial burden of the State due to its deficit.
- Authorizing the private sector to contribute to the financing of current and future projects in the electricity sector leads to a reduction in public debt and the volume of employment. Similarly, this creates a competitive electricity market, which ensures the latter at the lowest cost and with the best efficiency.

To this end, **article 2** of this law lays down the rules and principles governing the electricity sector, as well as the role of the State in this sector, and the rules for its privatization, or the privatization only of its management, entirely or partially. Similarly, **article 7** of this law provides for the creation of a **"National Electricity Regulatory Authority"** to which 16 powers are attributed in **article 12**. Among these powers:

- Develop a master plan for the electricity sector, in the field of production, transport and distribution (paragraph 1)
- Incentivize investments in the electricity sector (paragraph 3)
- Ensure competition in this sector, and control tariffs or non-competitive prices (paragraph 4)
- Set a ceiling price for the production, transmission and distribution of electricity (paragraph 6)
- Grant the private sector investment permits or authorizations in the electricity sector (Paragraph 9).

As this **NERA** was not created, due to a lack of consensus on this subject in successive governments, **article 7 of this law was amended by Law 775/2006** stipulating that until the creation of the **NERA**, and for one year temporary licenses and permits to produce electricity can be granted by **decision of Council of ministers** upon the **proposal of the minister of Energy and Water**. The problem is that no new licenses were issued. It was also **amended later by law 288/2014**, to temporarily authorize the government to grant the private sector investment permits in the electricity sector for a period of two years, following the proposal of the ministers of Energy and Finance. Similarly, still failing to create this body, three laws were issued in **2014 (N0 288), 2015 (N0 54), and 2019 (N0 129),** to

extend the authorization granted to the government to issue private sector investment permits in power generation.
The law has still not come into force, and instead of moving forward in the development of the energy sector, production has been in further decline.
Below are observations / shortcomings of the law:
• No allusion is made in this law concerning the possibility of the production of electricity by the private sector, through renewable energies.
• Electricity produced by the private sector must be sold to EDL, which retains the monopoly of transmission and distribution.
• Setting a ceiling price for electricity produced by the private sector (Article 12, paragraph 6), is likely to discourage investment in this area, as this price could be low for social reasons, and makes the return on this investment insufficient.
• Due to the lack of a plan, caused by the non-creation of the NERA, potential private sector investors do not know what to expect.
• For these various reasons, and for others, no request for authorization to produce electricity has been presented by the private sector, which indicates a **failure of this law**.

2.3. Timid Initiative in Favor of Renewable Energies

The official reform plans for the electricity sector in Lebanon have been proposed by the ministers Fneich, Tabourian and Bassil in 2006, 2008 and 2010 respectively. The 2006 plan suggested the auditing and computerization as well as the appointment of new board of directors for EDL. The 2008 paper focused on the electricity generation sector. The 2010 plan does not call for privatization, but the adoption of the principle of partnership between the public and private sectors. Therefore, it requires the participation of the private sector in the production and distribution processes.
This recourse was part of the 10 "initiatives" advocated by the Lebanese government, within the framework of its **"electricity policy" of June 2010**, which cover the electricity infrastructure, the sources and the demand for electricity energy, and the legal framework. This policy projected the production of 4,000 MW in 2014 at a cost of $4,870 million, and 5,000 MW after 2015. The development of renewable energies constitutes the **fifth "initiative" of this policy**, which consists in supporting public, private and individual initiatives, for the use of renewable energies to meet the 12% of the production of electricity in Lebanon… To achieve this objective, this policy provides four means:

•The launching by the Government (through the LCEC) for an IPP – partnership / development by the private sector for wind farm projects
• Begin to study the feasibility of solar park projects, or to assess their usefulness.
• Encourage the public and private sectors to produce electricity through waste
• Encourage all private and individual initiatives in the production of hydroelectricity.

Below are observations in reference to this part or “initiative” reserved by this “electricity policy” for renewable energies:
• This policy was very elusive about renewable energies: it devoted barely 6 lines to them in a 39-page document; while it was verbose about other energies, especially natural gas.
• The means provided by this policy to promote the production of electricity are very general and lack precision.
• No financing or incentives have been provided for the promotion of electricity production using renewable energies; while for other energies, this policy provides many details about their costs and financing.
• There is uncertainty or hesitation regarding the exploitation of solar energy, conditioned by feasibility studies, or evaluation of its usefulness.
• No timetable has been set for achieving the objective of raising the share of renewable energies to 12% in the production of electricity in Lebanon.
For these different reasons, only 2% of the electricity produced in Lebanon in 2019, was through renewable energies, as was indicated above.

2.4. More Advanced Initiatives in Favor of Renewable Energies

A year and 5 months after finalizing the 2010 "electricity policy", discussed in section 2.3, which neglected renewable energies in the production of electricity, the Lebanese Government adopted on **November 10, 2011** another policy called **"National Energy Efficiency Action Plan for Lebanon 2011-2015" (NEEAP),** which provided a detailed roadmap for the implementation of these energies. The NEEAP included a total of 10 "initiatives" four of which target the development of renewable energies. These initiatives are:

2.4.1. Initiative 6: Electricity production using wind energy

This initiative provides for the development, first of all, of a wind atlas which would cost approximately $85,000, and whose financing was borne by the Spanish funded UNDP/CEDRO project. whereas wind farms for the production of electricity, would be financed by the private sector. To this end, the United Nations Development Program (UNDP), as well as the Banque du Liban and the European Union, will offer investors in these wind farms interest-free long-term loans, within the framework of the National Action for Energy Efficiency and Renewable Energy (NEEREA). Similarly, electricity producers using renewable energies will be connected to the EDL network by the end of 2012 at the latest. As for the capacity of electricity that would be produced by the private sector through wind energy, it would vary between 100 and 200 MW until 2014.

2.4.2. Initiative 7: Production of electricity using solar energy

This initiative consists of creating photovoltaic (PV) and concentrated solar power (CSP) parks. To this end, the Spanish funded UNDP/CEDRO in its first three phases has developed pilot projects for public sector hospitals and schools with capacities ranging from 1.2 to 1.8 kW; the Council for Development and Reconstruction (CDR) has developed a pilot photovoltaic park project with a capacity of 1 to 5 MW; The Lebanese Center for Energy Conservation (LCEC) carried out a market study to identify wholesale and retail traders of solar photovoltaic equipment; CEDRO completed the prefeasibility study of photovoltaic (PV) and concentrated solar power (CSP) parks in the first half of 2012; the coordination with the Ministry of Public Finance to the development of financial incentives for the import of photovoltaic equipment; ensuring the financing (aid and loans) necessary for the installation of the first PV park in Lebanon in coordination with the Council for Development and Reconstruction (CDR), Electricity of Lebanon (EDL) and donors, by the first half of 2012; the adoption of a decree allowing the connection to the EDL network of producers of electricity produced using renewable energies, by June 2012; the adoption of a package of regulations necessary for the implementation of the concept of net-metering, by June 2013…

Thus, according to this plan, the installation of photovoltaic parks and/or CSP in IPP by the private sector, should allow the production of electricity at a capacity of 100 to 200 MW by 2014.

2.4.3. Initiative 8: Hydroelectricity production

This initiative consists of increasing the share of hydroelectricity, through the maintenance, rehabilitation and/or replacement of existing hydroelectric power plants; the creation of others by BOT; and construction of water dams; knowing that the effective production of these plants is 190 MW, while their production capacity is 274 MW. Thus, the production of the Litani, Nahr Ibrahim and Bared power plants is only about 4.5% of the total electricity production in Lebanon.

As for the means provided by this plan (NEEAP), to increase the share of hydroelectricity, they are as follows:

• Encourage the private sector to produce hydroelectricity, by encouraging investment in micro-hydraulic projects.

• The rehabilitation of existing power plants, should increase their production capacities, between 20 and 30 MW by June 2013

• The increase in the production capacity of the Richmaya plant, by 3 MW by December 2012.

• Completion of a feasibility study for the installation of two hydroelectric power stations in Kadisha.

With regard to the financing of the rehabilitation and construction of new hydroelectric sets, it would be provided by the Lebanese Government and other donors.

2.4.4. Initiative 9: Geothermal energy, energy recovery from waste and other technologies

This initiative aims to reduce waste, by transforming it into energy, and to promote geothermal energy for the production of electricity. To achieve these objectives, the plan (NEEAP) provides for the following means:

• Encourage the private sector to adopt “waste-to-energy” technologies for electricity generation, and carry out a study on geothermal energy.

• Encourage the public and private sectors to adopt incineration technologies to generate electricity from waste.

• Complete the biomass strategy for Lebanon, in the second half of 2012. This strategy was financed by the Spanish funded UNDP/CEDRO project (in its first three phases) with an approximate cost of $210,000.
• Build energy production units from waste, to reach a capacity of 15 to 25 MW by 2014.

Indeed, this "National Energy Efficiency Action Plan for Lebanon 2011-2015" (NEEAP) is more serious in terms of promoting the production of electricity through renewable energies than the "electricity policy" of June 2010, because it is not limited to the statement of objectives, but it provides for each of these statements a clear roadmap. However, although the intentions of encouraging the private sector to participate in the production of electricity through renewable energies are not lacking in this plan, the specific fiscal, monetary and regulatory incentives for this participation remain absent. Thus, for this reason, and because of the non-implementation of several actions provided for by this plan, the latter has not had much effect on the exploitation of renewable energies for the production of electricity. …

2.5. The National Renewable Energy Action Plan (NREAP)- 2016-2020

After the Paris agreement 2015 Lebanon committed, unconditionally, to reduce its emissions by 15% and its power demand by 3% by 2030. The RE targets that are needed to reach the 12% RE share of by the year 2020. It is obvious that this proposed and adopted action plan had the same goal as the previous national action plan.

2.6. The Production of Electricity by the BOT

This form of privatization of electricity production in Lebanon was provided for by **law 288 of 30.04.2014**, in its **article 2 (paragraph A)** which stipulates: "Projects for the construction of [electrical] power plants are granted for the financing, production, operation, and transfer of their ownership to the State, under administrative, technical and financial conditions, which include specifications to be developed by the Ministry of Energy and Water ". This law also makes no reference to the production of electricity using renewable energies, although the use of the latter was indicated by the “electricity policy” decided in June 2010, i.e., 4 years earlier. Similarly, as it does not include any regulation of the BOT, this law has not been implemented, like the two other laws that preceded it, and

which were presented in previous sections. However, the application of this law was **extended until 08.05.2018, by law N0 54 of 24.11.2015**.

2.7. Tax Incentives

Tax incentives for the production of electricity using renewable energies, which were lacking in the "electricity policy" of 2010, and in the "National action plan for energy efficiency for Lebanon 2011-2015" (NEEAP) of 2011, were provided for 6 years later in **Decree No 167 of 17.02.2017**, relating to "the fixing of the details of application of **article 20 of the Environmental Code No 444 of 29. 0.7. 2002**", which were discussed earlier.

According to **article 2** of this decree, benefits from the tax credit [actually from the reduction of tax on income or profits], "the production of electricity thanks to solar, wind, hydraulic, geothermal energies, and that resulting from the treatment of waste" (**article 1, paragraph 2 C**). This tax reduction is also regressive, insofar as it amounts to 50% on the profits made on these activities during the first five fiscal years following that of the entry into force of this decree, then it gradually decreases until reaching 10% in the 9th fiscal year, as shown in Table 4.

Similarly, equipment intended for the production of electricity using solar, wind, hydraulic, geothermal energy, and that resulting from the treatment of waste, benefit from "depreciation, if this equipment has been installed with the aim of reducing the use of fossil energy" (**article 1, paragraph 3 D**).

In addition, according to **article 4 of this decree 167/2017**, "From the first year following the entry into force of this decree, any natural or legal person who has incurred expenses aimed at protecting the environment in a sustainable way, benefits from a reduction in income tax", according to one of the following two methods:

- Reduction equivalent to 15% of expenditure intended for the protection of the environment in a sustainable manner (**article 4, paragraph 1 A**)
- A percentage of tax on income or profits from industrial, commercial and non-commercial professions, according to the scale in Table 4, which have been placed a little further on.

Much more, benefit from the reduction of customs taxes, equipment intended for the production of electricity thanks to solar, wind, hydraulic, geothermal energies, and that resulting from the treatment of waste, if this equipment has been installed for the purpose

to reduce the use of fossil energy (**article 7, paragraph 2 A**), according to the scale included in Table 2, which have been placed a little further on.
Indeed, the tax incentives for the production of electricity through renewable energies, provided for by this decree 167/2017, seem to us persuasive and plausible. However, the conditions to be met in this decree in order to benefit from these tax advantages, seem to us a little draconian, and therefore risk discouraging several investors in the production of electricity from renewable energies.
In addition, it should be noted that there are several non-technical expressions in this decree, such as: "…production of solar energy…"; reduction of income tax by "15% of expenses" …

2.8. Public Purchase Contracts for Wind Power

In February 2018, the Ministry of Energy and Water Resources signed contracts for the purchase of electricity from three wind energy parks, installed in Akkar, with a capacity of 226 MW. Yet, these parks requested the postponement of these contracts, because of "the political, economic and financial situation". In fact, the ministerial committee (founded in 2014) had examined the offers of different companies and decided a price of 12.5 cents per kilowatt. However, these wind energy initiatives are significantly more expensive than similar projects in the region and across the globe, with the global cost of electricity averaging 6 cents per kWh for onshore wind in 2017. For Lebanon, the higher cost is mainly due to the uncertainty in the sector, which is driving up the risk premium that companies account for in the projects' finances. These wind farms, planned to be completed by 2020, have remained mostly on paper.

2.9. The Return in 2019 to the Law of "Regulation of the Electricity Sector" of 2002

This return was made through **Law 129 of 30.04.2019**, which **reinstated Law 288 of 30.04.2014,** which was presented in section 2.6 above, and whose article **2 (paragraph A**) establishes the system of the BOT in these terms: "[Electrical] power plant construction projects are granted for the financing, production, operation, and transfer of their ownership to the State, under administrative, technical and financial conditions, that includes specifications that would be finalized by the Ministry of Energy and Water Resources".

Similarly, this **law 288/2014 had been extended by law N0 54 of 24.11.2015 until 08.05.2018.** Thus, these three **laws of 2014, 2015, and 2019** had the function of **extending Law 462 of 02.09.2002 relating to "regulation of the electricity sector", article 7** of which provides for the creation of a **"regulatory body of the electricity sector"** which is the only one empowered to issue to the private sector, building permits for power plants. However, as this body was not created, for lack of consensus on this subject in successive governments, **article 7** of this law was **amended by law 288/2014**, to authorize provisionally and for two years, to the government to grant the private sector investment permits in the electricity sector, on the proposal of the ministers of Energy and Finance.
Yet, despite the **triple extension of this law 462/2002**, no electricity investment permit has been granted to the private sector. Moreover, this **law 129/2019** was the subject of an appeal filed by 10 Lebanese parliamentarians to the Constitutional Council, because in their point of view, it constitutes an **infringement of 5 articles of the Constitution (articles 36, 89, 16, 17 and 65),** in addition to its transgression of the principle of **"exception and mitigating circumstances".**
As for the Constitutional Council, it partially invalidated **Law 129/2019**, because of **paragraph B of its article 2 relating to "mitigating circumstances",** and which obscured the role of the **Department of Adjudications, the Public Accounting Plan, and the Law of Partnership with the Private Sector (PPP) (Law 48/2017).** At the same time, this council rejected the other reasons for the appeal, including the violation of articles 16, 17 and 65 of the Constitution which prohibit the government from granting projects.

2.10. Net-metering in Lebanon

Net-metering or net billing is an electricity metering system. It allows better management of solar self-consumption and photovoltaic electricity production. It is presented as an intelligent "reverse" meter system that automatically calculates what is produced and consumed on site, what is injected into the network, and what is drawn from the network.
Net-metering started in the United States in 1983, in the state of Minnesota, following complaints from photovoltaic electricity producers, who wanted to be able to consume their electricity produced at different times of their production, without having a storage system storage (battery) which was still too expensive at the time.

To introduce this system in Lebanon, a draft law has been prepared by the Ministry of Energy and Water, in cooperation with the European Bank for Reconstruction and Development (EBRD) and EDL, and with the participation of experts from the Lebanese Energy Conservation Center (LCEC Lebanese Net-Metering system in the draft law of March 12, 2022 (Distributed law), are:

• Any producer of photovoltaic electricity must subscribe to this Net-Metering system of the draft law of March 12, 2022 (Distributed law), in order to be connected to the EDL network in accordance with the provisions of Law 462/2002, and must pay a tax for this connection (**article 2, paragraph 2.3).**

• The maximum photovoltaic electricity production capacity is set at 10 MW per producer, at the connection point **(article 2, paragraph 2.4)**

• The surplus production of photovoltaic electricity injected by the subscriber to the EDL network, compared to its consumption of this network, is sold to the EDL at the end of the financial year, according to the tariff that would set the latter **(article 1, paragraph 9)**

• The producer of photovoltaic electricity has the right to sell its production to a consumer, in accordance with an agreement between the two, and according to a price fixed beforehand by the seller (**article 1, paragraph 15).** This marks the end of the monopoly of the production and distribution of electricity, from which the EDL has benefited until now.

• If the producer and the consumer of the photovoltaic electricity are on the same site, or on neighboring sites, the electricity exchanged does not pass through the EDL network **(article 4, paragraph 4.2)**, which does not assume transport tax.

• On the other hand, if the producer and the consumer of the photovoltaic electricity are not on the same site, or on neighboring sites, the electricity exchanged must go through the EDL network **(article 3, paragraph 3.4)**, and a transport tax must be paid to EDL

• It is the **"Electricity Sector Regulatory Authority",** created under Law 462/2002, which oversees the application of the law relating to Net-metering (**Article 1, paragraph 2).** Until the members of this body are appointed, it is the Minister of Energy and Water who temporarily assumes the powers and tasks of this entity (**Article 9. Provisions**).

3. Energy Efficiency Regulations and Incentives

The concept of energy efficiency, borrowed from physics, designates a set of technical and/or logistical solutions, making it possible to reduce the energy consumption of a system, for an identical or even superior service rendered. During the first oil crisis in 1973, this concept was adopted for an economic purpose, namely to ensure the energy and economic independence of oil-consuming countries. Then, from the “1990s”, ecological objectives were attributed to this concept, particularly the reduction of greenhouse gas emissions responsible for global warming, other pollutants, and the excessive use of non-renewable natural resources.

To achieve its environmental goals, energy efficiency essentially targets three areas:

- The building [housing, urbanization, and domestic equipment (thermal insulation, fenestration, walls, efficient heating and cooling systems, domestic hot water, lighting, refrigerators, etc.)]
- Transport (private vehicles, public transport, freight),

The building industry that interests us here, because the regulations and the Lebanese fiscal and monetary incentives targeting energy efficiency, have targeted this sector, as will be seen further ahead.

3.1. Energy efficiency and the Electricity Policy of 2010

This policy, which included 10 “initiatives”, one of which falls under energy efficiency “Demand management/rationalization of energy consumption [energy efficiency]”. This initiative consists of managing the demand for electricity, in order to reduce consumption by at least 5%, through:

- The adoption of the law on energy conservation, the “institutionalization” of the Lebanese Center for Energy Conservation (LCEC), and the launch in 2010 of the National Plan for the Rationalization of Energy Consumption.
- The large-scale use of efficient domestic lighting (CFL) from 2010, until banning rudimentary [traditional] electrical equipment in the future
- The constant increase in the capacity of solar water heaters (SWH), and create financing facilities [for their acquisition], in collaboration with the banking sector, until the realization of the motto "in every home, a water heater ".

• Encourage energy-saving public lighting
• Develop a mechanism for calculating energy efficiency and the use of renewable energies (NEEREA)…

The duration of the projects (LED lamps, solar water heaters, and public lighting) planned by this initiative was planned to be achieved within a period of 4 years and would cost around $25 million.

The least that can be said of this initiative, that it looks like a set of slogans, that it occupies only half a page of the 39 pages of **"The Electricity Policy" of 2010**, and that it is poorly drafted legally and scientifically. Therefore, this gives the impression that energy efficiency has been inserted into the text of the “electricity policy”, just to avoid blame for having omitted it.

Likewise, it should be noted that this initiative, which was launched in June 2010, was preceded by a decision taken along the same lines in March of the same year, as is observed below.

3.2. Actions in Favor of Energy Efficiency

Following the **Government Decision N0 59 of 10.03.2010,** three energy efficiency projects were launched by the Ministry of Energy and Water, namely:

• The **distribution of 3 million LED lamps** to 1 million households with modest economic conditions, at the rate of 3 lamps per household. This project, which would cost the State $7 million, should reduce the electricity bill of these households by $76 million per year, according to the Ministry in question.

• **Incentives for the purchase of solar water heaters**, thanks to zero% interest bank loans, repayable over 5 years. At the same time, the Ministry of Energy and Water pays $200 of the price of each solar water heater after its installation. This aid of $200 should benefit 7,500 households, which would represent a total amount of $1.5 million that the Ministry in question would deposit at the Banque du Liban for this purpose.

In 2011, 4,100 households benefited from the aforementioned loans, and 1,980 households benefited from the assistance of the Ministry, for a total amount of $396,000. At the same time, 9,810 water heaters were purchased in 2011 by Lebanese who did not benefit from zero interest loans or aid from the Ministry. Thus, the number of water

heaters sold rose in the same year to 13,910, and the number of companies in this field, registered with the LCEC, increased from 25 to 110.

• **Public lighting of highways using solar energy**, and the sale as part of this project of photo sensors at affordable prices to municipalities.

The public financing of these 3 projects amounted to 9.08 million $, drawn from the budgetary appropriations granted to the Ministry of Energy and Water, for the support of fuel oil prices.

3.3. The Creation of NEEREA

"The National Energy Efficiency and Renewable Energy Action" (NEEREA) is a financing mechanism that enables the private sector to obtain subsidized loans for energy efficiency and renewable energy projects, through commercial banks in Lebanon, under the supervision of the central bank (BDL).

To this end, NEEREA was created on **November 25, 2010 through circular 236 of the Banque du Liban (BDL),** which also lists the conditions and terms for obtaining subsidized green loans. Similarly, **circulars 313 and 318 issued by the BDL in 2013, as well as that of 346/2014**, introduced new incentives for **energy efficiency, certified green buildings, and renewable energies**.

Until January 2015, more than 200 green projects in these three areas, and a total amount of more than $250 million, have been approved under the NEEREA financing mechanism.

It should also be noted that the BDL also collaborates in this financing mechanism with the Ministry of Energy and Water, the United Nations Development Program (UNDP), the European Union (EU), and the Lebanese Center for Energy Conservation (LCEC).

NEEREA is dealt in more detail under the section "Available financial mechanisms".

3.4. Assessment of Energy Efficiency in Lebanon in 2012

In 2013, **the Regional Center for Renewable Energy and Energy Efficiency (RCREEE)** drew up an **assessment of energy efficiency for the year 2012**, which gave rise to the following findings:

• No legal framework had been established in Lebanon regarding energy efficiency measures. On the other hand, a draft law had been prepared detailing standards and financial incentives for energy efficiency in the field of domestic electrical equipment.
• Voluntary energy efficiency standards have been adopted for refrigerators, air conditioners, and gas and electric water heaters.
• The National Plan (2011-2015) on energy efficiency was adopted in November 2011
• The LCEC is the entity responsible for developing strategies and implementing national energy efficiency policies.
• Energy efficiency projects are exempt from taxes and duties
• The National Energy Efficiency and Renewable Energy Fund (NEEREA) was created in 2010 to finance projects in these two areas through subsidized loans at low interest rates, including building loans ecological BREEAM or LEED certifications, which cover up to 45% of their construction cost.
• The customs tax on the import of solar water heaters and LED lamps is 5%
• At the end of 2012, 350,000 m2 of solar water heaters have been installed in Lebanon.
• No construction of buildings that meet energy efficiency standards. However, several pilot projects meeting the standards of energy efficiency and green buildings have been implemented in this country.
• At the end of 2012, 3,090,000 LED lamps have been distributed.

3.5. Energy efficiency in the "National Energy Efficiency Action Plan for Lebanon 2011-2015" (NEEAP I)

This plan that was discussed previously includes 14 "initiatives", 4 of which fall under energy efficiency promotion, and they are:

3.5.1. Initiative 1: Towards a ban on the import of incandescent lamps in Lebanon

This initiative aims to ban the import of incandescent lamps in Lebanon by the end of 2012. Among the means made available to this initiative:

• Complete the distribution of 3 million CFLs by the end of 2011 in coordination with EDL, municipalities and civil society. Negotiate with CDM carbon credit buyer and sign agreement by December 2011.
• Coordinate with the buyer of the carbon credits for the preparation of the project design document, and submit it by December 2012.
• Coordinate with the Ministry of Public Finance, the possibility of adopting dissuasive taxes on the import of incandescent lamps, and incentives for the import of CFLs, in the first half of 2012.
• Carry out a market study on the use of incandescent/CFL lamps to measure the change in this field at the end of 2012.
• Prohibit the importation of incandescent lamps into Lebanon, by a decree planned for December 2012 at the latest.
• Sensitization of citizens to the use of LED lights in newly constructed buildings, by September 2011.

Indeed, apart from the distribution of LED lamps, nothing has been achieved by all these means. More particularly, import of Incandescent Lamps to Lebanon was not banned and the distribution of 3 Million CFL was done prior to the NEEAP I.

3.5.2. Initiative 2: The adoption of the law on energy conservation, and the institutionalization of the Lebanese Center for Energy Conservation (LCEC) as the National Energy Agency for Lebanon

This law provides a legal framework for energy audits, energy efficiency standards and labels, financial incentives in this area, and the LCEC.

Among the means provided for this purpose:

• Present the draft law on energy savings to the Lebanese government by June 2011, to parliament by September 2011, to be voted on by the latter by the end of 2011.
• Work towards the promulgation of decrees and decisions relating to mandatory energy audits, and financial incentive/disincentive measures in terms of energy efficiency.
• Donate land belonging to the Ministry of Energy and Water, for the construction of the new LCEC headquarters, as a positive energy building by the first half of 2012 (green building), even if it is completed by the end of 2014.

Similarly, none of these means have been achieved.

3.5.3. Initiative 4: Solar water heaters for buildings and institutions

The objective of this initiative is the installation of 190,000 m2 of solar water heaters in the residential sector, through certain actions, including financial and technical mechanisms.

As for the means provided for the achievement of this objective, it is cited:

- Complete the distribution of 400 solar water heaters by the end of 2011.
- Promote the installation of 350 solar water heaters by the first half of 2012.
- Continue to subsidize 7,500 solar water heaters at $200 each for a sum of 1.5 million USD, and grant loans at 0% interest over 5 years, saving 20 million USD per year.
- Create a website specific to the solar water heater, to be updated regularly and to become a central reference.
- Launch a national awareness campaign for the "A solar water heater for every household" project at the end of 2011.
- Provide technical support to manufacturers and suppliers of solar water heaters to improve the quality of their products in 2011.
- Coordinate with the Ministry of Public Finance, for the development of financial incentives for the import of solar water heaters in the first half of 2011.
- Prepare a draft law that forces new buildings to install solar water heaters in 2012.
- Promote the installation of solar water heating systems for collective use in large installations.

Most of these means are appropriate and relevant. But, only the first three were used, to encourage the installation of water heaters. This initiative was achieved at 53% according to LCEC (when counting also the UNDP and EU initiatives).

3.5.4. Initiative 10: Building Code for Lebanon

This initiative essentially aims to develop a **building code for Lebanon.** However it blocked the implementation of the Thermal Standard 2010 and didn't succeed in developing an alternative energy code[22]. This initiative was **not implemented**[23].

[22] Adnan Jouni, Rita Najjar, and Adel Mourtada, "Evaluation of National Energy Action Plan: The Case of the Lebanese NEEAP (2011-2015)", REDEC 2016, IEEE- 10 1109

[23] S. Mortada, "Second National Energy Efficiency Action Plan for Lebanon NEEAP 2016-2020", Beirut Energy Forum, September 9, 2015

3.5.5. Initiative 11: Financing Mechanisms and Incentives

This initiative highlighted the financing mechanisms and incentives that would help reduce the energy consumption and more specifically **NEEREA and Kafalat** (these mechanisms are detailed further along in the report). However, energy saving from announcing beneficiary projects was only 7 GWh/year (by the end of 2015)[11].

3.5.6. Initiative 14: Promotion of Energy Efficient Equipment

38 GWh/year was targeted as energy savings from standards and labels from the implementation of this initiative. Five Minimum Energy Performance Standards (MEPS) for five equipment were adopted **before the NEEAP**, no enforcement or development of labels were conducted[11].

3.6. Energy efficiency in the "National Energy Efficiency Action Plan for Lebanon 2016-2020" (NEEAP II)

After the Paris agreement of 2015, Lebanon committed unconditionally, to reduce its emissions by 15% and its power demand by 3% by 2030. The second adopted NEEAP covered another five years from 2016 to 2020 and included several EE initiatives dedicated to primary energy savings and end-use measures. The end-use measures targeted mainly the building, industry, agriculture and public sectors, in addition to horizontal measures that have a cross-sectoral impact on the economy. The primary proposed energy saving measures were on the supply side, primarily in the generation, transmission, and distribution segments of the power sector. In this plan, 26 EE initiatives were suggested to reduce electricity demand and the total energy savings were estimated around 828.1 GWh.

3.6.1. H1-Initiative 1: Implementing Minimum Energy Performance Standard (MEPS) and Labeling Program for at least 5 Types of Equipment

This initiative aimed to implement MEPS and Labeling Program for at least 5 types of equipment (air conditioners, lamps, refrigerators, televisions, washing machines). The MEPS implementation procedure should include the following steps:

- Establish the legal and regulatory frameworks
- Analyze and set standards:
- Assess the energy performance of products currently sold in the market
- Establish the technical feasibility and cost of each technology option that might improve a product's energy efficiency
- Assess a national impact analysis
- Determine the economic impact on consumers (purchasing + operating cost)
- Predict the impact on the manufacturers (if there are local ones)
- Select products and set priorities
- Develop a testing capability: define testing facilities needed and test procedures in order to have low-cost high quality tests
- Design and implement a labeling program
- Design and implement a communication campaign
- Establish a monitoring and verification scheme
- Ensure program integrity
- Establish fair, consistent, and practical criteria for certifying the energy efficiency of products
- Establish sufficient penalties and adequate administrative processes for enforcement.
- Combine standards and labels with other policies (incentives, taxes...)

Electrical equipment account around 40% of the total energy consumption in buildings and industry (12). Most of these equipment has a high lifetime, i.e. remain in a household for an extended time and hence present high energy consumption. In order to reduce the energy consumption resulting from purchasing inefficient equipment, MEPS and mandatory labeling are a must allowing for an adequate control of the market. This initiative's cost was estimated around 1 Million Dollars.

3.6.2. H2-Initiative 2: National Financing Mechanisms and Incentives 2016-2020 (NEEREA 2016-2020)

This measure in NEEAP II and NREAP extended NEEREA till 2020 already detailed in the section of the financial mechanisms here later. It is necessary to mention that amount of

energy targeted to be saved by this initiative was estimated around 49.2 GWh by 2020 with a budget of around 480 Million Dollars.

3.6.3. H5: Initiative 5: A Political Momentum Towards the Development of the Energy Conservation Law (2016-2018)

This measure aims at creating a **political momentum towards the development of the Energy Conservation Law** towards a more comprehensive framework law and towards having a smooth adoption by the Lebanese Parliament.
The Energy Conservation Law was approved by the Council of Ministers. The law regulates the framework of energy efficiency topics in Lebanon:

- Projects consuming energy (> 400 toe equivalent to 4,640 MWh or 2,500 KVA) have to obtain license from LCEC regarding their compliance with policies and measures for energy conservation and efficiency
- Mandatory audits for institutions consuming more than 400 toe (2,500 KVA)
- Mandatory certification for ESCO
- Mandatory audits for public buildings
- Incentives for green buildings
- Energy consumption labeling ordinance (appliances, electrical motors, lights…)
- Banning import of non-efficient appliances and equipment
- Incentives for importing efficient equipment
- Incentives on importing efficient low consuming vehicles

3.6.4. End-Use Measures in the Building Sector

The Summary of the activities relevant to Building Code in the NEEAP II were as follows:

- B01: Double Wall Ordinance
- B02: Testing Facility for Building Components
- B03: Building Code
- B04: Use of Efficient Equipment
- B05: Energy Performance Certificate for Buildings

- B06: Energy Audits for Public Buildings
- B07: Implementing Energy Efficiency Measures in Selected Public Buildings
- B08: Pilot Project: Exemplary Green Building (LCEC new premises)
- B09: Capacity Building for Refurbishment

3.7. The Energy Conservation Draft Law

An energy conservation law has been approved by the Council of Ministers and this law sets about some measures relative to the building sector.

The scope of application, which is Chapter 2 of the draft law, related to green and sustainable buildings, can be listed as the following:

- Energy efficiency requirements and programs for existing and new buildings
- Energy efficiency labels and requirements for energy-related products
- National plans and programs to promote energy efficiency.

Chapter 3 calls to attention the role of the Ministry of Energy and Water in setting the policies related to EE, reporting and evaluating the implementation, raising awareness in conserving energy and contributing in encouraging scientific researches in this field (Chapter 6).

Chapter 4 establishes the procedure towards conserving energy in buildings. It mandates the conservation of energy (minimum requirements) in new and existing buildings (article 10). The buildings that consume beyond the energy allowed, based on establishing an energy audit, need to request for a special permit (article 15).

As per Chapter 5, all materials and equipment for buildings have to be labeled as efficient according to international standards determined by LIBNOR; thus inefficient equipment and the materials not considered as green materials should be banned by the local government through their specific institutions.

Incentives are mentioned in Chapter 7 of this draft law, in addition to the fact that all the efficient equipment and green materials should be exempted from customs duties.

Violation and penalties in this matter are also determined in the draft law.

The law is a framework that needs to be followed by executive decrees for the technical, inspection and compliance aspects development.

4. The Environmental Legislation for Building Design and Construction

The subsequent paragraph summarizes the Lebanese Environmental Legislation relating to sustainable building design and construction protecting human health and the environment. It also emphasizes the role of the Ministry of Environment as a main actor in protecting the environment in general and particularly from the negative impact of the construction industry.

4.1. Tax Incentive for the Import of Equipment and Technologies that Protect the Environment

This incentive was provided for in **paragraph 1 of article 20 of the Environmental Code No 444 of 29.0.7. 2002**, in the form of a **50% reduction in customs taxes** on the import of such equipment and technologies, some of which could be domestic, and therefore meet the criteria of green building. However, the application of this article was conditioned by the promulgation by the Council of Ministers of a decree which sets the principles and conditions, on the proposal of the two ministers of the environment and public finances.
Thus, the application of this article remained in abeyance for 15 years, that is to say until the promulgation of the **Decree No 167 of 17.02.2017**, relating to "**the fixing of the details of application of the article 20 of the Environmental Code No 444 of 29. 0.7. 2002**".
As for the technologies and equipment protecting the environment, meeting the criteria of green building, and benefiting from the reduction of customs taxes, they are limited according to **paragraph 2 of article 7** of this decree of application, to **"Equipment intended to produce electricity using solar, wind, or hydraulic energy, or that resulting from the treatment of waste...".** Thus, the decree excludes all other equipment and materials required by green building, such as solar panels for water heaters, thermal insulation materials (double glazing, waterproofing, etc.), energy-saving household appliances. energy...
In reference to the reduction of customs taxes relating to the import of equipment and technologies provided in **paragraph 2 of article 7** of this decree, the reduction amounts to 50% for imports in the first five fiscal years following the enforcement of this decree, then it gradually decreases until it reaches 10% in the 9th fiscal year, as shown in Table 2.

Table 2: Rates of reduction of customs duties on the import of equipment and technologies that protect the environment, according to paragraph 1 of article 7 of decree No 167 of 17.02.2017, relating to " fixing the details of application of article 20 of the Environmental Code No 444 of 29. 0.7. 2002"

Fiscal years following the entry into force of Decree No. 167	Customs duty reduction rate (In %)
From 1st to 5th year	50
The 6th year	40
The 7th year	30
The 8th year	20
The 9th year	10

Source: Paragraph 1 of article 7 of decree No 167 of 17.02.2017

Indeed, the reduction of these customs taxes is intended to encourage the import of these equipment and technologies favorable to the protection of the environment. Reference to the customs taxes currently applied to the import of materials and domestic equipment favorable to the protection of the environment, they vary from zero to 5% (Table 3), except for HVAC where they are 20%, due to their high consumption of electricity produced using hydrocarbons. Similarly, while insulation materials imported from China are taxed at 5%, those from Saudi Arabia are not (Table 3), due to tax exemptions on trade between Arab countries.

Table 3: Customs taxes on the import of environmental protection equipment and materials in Lebanon, (2022)

Material/Equipment	Border taxes (%)
Solar Thermal Heater	5
PV generation system	0
Batteries	5
Wind generation system (home -scale)	0
Heating, Ventilation, and Air Conditioning (HVAC)	20
Heat Recovery System	0
Boilers	5
Control System	5
Water Efficient Fixtures	5

Efficient Lighting (all types of lighting)	5
Insulation material mostly imported from Saudi Arabia	0
Insulation material mostly imported from China	5
Eco-friendly furniture (recycled, recyclable,…)	Not available
Eco-friendly Paints and Coatings (wall and roof)	0 - 5
Domestic Electrical Appliances	5
Windows/Glazing	0

Source: Lebanese Customs (2022)

Moreover, it turns out that these customs taxes currently applied in Lebanon (Table 3), cover a whole range of environmental protection materials and equipment, which were not provided by article 7 of the Decree No 167 of 17.02.2017.

4.2. Tax Incentive for the Production in Lebanon of Equipment and Technologies that Protect the Environment

Production falls under what **Decree No 167 of 17.02.2017** calls **"Industrial Environmental Activities" (Article 1)**, "Any natural or legal person who carries out one of the industrial environmental activities, benefits from **a reduction in tax on the profits** it makes on these activities …" (**paragraph 1 of article 2** of this decree). This tax reduction is 50% on the profits made on these activities during the first five fiscal years following the enforcement of this decree, then it gradually decreases until reaching 10% in the 9th fiscal year, as shown in Table 4.

Table 4: Rates of reduction of tax on profits made on the production of equipment and technologies that protect the environment, according to paragraph 1 of article 2 of decree No 167 of 17.02.2017, relating to "the fixing of the details of application of article 20 of the Code of the environment No 444 of 29. 0.7. 2002"

Fiscal years following the entry into force of Decree No. 167	Income tax reduction rate (In %)
From 1st to 5th year	50
The 6th year	40
The 7th year	30

The 8th year	20
The 9th year	10

Source: Paragraph 1 of article 2 of decree No 167 of 17.02.2017

It should be noted that this digressiveness of the tax on profits, aims to **encourage investment in industrial activities of the environment**.

Similarly, as this **article 2 of decree No 167 of 17.02.2017**, aims to **encourage the national production of equipment favorable to the protection of the environment**, the prices of the latter should fall, which would be likely to facilitate the satisfaction of green building criteria.

However, it should be noted that in article 2 of this decree, the reduction of the tax on income or on profits, was indicated in English as being "Tax credit rate", which is an inappropriate translation , because the “Tax credit rate” consists in deducting from the tax on the income or on the profits of the investors, some of their expenses in the production of the equipment in question; which does not correspond to the reduction in tax on income or on profits which appears in article 2 of this decree, which does not mention or take into account any expenditure of this kind.

Although, the procedure of the application of the Article 20 was determined in the Decision 35/1-2021, from the submission of the relevant documents to the technical approval of the Ministry of Environment till the reduction in taxes approval of the Ministry of Finance, it is noteworthy that to date, no application has been submitted, due to a certain lack in the interpretation of the law and lack in awareness as per the interviewed representative of the Ministry of Environment.

4.3. The Role of the Ministry of Environment in the Construction Industry as per Legislations

The **Law 690/2005** has defined and organized the **role of the Ministry of Environment** in general. Particularly, as per the **Article 2**, “ The Ministry of Environment is tasked / in charge of all the affairs of the environment sector, and it undertakes and participates in setting the general policies, projects, plans, strategies, activities, studies, legislation, specifications and standards, setting indicators, and participating in all bodies, councils and committees in all matters related to and **ensuring the safety of the environment and the**

conservation and sustainability of natural resources...". Green and Sustainable Buildings directly impact the environment and the conservation of natural resources.

Moreover, the third part of **Article 6**defines the **Residential Environment Department** as an entity charged with "supervising the environmental conditions for licenses for the establishment and investment of rated institutions .... and everything related to the interrelation of the residential environment with the safety of the environment ...". This entity is represented in the committee that assesses the **Environmental Impact Examination and Assessment reports** required for big construction projects determined in the **Decree No 8633/2012**.

More specifically, this decree determines the principles of **Environmental Impact Assessment** (EIA), the projects that require a mandatory EIA report such as, but not limited to, hospitals, airports and ports (Chapter 3, Annex 1 of the decree 8633/2012), and the projects that require and Initial **Environmental Examination Assessment** (EEA) Report such as touristic projects (hotels, resorts…) and residential towers that exceeds 15 stories. For each of those big environmental impact projects when an EIA or EEA report must be submitted, the Minister of Environment must issue a decision to form a 3-member committee comprising the **Residential Environment Department** and the concerned authorities to evaluate the project's environmental impact study before issuing the required licenses. Also, the Ministry of Environment is represented by a delegate in the licensing committees in each governorate to ensure the successful licensing within the environmental conditions.

The measured GHG emissions concentrations from institution/facility or project (big-scale projects) as defined by the Decision 16-1/2022 should be compared according to the measurement conditions shown in the annexes of the decision according to the design of the pollution source. "…Emissions […] cannot contribute to an increase in the levels stipulated in the maximum levels of outdoor air pollutants by more than 25%....".

Although this decision is new, its application could be promising especially for the projects with private diesel generators.

IV. Existing Technical Instruments for Green Buildings in Lebanon: Rating Systems and Green Certifications

A green building provides healthy living and working conditions with lower environmental impacts than a standard building. The goal of a green building is to minimize pollution and health hazards, optimize resource use and maximize the proportion of recycled materials used in its construction and throughout its life. For that purpose, rating systems came into play.

Rating systems for assessing the environmental impact of buildings are **technical instruments that aim to evaluate the environmental impact of buildings and construction projects**. Rating systems can also cover urban-scale projects, community projects, and infrastructures. These schemes are designed to **assist project management in making the projects more sustainable by providing frameworks with precise criteria for assessing the various aspects of a building's environmental impact**. In Lebanon, several international rating systems are popular and in use, in addition to its own local ratings that it has adopted and is in the process of advancing. The below is a **comprehensive listing of existing certifications in use in Lebanon**, and how **they compare to each other** in all aspects, from **schematic of rating, scoring, weighting, certifications, methodology of achieving certifications, and new certificates in progress.**

1. Comparative Study of International and Local Green Certificates Mostly Used in Lebanon

1.1. International Green Labels

1.1.1. Leadership in Energy and Environmental Design (LEED) V4.1

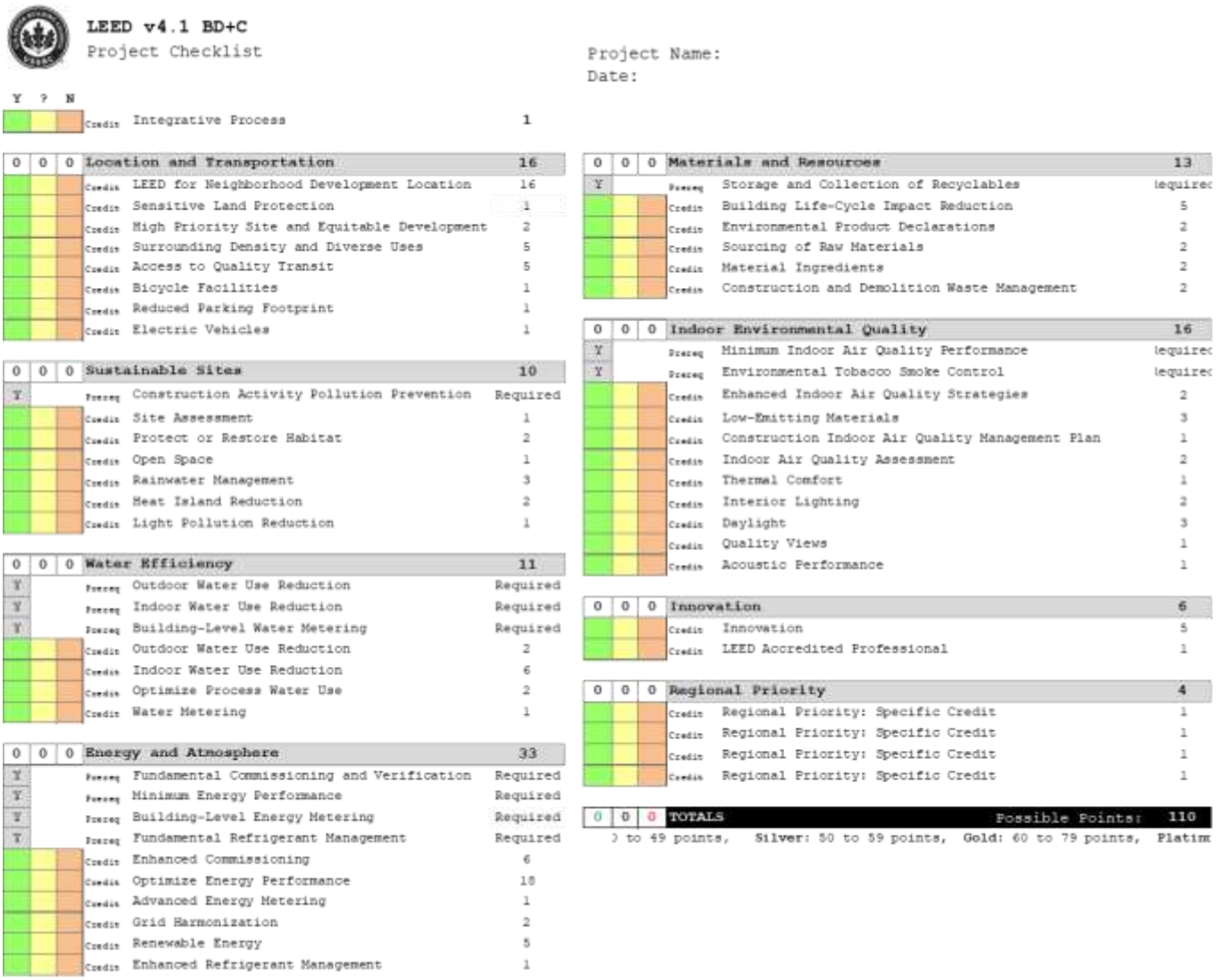
LEED (Leadership in Energy and Environmental Design) is the most widely used green building rating system worldwide. LEED certification is a globally recognized. The label was developed by USGBC, a nonprofit organization with a focus on sustainability of buildings and real estate, in the United States in 1991. To achieve LEED certification, a project earns points by adhering to prerequisites and credits that address carbon, energy, water, waste, transportation, materials, health and indoor environmental quality. Projects go through a verification and review process by GBCI and are awarded credit points that correspond to a level of LEED certification: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (80+ points) with a total number of points of 110. The LEED® rating system has eight credit categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Material and Resources, Innovation in Design Process and Regional Priority.

LEED is for all building types and all building phases including new construction, interior fit outs, operations and maintenance and core and shell. Project teams can use LEED v4 checklists to track their project goals and progress. An example of a scorecard checklist is provided in figure 1.

LEED certification involves four main steps:

- Registering the project by completing key forms and submitting payment.
- Applying for LEED certification by submitting the completed certification application through LEED Online and paying a certification review fee.
- Reviewing: of the LEED application by GBCI
- Certifying.

A project will need to enter data at least annually to keep their certification active, but recertification will be valid for three years. Every three years, projects will submit their data for review to renew certification and document ongoing achievements.



LEED v4.1 BD+C
Project Checklist

Project Name:
Date:

Y	?	N			
			Credit	Integrative Process	1

Y	?	N			
0	0	0	**Location and Transportation**		16
			Credit	LEED for Neighborhood Development Location	16
			Credit	Sensitive Land Protection	1
			Credit	High Priority Site and Equitable Development	2
			Credit	Surrounding Density and Diverse Uses	5
			Credit	Access to Quality Transit	5
			Credit	Bicycle Facilities	1
			Credit	Reduced Parking Footprint	1
			Credit	Electric Vehicles	1
0	0	0	**Sustainable Sites**		10
Y			Prereq	Construction Activity Pollution Prevention	Required
			Credit	Site Assessment	1
			Credit	Protect or Restore Habitat	2
			Credit	Open Space	1
			Credit	Rainwater Management	3
			Credit	Heat Island Reduction	2
			Credit	Light Pollution Reduction	1
0	0	0	**Water Efficiency**		11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
			Credit	Outdoor Water Use Reduction	2
			Credit	Indoor Water Use Reduction	6
			Credit	Optimize Process Water Use	2
			Credit	Water Metering	1
0	0	0	**Energy and Atmosphere**		33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
			Credit	Enhanced Commissioning	6
			Credit	Optimize Energy Performance	18
			Credit	Advanced Energy Metering	1
			Credit	Grid Harmonization	2
			Credit	Renewable Energy	5
			Credit	Enhanced Refrigerant Management	1
0	0	0	**Materials and Resources**		13
Y			Prereq	Storage and Collection of Recyclables	Required
			Credit	Building Life-Cycle Impact Reduction	5
			Credit	Environmental Product Declarations	2
			Credit	Sourcing of Raw Materials	2
			Credit	Material Ingredients	2
			Credit	Construction and Demolition Waste Management	2
0	0	0	**Indoor Environmental Quality**		16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
			Credit	Enhanced Indoor Air Quality Strategies	2
			Credit	Low-Emitting Materials	3
			Credit	Construction Indoor Air Quality Management Plan	1
			Credit	Indoor Air Quality Assessment	2
			Credit	Thermal Comfort	1
			Credit	Interior Lighting	2
			Credit	Daylight	3
			Credit	Quality Views	1
			Credit	Acoustic Performance	1
0	0	0	**Innovation**		6
			Credit	Innovation	5
			Credit	LEED Accredited Professional	1
0	0	0	**Regional Priority**		4
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
0	0	0	**TOTALS**	Possible Points:	110

) to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum**

Figure 1: LEED scorecard checklist sample

1.1.2. BREEAM (Building Research Establishment's Environmental Assessment Method)

BREEAM is an international standard that is locally adapted, operated and applied through a network of international operators, assessors and industry professionals. BRE Global Limited is the National Scheme Operator of BREEAM in the UK. Through its application and use BREEAM helps clients measure and reduce the environmental impacts

of their buildings and in doing so create higher value, lower risk assets. To date, BREEAM has been used to certify over 530,000 building assessments across the building life cycle and is being applied in over 70 countries. BREEAM Schemes for the UK and internationally, each designed to assess the environmental performance of developments at various stages in the life cycle, and these include:

- BREEAM Infrastructure for new infrastructure projects
- BREEAM Communities for developments at the neighborhood scale or larger
- BREEAM New Construction for new-build domestic (international only) and non-domestic buildings
- Home Quality Mark for new-build domestic buildings (UK only)
- BREEAM In-Use for existing non-domestic buildings in-use
- BREEAM Refurbishment for domestic (UK only) and non-domestic building fit-outs and refurbishments.

There are a number of elements that determine the **overall performance of a project assessed** using BREEAM; these are as follows:

- The scope of the assessment
- The BREEAM rating level benchmarks
- The minimum BREEAM standards
- The environmental section weightings
- The BREEAM assessment issues and credits
- How these elements combine to produce a BREEAM rating for a project is summarized on the following pages. This is followed by a description and example describing the methodology for calculating a rating.

The BREEAM rating benchmarks for projects assessed using the BREEAM International New Construction 2016 scheme are as follows

BREEAM Rating	% score
OUTSTANDING	≥ 85
EXCELLENT	≥ 70
VERY GOOD	≥ 55
GOOD	≥ 45
PASS	≥ 30
UNCLASSIFIED	< 30

Environmental weightings are fundamental to any building environmental assessment method as they provide a means of defining, and therefore ranking, the relative impact of environmental issues. BREEAM has developed a new, independently peer reviewed,

weightings methodology. In order to provide weightings that are adapted for local conditions, the weightings are reviewed for the first project that registers for assessment in a country or region. The culture, economy, climate and work practices can also affect the development of criteria and the method of assessing certain BREEAM issues. Climatic zones are determined under BREEAM and weighting according to local conditions will apply.
BREEAM Scorecard comprises 10 assessment categories (management, health & wellbeing, energy, transport, water, materials, waste, land use & ecology, pollution and innovation) and credits are awarded in these categories based on the performance of the building assessed. BREEAM International New Construction 2016 consists of 57 individual assessment issues spanning the nine environmental categories, plus a tenth category called 'Innovation'. Each issue addresses a specific building related environmental impact or issue and has a number of credits assigned to it.
The process of determining a BREEAM rating is outlined below and an example calculation included in table below:

- Firstly, the scope of the project being assessed needs to be determined, i.e., Shell Only or Shell and Core. The appropriate BREEAM assessment tool or calculator then adjusts the scoring and weightings to reflect the categories and individual credits assessed.
- The BREEAM Assessor will then determine for each of BREEAM's nine environmental sections (as applicable) the number of 'credits' awarded. This must be determined by the BREEAM Assessor in accordance with the criteria of each assessment issue (as detailed in the technical sections of this document).
- The percentage of 'credits' achieved is then calculated for each section.
- The percentage of 'credits' achieved in each section is then multiplied by the corresponding section weighting. This gives the overall environmental section score.
- The section scores are then added together to give the overall BREEAM score.
- The overall score is then compared to the BREEAM rating benchmark levels and, provided all minimum standards have been met, the relevant BREEAM rating is achieved.
- An additional 1% can be added to the final BREEAM score for each 'innovation credit' achieved (up to a maximum of 10% and with the total BREEAM score capped at 100%).

BREEAM certification involves five main stages:

Stage 1: Decide which BREEAM scheme applies
Stage 2: Contact a licensed BREEAM Assessor or BREEAM In-Use Auditor
Stage 3: Carry out a pre-assessment
Stage 4: Register for an assessment

Stage 5: Get certified

Table 5: BREEAM Score

BREEAM section	Credits achieved	Credits available	% Of Credits achieved	Section weighting (fully fitted)	Section score
Management	10	20	50.00%	0.12	6.00%
Health and wellbeing	17	21	80.95%	0.14	11.33%
Hazards	1	1	100.00%	0.01	1.00%
Energy	16	34	47.05%	0.19	8.94%
Transport	5	11	45.45%	0.08	3.63%
Water	5	9	55.56%	0.06	3.33%
Materials	10	14	71.43%	0.125	8.92%
Waste	3	13	23.07%	0.075	1.73%
Land use and ecology	5	5	100.00%	0.1	10.00%
Pollution	9	12	75.00%	0.1	7.44%
Innovation	2	10	20.00%	0.1	2.00%
Final BREEAM score					64.32%

1.1.3. HQE (Haute Qualité Environnementale)

The **HQE®** is a process that is based on performance benchmarks drawn up by the "Centre Scientifique et Technique du Bâtiment" (CSTB) created in 1947 in France. HQE® is an "approach", it can lead to a certification that approves the consideration of environmental issues in the construction of a building. This approach is divided into 14 targets (mentioned below) distributed in 4 themes (eco-construction, eco-management, comfort and health) and theme encompasses a number of sub-themes, bringing the number of treated themes up to 52.

To “have an environmental approach”, a project must perform all the **14 targets** on a “basic level”. Moreover, to get the HQE Certification, the project must work harder on some targets: 7 targets must be handled on a basic level, 4 on a performing level and 3 on a high-performance level.
To assess the level of performance on each target the certification relies on a system of points. To get the certification, the architect must produce certain documents justifying the work done on each target. The reference base being very technical, hardly readable, the architects often hire an engineering subcontractor to manage the certification.
HQE™ certification covers the entire lifecycle of a building (construction, renovation and operation): non-residential buildings, residential buildings and detached houses as well as urban planning and development. The overall performance levels of certified buildings in the fields of energy, environment, health and comfort by applying a star ranking. The performance ranges from Good (between 1 and 4), Very Good, (between 5 and 8), Excellent (between 9 and 11) to Exceptional (above 12)

14 targets divided into 4 themes assessed with up to 4 stars:

- Site
- Components
- Worksite
- Energy
- Water
- Waste
- Maintenance
- Hydrothermal comfort
- Acoustic comfort
- Visual comfort
- Olfactory comfort
- Spaces quality
- Air quality
- Water quality

The process to obtain the certification includes three major steps:

1. Registration: Submission of certification application files incl. document review and transmission and acceptance of the registration;
2. Pre project phase (optional)
3. Audit of the standard requirements by an independent expert; design phase, review of project design documents, including SMO (Operational Management System), plans, etc…
4. Construction Phase, verification on site of Construction activities

The official announcement of certification level including transmission of certificate will be issued after the above audit.
In Lebanon, HQE™ certification is operated by **IRI (Industrial Research Institute)**, the official and exclusive certification partner of CERWAY in the Middle East region. **CEDRE** (Construction Ecologique et Durabilite Reglementaire Environmentale), adopted by IRI, is

based on HQE and uses the same methods of auditing and certifications as well as maintaining the same 14 targets.

1.1.4. EDGE

EDGE, issued by International Finance Corporation (IFC), is a green building certification system focused on making new residential and commercial buildings more resource-efficient. EDGE is comprised of a web-based software application, a universal standard and a certification system. GBCI administers EDGE certification in nearly 120 countries around the world.

The **EDGE software application is free at edgebuildings.com**. Based on a building's parameters, the EDGE software discovers energy- and money-saving design opportunities through region-specific and use-based analysis. As a free design tool, EDGE presents hypothetical costs, savings and payback periods for green building measures, helping developers and buildings make the business case for green building. EDGE is a green building certification system that allows design teams and project owners to assess the most cost-effective ways to incorporate energy and water saving options into homes, hotels, hospitals, offices and retail spaces. The EDGE certification process is a simple system that has only three categories to meet requirements for: energy, water, and materials.

Projects that achieve a 20 percent projected reduction in use of energy, water and embodied energy in materials compared to conventional buildings are eligible for EDGE certification. Certification is offered at a modest cost by GBCI (Green Business Certification Inc.) in order to validate project achievement for financial and community stakeholders. Levels of edge certification are 3:

- LEVEL 1: EDGE Certified: Requirements are 20% or more savings in energy, water and embodied energy in materials.
- LEVEL 2: EDGE Advanced: Requirements are EDGE certified with 40% or more on-site energy savings.
- LEVEL 3: Zero Carbon: Requirements are EDGE Advanced with 100% renewables on-site or off-site, or purchased carbon offsets to top off at 100%. All energy must be accounted for, including diesel and LPG.

To achieve the EDGE certification, the following six steps are required:

- Create project in the EDGE App
- Register project with GBCI, and pay the registration fees
- Select an EDGE Auditor

- Apply: Submit application and pay certification fees
- Review: EDGE project is reviewed by EDGE Auditor and GBCI
    - Part 1: Design Audit
    - Part 2: Site Audit
    - Appeal Review (optional, appeal fees apply)
    - Submitting an Inquiry
    - Certification Timelines and Deadlines
    - Mixed-Use and Multiple Buildings
- Certify: Receive Preliminary Certificate or EDGE Certification

1.2. Local Green Certificates

1.2.1. ARZ 1.0

The **ARZ Building Rating System (BRS)** founded by **LGBC (The Lebanon Green Building Council)** in 2011, in partnership with IFC, was created with the target of being recognized as an international standard while accounting for the specific context of Lebanon's climate, environment, and building techniques. ARZ BRS is designed to measure the extent to which existing commercial buildings in Lebanon are healthy, comfortable places for working and doing business, consuming the right amount of energy and water, while having a low impact upon the natural environment.

The ARZ BRS system includes a list of technologies, techniques, procedures and energy consumption levels that LGBC expects to see in green buildings. An assessor accredited by LGBC will take an inventory of the energy and water consumption, technologies, techniques and procedures that are used in the building and then LGBC will score the building according to how well the inventory matches the list of technologies, techniques and procedures that make up the ARZ BRS requirements. The results of an assessment are a certificate issued by LGBC that details the level achieved, an accompanying report with recommendations on how the rating level could be improved and a plaque to be erected on the building premises.
ARZ BRS certification levels are, non-certified (<80 pts) Certified (80 pts), Bronze (100pts), Silver (120pts) and Gold (150pts). The ARZ BRS is made up of nine modules that are separately scored with energy use at its core. The results are weighted according to how significant the module's maximum impact upon the environment could be.

There are **nine modules to the ARZ BRS**: eight core modules (Energy Performance, Thermal Energy, Electrical Energy, Building Envelope, Materials, Indoor Environmental Quality,

Operations and Management, Water Conservation), and one bonus module, each weighted according to the Lebanese context. A building can achieve 150 points from the eight core modules and a further 16 points from bonus.

The methodology to achieve ARZ 1.0: with a 5-year renewal period and 1.5-year re-assessment period

- Registration (3 months max)
- Select assessor
- Agreement (3 months max)
- Assessment (1-month max)
- Report
- Certification issued by LGBC (1-month max)

1.2.2. ARZ 2.0

Over the course of the first years of launching the ARZ 1.0 GBRS, many challenges presented themselves and lead to the unsuccessful launch of the system.
The LGBC, under the present EU–funded UNDP–CEDRO V project, investigated closely the challenges faced and disseminated hereafter a detailed lessons-learnt report pinpointing areas of possible mitigation measures and some recommendations to ensure the success and viability of the newly developed ARZ 2.0 GBRS.
ARZ 2.0 GBRS will be addressing many of the shortcomings of its predecessor. First of all, ARZ 2.0 will cover all building types, new constructions and existing ones, residential, commercial (tertiary).
ARZ 2.0 web portal will be a public domain, easily accessible by a large part of the community. It will also serve as a tool to raise people's awareness especially that its guideline will be available in both languages: English and Arabic. Assessment result will be free of charge when performed electronically; it will be at a minor fee when LGBC review is requested. The LGBC will announce this fee during Year 3 of this project after carrying the necessary related market studies.
ARZ 2.0 GBRS doesn't follow a credit system like most of the existing rating systems. Buildings are rated according to a set of criteria related to their sector and status. For each 'building sector / building status combination', referred in ARZ 2.0 as 'application':

- A criterion will earn a score from 0% to 100% inclusive.
- Each criterion has a weight within the module.
- The module score will have a value from 0% to 100% inclusive.

- Each module has a weight depending on the 'application'.
- The building score will have a value from 0% to 100% inclusive.
- When the modules' scores are close to each other, i.e., the maximum scores' difference is less than 20%, the building rating is defined as per the table below.
- When the modules' scores are not close to each other, i.e., the maximum scores' difference is greater than 20%, the building score will be replaced by the minimum module score + 20%, then the building rating is defined as below.

Building score	**Building rating**
00 to 49	Uncertified
50 to 59	Certified
60 to 69	Bronze
70 to 79	Silver
80 to 89	Gold
90 to 100	Platinum

The set of criteria used for scoring are: **Site, Material, Water, Wellness, Energy**. Each criterion encompasses several related sub indicators.
For each data entry in any criterion, there is a functionality in the platform that allows the user to instantaneously compute the criterion score, the module score, the building score and the building rating corresponding to the bulk of data entered so far.
These outputs are dynamically re-computed as long as data is entered. one doesn't have to wait until the end of data entry in order to discover the scores and rating. The ARZ 2.0 features a dynamic functionality that recommends improvements for the facilities to earn the maximum return on the different score levels (i.e., criterion / module / building).

1.2.3. GRASS (Green Recovery and Sustainable Solutions)

"GRASS" is a new rating system that covers the main features of Green Buildings Standards that are suitable for Mediterranean Climate, Environment and Lifestyles, by **ALMEE (Lebanese Association for Energy Saving and for Environment)**. It is a new approach of rating system for New Designed and Existing Commercial & Residential Buildings in Mediterranean region. Its intent is to mitigate negative impacts of buildings on the

environment including CO2 emissions, heat island effect, intensive energy consumptions, water consumption, etc.

"GRASS" consists of **four major indicators or credit categories (Envelope, Green Sites, Energy System Design and Equipment, Water Management and Indoor Environment)** and **20 sub-indicators**.

To earn "GRASS" for **New Designed or Existing Building certification**, the project must satisfy all of the prerequisites and a minimum number of points based on its compliance with the requirements of each credit.

Using the checklist of **Commercial or Residential Building Assessment**, a certified assessor must go through all the credits of the four indicators mentioned above to calculate and submit the final scoring points out of 500. Then, the total points are divided by 500 in order to calculate the score out of 100. Based on this percentage, the level attained is determined.

Percentage = (Awarded Points/500) x100

The weights of each indicator out 500 and in percentage are the following:

Indicator	Percentage %	Score out of 500
Envelope	39 %	191
Green Sites	14 %	72 (Commercial) 57 (Residential)
Energy System Design and Equipment	35 %	177 (Commercial) 183 (Residential)
Water Management and Indoor Environment	12%	60 (Commercial) 69 (Residential)

Represented below are the level of certification with respect to percentage of awarded points:

Level	Percentage	Certificate
Level 1	≥ 80.1%	Emerald
Level 2	70.1% - 80%	Matis
Level 3	60.1% - 70%	Jade
Level 4	50% - 60%	Laurel

Steps needed to certify a project according to the GRASS building rating system:

- Registration
- Agreement
- Assessment
- Report (by assessor to ALMEE)
- Certification (by ALMEE)

2. Comparative Table of International and Local Green Labels Mostly Used in Lebanon

In order to have a more comprehensible view of the certificates mentioned above, Table. 6 summarizes aspects of international and local certificates (LEED, BREEAM, HQE, EDGE, ARZ 1, ARZ 2, GRASS). It comprises: comparing categories, how they are weighted, each label's rating levels, life cycle phases and types of buildings rated by each label.

Table 6: Summary and Comparative Analysis of the Main Features of Selected Rating Systems

Categories	BREEAM	LEED	HQE	EDGE	ARZ 1.0	ARZ 2.0	GRASS
Management (and Operations)	✓	✓	Included as a target in theme (Environment)	✗	✓	Included in each of the assessment criteria	✗
Building Envelope	✗	✗	✗	✗	✓	Included in the assessment criteria (Energy)	✓
Energy	✓	✓	✓	✓	included under two categories Energy Performance and Electrical Energy	✓	✓
Location and Transport	✓	✓	Included as worksite targets in theme (Environment)	✗	Included in the assessment criteria (Operations and Managements)	✓	Included in the assessment criteria (Energy)
Sustainable Sites (or Land use and Ecology)	✓	✓	Included as a site and worksite targets in theme (Environment)	✗	Included in the assessment criteria (BONUS)	✓	✓
Indoor Environmental Quality (or Health and Wellbeing)	✓	✓	✓	✗	✓	✓	✓
Heating, Ventilating, Air Conditioning and Refrigeration	Included in the assessment criteria (Health and Wellbeing)	Included in the assessment criteria (Energy and Atmosphere)	Included as a site and worksite targets in theme (Health)	✗	✓	Included in the assessment criteria (Energy)	
Water efficiency	✓	✓	Included as a Water and Water quality targets in theme (Environment and Health)	✓	✓	✓	✓
Material and Resources	✓	✓	Included as a components target in theme (Environment)	✓	✓	✓	
Pollution	✓	Included in the assessment criteria (Material and Resources and Indoor Environmental Quality)	✗	✗	✗	Included in the assessment criteria (site)	✗
Waste	✓	Included in the assessment criteria (Material and Resources)	Included as a target in theme (Environment)		Included as Solid waste management in the assessment criteria (Operations and Managements)	Included in the assessment criteria (Materials)	✗
Innovation (bonus)	✓	✓	✗	✗	✓	Included in each of the assessment criteria	✓

Categories	BREEAM	LEED	HQE	EDGE	ARZ 1.0	ARZ 2.0	GRASS
Weighting System	Applied to each category	All credits are equally weighted, but the number of credits related to each issue is different	✗	✗	Applied to each category	Applied to each category	Applied to each category
Rating Levels	Unclassified Pass Good Very Good Excellent Outstanding	Certified Silver Gold Platinum	Pass Good Very Good Excellent Exceptional	EDGE certified EDGE Advanced ZERO Carbon	Uncertified Certified Bronze Silver Gold	Uncertified Certified Bronze Silver Gold Platinum	Laurel Jade Matis Emerald
Life Cycle Phase							
Pre-Design and Design	✓	✗	✓	✓	✓	✓	
Construction	✓	✓	✓	✓	✓	✓	✓
Post-Construction	✓	✓	✓	✓	✓	✓	✓
Use/Maintenance	✓	✓	✓	✗	✓	✓	✓
Building Types Certified							
New Residential	✓	✓	✓	✓	✗	✓	✓
New Commercial	✓	✓	✓	✓	✗	✓	✓
New Tertiary	✓	✓ (Not Including Industrial Bldgs.)	✓	✓	✗	✓	✓
Existing Residential, Commercial and Tertiary	✓	✓ (Not Including Industrial Bldgs.)	✓	✗	✓ (Not Including Residential Bldgs.)	✓	✓

V. Existing Technical Instruments for Green Buildings in Lebanon: Standards, Norms, and Tools

A standard is a set of guidelines and criteria against which a product can be judged. Standards are usually issued for compliance and quality reasons. Common standards related to building practices are created through consensus processes by many Lebanese actors based on international practices adapted for the Lebanese context, and approved by a recognized body that provides for common and repeated use as rules, guidelines, or characteristics for activities or their results.

In Lebanon, standards are discussed and prepared by the technical committees formed by LIBNOR. These committees include representatives from both public and private sectors, including Ministries, Public Administrations, Laboratories, Universities, Syndicates, Chambers of Commerce Industry and Agriculture, Associations, NGOs and others. Based on the context of the proposed standard, a Technical Committee (TC) is established, which includes representative from the previously mentioned sectors. The TC conducts a background check on the proposal and searches for existing international standards for adoption (such as ISO, IEC, EN), or drafts the Lebanese Standards from scratch. Within the TC meetings, the draft is agreed upon and finalized. Lebanese national standards are voluntary in principle; however, after a voluntary period and upon a suggestion from one of the involved stakeholders and approval by LIBNOR's Board of Directors, a standard may be granted the mandatory status by a decree from the Council of ministers.

In this section, the available technical instruments that could contribute to the Green Building Industry are presented.

1. The Thermal Standard for Buildings in Lebanon (TSBL 2005)

The **Thermal Standard for Buildings in Lebanon (TSBL 2005)** has been developed in the context of Project **"Capacity Building for the adoption and application of Thermal Standards for Buildings".** The project was funded by the Global Environment Facility,

managed by the United Nations Development Program, and executed under the Lebanese General Directorate of Urban Planning, Ministry of Public Works and Transport. The project falls under the Climate Change focal area and aims at the establishment of Thermal Standards for Buildings, and at enabling their adoption and application through the provision of capacity building and information dissemination. It should be noted that the word standard in the TSBL 2005 does not reflect the conventional definition of a standard and is not linked to standards developed by LIBNOR. TSBL 2005 is a report including a set of recommendations for those willing to develop energy efficient buildings.

2. The Thermal Building Standard for Lebanon (Booklet and Tool 2010)

The Thermal Building Standard for Lebanon Standard (Booklet and Tool)- for new residential and non-residential buildings - was developed in 2010 by the **Order of Engineers and Architects of Beirut, LIBNOR and ECOTECH Engineering** with the support of the French Agency for Environment and Energy Saving, **ADEME** and the Lebanese Association for Energy Saving and for Environment, **ALMEE** and with the contribution of Lebanon Green Building Council **LGBC** and the **ASHRAE.** It specifies minimum energy criteria to be met. This standard aimed to improve the thermal performance of building envelopes which in turn reflects on an improvement in the thermal comfort conditions within the buildings and consequently on the reduction of the energy needed for space heating and cooling. A software (Tool TBSL) was also developed for the application of this standard. This standard remains not mandatory to date but it is encouraged by the Orders of Engineers and Architects.

3. Criteria for Green Buildings in Lebanon (2017)

The Criteria for Green Buildings in Lebanon was developed in 2017 by the **OEA, ASHRAE (Lebanese chapter), ECO-Consulting, LGBC and APAVE (Committee dedicated since 2014 to develop it).** It constitutes reference standards and codes that are applicable for all projects in Lebanon, that would promote environment-friendly sustainable planning and design.

4. Energy Efficiency Standards

LIBNOR adopted **voluntary energy efficiency standards for five household appliances: solar water heaters (SWH), compact fluorescent lamps (CFL), refrigerators, A/C split units and electric and gas water heaters.** In decree 5305, passed on October 28, 2010, Lebanon's Council of Ministers (CoM) made the standards mandatory for solar water heaters (SWH) and compact fluorescent lamps (CFL).

5. Lebanese Energy Efficient HVAC Equipment Standard (2011)

The purpose of this voluntary standard is to provide minimum requirements for the selection of building air - conditioning equipment and appliances to contribute to the energy - efficient performance of building systems.

This standard is intended to:

- balance environmental responsibility, resource efficiency, occupant comfort, and community sensitivity, and
- respond to current market conditions and encourage a shift in the market towards higher energy - efficient equipment

6. Guidelines on Preparing Technical Proposals for non-certified High Energy Performance Buildings

A technical guideline was developed by LCEC in 2016, "Guidelines on Preparing technical proposals for non-certified high energy performance buildings", and aimed to facilitate the submittal of projects tackling energy efficiency in the building sector for those willing to benefit from the financing mechanism in place (NEEREA). However, the economic and monetary collapse of the banking sector has stopped the financing mechanisms in Lebanon.

7. Building Environmental Performance- Principles, Requirements and Guidelines

A technical committee was created at LIBNOR to develop a standard that tackles sustainable buildings. The standard is under preparation and it will be entitled: **A "Building Environmental Performance- Principles, Requirements and Guidelines".** This standard was intended to be published as a voluntary standard then can be transformed to a mandatory one if any of the Lebanese stakeholders' request this. The technical committee TC205 at LIBNOR has been preparing this new building code which will include 5 sections: Energy, Indoor Environmental Quality (IEQ), Water, Waste and Site. TC205 includes stakeholders from both public and private sectors that were divided into 5 working groups relative to the proposed sections. The committee has already prepared the Energy and IEQ sections and the final draft was scheduled to be shared with the committee for commenting. The Energy section of this new building code includes two parts: envelop and equipment. The Energy Working Group has adopted a prescriptive approach for both parts. The Energy section will be shared with the Navigant team. Unfortunately, the pandemic and the crisis that the country faced till date have prevented further development of this code as per the stakeholders.

8. Minimum Energy Performance Standards (MEPS)

MEPS were included as a main initiative to be implemented in the first National Energy Efficiency Action Plan (NEEAP 2011-2015) and the second one (2016-2020). This measure tackles the proposal of a list of MEPS for equipment and tools that consume energy. Minimum Energy Performance Standards or MEPS determine the minimum energy efficiency that products shall meet, in order to be sold in the market. MEPS tend to protect the consumers from products that have low energy performance. MEPS can be applied to most technologies. However, it should only be applied when there is certainty that alternatives are available, and these alternatives are affordable to the consumers. MEPS should be introduced for refrigerators, cooling, heating and water heating equipment, televisions, lights and electrical motors. The first step would be to start with an Energy

Consumption Labeling Ordinance that would open the way to implement MEPS in Lebanon. It requires manufacturers to decrease the energy consumption of their products by establishing MEPS, therefore "pushing" the market away from the worst performing product.

A "GUIDANCE FOR INTEGRATING EFFICIENT COOLING IN NATIONAL POLICIES IN LEBANON-2020: Proposed roadmap" was published in 2021 by UNDP and the MoE. In order to achieve the emissions' reduction goal, the National Cooling Plan recommends the implementation of a mandatory MEPS and labels regulation and shows the required adoption steps. Recommendations were provided for the MEPS and labels for refrigerators and ACs. The adoption of advanced energy efficiency standards and a transition to low GWP refrigerants are required to realize GHG savings. The adoption of increasingly ambitious MEPS and labels will not lead to higher costs for the end-users. Instead, with current electricity prices life-cycle-costs (LCC) for end-users will stay about the same; and with the expected higher electricity prices in the future, that LCC will even be lower for end-users and the economy. This "National Cooling Plan" (NCP), recommended the following elements towards the introduction of the MEPS and Labels regulation:

- Establishment of the Minimum Energy Performance Standards,
- Establishment of the Labelling System,
- Development of Testing Procedures.

MEPS has not been yet adopted in the country.

9. Building Energy Performance Tool

The Building Energy Performance is a tool recently developed within the project BUILD_ME: Towards a Low-Carbon Building Sector in the MENA Region - Phase I (2016-2018) Phase II (2019-2021) by the International Climate Initiative (IKI) - Guidehouse (Navigant) in collaboration with LCEC. It focuses on reviewing the energy performance of Lebanese building sector and proposing a concept for a voluntary energy efficiency classification scheme.

10. Codes and Standards by LIBNOR for the Sustainable Buildings - Construction and Materials

The Lebanese Standards Institution LIBNOR prepared of a number of codes and standards such as standards of Building Construction, Refrigeration and Air Conditioning; Machinery, Solar Energy, Building Environment Design, Thermal Insulation and Home appliances. Most of those standards are not mandatory by law, they rather offer guidance for developers, investors and engineers who are intended to construct energy efficient buildings.

Table 7: The Lebanese Voluntary Standards and norms adopted by LIBNOR relevant to sustainable building (Construction Materials and Building Sector)

Standards/Norms	Document Number	Description
Sustainability in building construction - General principles	NL ISO 15392 : 2011	This International Standard identifies and establishes general principles for sustainability in building construction. It applies to the life cycle of buildings and other construction works, from their inception to the end of life.
Sustainability in building construction - Framework for methods of assessment of the environmental performance of construction works - Part 1: Buildings	NL ISO 21931 1 : 2016	It provides a general framework for improving the quality and comparability of methods for assessing the environmental performance of buildings. It identifies and describes issues to be taken into account when using methods for the assessment of environmental performance for new or existing building properties in the design, construction, operation, refurbishment and deconstruction stages.
Sustainability in building construction - Sustainability indicators - Part 1: Framework for the development of	NL ISO 21929 1 : 2016	It establishes a core set of indicators to take into account in the use and development of sustainability indicators for assessing the sustainability performance of new or existing buildings, related to their design, construction,

indicators and a core set of indicators for buildings		operation, maintenance, refurbishment and end of life.
Sustainability in building construction- Sustainability indicators - Part 2 : Framework for the development of indicators for civil engineering works	NL ISO TS 21929 2 : 2018	It establishes a list of aspects and impacts which should be taken as the basis for the development of sustainability indicators for assessing the sustainability performance of new or existing civil engineering works, related to their design, construction, operation, maintenance, refurbishment and end-of-life.
Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling)	NL ISO 14021 : 2018	It specifies requirements for self-declared environmental claims, including statements, symbols and graphics, regarding products. It further describes selected terms commonly used in environmental claims and gives qualifications for their use.
Environmental management -- Environmental performance evaluation – Guidelines	NL ISO 14031 : 2016	It gives guidance on the design and use of environmental performance evaluation (EPE) within an organization
Environmental management- Life cycle assessment - Examples of application of ISO 14041 to goal and scope definition and inventory analysis	NL ISO TR 14049	This Technical Specification provides the requirements and a structure for a data documentation format, to be used for transparent and unambiguous documentation and exchange of Life Cycle Assessment (LCA) and Life Cycle Inventory (LCI) data, thus permitting consistent documentation of data, reporting of data collection, data calculation and data quality, by specifying and structuring relevant information.
Environmental management - Life cycle assessment - Illustrative examples on how to apply ISO	NL ISO TR 14047 : 2016	It provides examples to illustrate current practice of life cycle impact assessment according to ISO 14044:2006.

14044 to impact assessment situations		
Environmental management - Life cycle assessment - Data documentation format	NL ISO TS 14048 : 2011	It provides the requirements and a structure for a data documentation format, to be used for transparent and unambiguous documentation and exchange of Life Cycle Assessment (LCA) and Life Cycle Inventory (LCI) data, thus permitting consistent documentation of data, reporting of data collection, data calculation and data quality, by specifying and structuring relevant information
Environmental management - Life cycle assessment - Principles and framework	NL ISO 14040 : 2011	It describes the principles and framework for life cycle assessment (LCA)
Environmental management - Life cycle assessment - Requirements and guidelines	NL ISO 14044 : 2011	It specifies requirements and provides guidelines for life cycle assessment (LCA)
Guide for addressing environmental issues in product standards	NL ISO GUIDE 64 : 2011	It provides guidance on addressing environmental issues in product standards
Environmental labels and declarations - General principles	NL ISO 14020 : 2011	It establishes guiding principles for the development and use of environmental labels and declarations
Environmental labels and declarations - Type I environmental labelling - Principles and procedures	NL ISO 14024 : 2011	It establishes the principles and specifies the procedures for developing Type III environmental declaration programs and Type III environmental declarations
Sustainability in building construction - Environmental declaration of building products	NL ISO 21930 : 2011	It provides the principles and requirements for type III environmental declarations (EPD) of building products.

Environmental management – Vocabulary	NL ISO 14050 : 2011	It contains definitions of fundamental concepts related to environmental management, published in the ISO 14000 series of International Standards
Environmental management - Integrating environmental aspects into product design and development	NL ISO TR 14062 : 2011	It describes current concepts and practices relating to the integration of environmental aspects into product design and development (the term "product" encompassing both material goods and services).
Environmental management - Environmental communication - Guidelines and examples	NL ISO 14063 : 2011	It gives guidance to an organization on general principles, policy, strategy and activities relating to both internal and external environmental communication.
Greenhouse gases - Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition	NL ISO 14065 : 2016	It specifies principles and requirements for bodies that undertake validation or verification of greenhouse gas (GHG) assertions
Greenhouse gases - Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements	NL ISO 14064 2 : 2011	It specifies principles and requirements and provides guidance at the project level for quantification, monitoring and reporting of activities intended to cause greenhouse gas (GHG) emission reductions or removal enhancements.
Greenhouse gases - Part 3: Specification with guidance for the	NL ISO 14064 3 : 2011	It specifies principles and requirements and provides guidance for those conducting or

validation and verification of greenhouse gas assertions		managing the validation and/or verification of greenhouse gas (GHG) assertions

11. Criteria for Net-Metering

The EDL net-metering committee has set a list of required compliance standards (safety and other) and acceptable components for renewable energy plant owners when applying to get enrolled into a net-metering scheme. (Inverter Compliance Standard, PV modules Compliance Standard…)

VI. Financial Mechanisms for Green Buildings in Lebanon

Since 1997, **at least five mechanisms for financing projects in green buildings**, **renewable energies and energy efficiency** have been developed in Lebanon and detailed hereafter.

1. Building Energy Efficiency Project (PEEC) in Lebanon

This project was prepared by the **French Ministry of Ecology and Sustainable Development (MEDD)**, which presented it to the steering committee of the **French Fund for the Global Environment (FFEM)**, which accepted it on April 1. **1997, for an amount of €868,959.40**. Then, the broad lines of this project were the subject of an agreement with the **Lebanese Ministry of the Environment (MoE) on November 18, 1998**. The project document was signed between the **French Development Agency (AFD) and the French Environment and Energy Management Agency (ADEME), February 22, 1999.**

1.1. Project objectives

This demonstration project consists, of developing energy-related improvements in the areas of **the envelope and equipment of certain new buildings**; and to develop a national support program aimed at **disseminating best practices for energy efficiency in construction**. More specifically, this project aimed to **raise awareness among Lebanese decision-makers, and support them** in preparing a new energy management policy in the housing sector, with a view to reducing the consumption of electricity produced through fossil fuels, and therefore CO2 emissions, as part of the FFEM's fight against the greenhouse effect.

1.2. Execution

This project (PEEC) included five programs that were implemented in five climatic zones, with four operators from the private, cooperative and social sectors. These programs were:

- A private developer's site in Zouk Mosbeh, north of Beirut (1999-2001)
- A program in the cooperative sector in Maghdoucheh near Saïda (2002-2004)
- Two orphanages of the Dar Al Aytam foundation, one in the southern suburbs of Beirut (Ouzaï), and the other in the Bekaa plain (Khirbet-Rouha)
- A family building in a residential area (Aïn Aalak) in northern Metn.

1.3. Project Evaluation

Among the results achieved by this project:

- Reinforcement of tools and skills for the design of collective housing, with thermal insulation, and their availability to property developers, through the Orders of Lebanese Engineers and Architects (OEA).
- The pilot programs carried out by PEEC, a company has started manufacturing on site profiles and frames for double glazing.
- Innovations have been introduced in Lebanon in the field of collective solar domestic hot water (SWH)
- The Building Code promulgated in 2005, introduced provisions favoring the construction of double walls, following the recommendations of PEEC in this area.

- In Lebanon, there is knowledge to design, produce, install and manage quality collective solar systems. But what hinders the extension of these systems is the electricity pricing, which does not reflect the reality of the costs. This energy is sold at highly subsidized prices.

It should be noted that this financial mechanism (PEEC) has come to an end, following the completion of the five pilot programs mentioned above.

2. The Grant Contract

This contract was signed in **2007 by the Banque du Liban (BDL), and the European Union (EU)** which provided Lebanon with aid of **14.8 million euros** for the financing of projects for the **use of renewable energies by the sector private**. **€12.2 million of this sum was managed by BDL, and €2.6 million by KAFALAT**. Kafalat is a Lebanese public interest financial company intended to help small and medium-sized enterprises (SMEs) access financing from commercial banks, by providing them with a loan guarantee based on feasibility studies, or on a business plan, demonstrating the viability of the economic project proposed by the SME, to obtain a subsidized bank loan, or the guarantee of this company. The capital of this company belongs to 75% to the National Institute for the Guarantee of Deposits, and in a proportion of 25% to 50 Lebanese banks.

The sum allocated to the BDL was granted to small and medium-sized enterprises (SMEs), in the form of loans capped at $5 million per loan. Similarly, the loan benefits from a subsidy equivalent to 5% of its amount, if it is among the loans specified to subsidized industrial, agricultural, tourist or technological projects, and 15% if it is not subsidized. Thus, the interest rate on these loans becomes close to zero%, which reduces the cost of borrowing for companies embarking on renewable energy projects. Reference to the amount allocated to KAFALAT, it is intended to finance loans to SMEs embarking on projects that are part of its three-energy efficiency and renewable energy programs, as follows:

- Loans to companies that invest in the purchase of equipment that reduces their energy consumption, by increasing their productivity. The loan is capped in this case at LBP 300 million, and its duration is 7 years. However, if the loan is intended to use renewable energies, its ceiling is 600 million, and its duration is 10 years.

- The guarantee for bank loans that companies use for the production of electricity through renewable energies. The loan could reach LBP 1.2 billion, and its duration is 15 years, with a grace period of two years. Similarly, these are subsidized loans, and the banks that grant them are exempted from setting up compulsory reserves for them with the BDL.
- The guarantee for bank loans which will benefit producers of electricity through renewable energies, and who sell their surplus production by injecting it into the public EDL network (Net-metering), when Lebanese legislation so allow later. In this case, the term of the loan would be 15 years, and the grace period 3 years.

This shows that **Distributed XXX, the draft law** of which only saw the light of day in March 2022, **was planned by KAFALAT in 2007**.
In general, the fiscal and monetary incentives provided by this "Subsidy Contract" are persuasive. But, the loan ceiling set by the BDL at 5 million for SMEs to finance projects for the use of renewable energies seems relatively high, given the assets of most of these companies, which are less than 1 million of USD. Therefore, it would have been wiser for the BDL to set the ceiling for these loans at less than $1 million, to allow as many SMEs as possible to benefit from them.

3. The Solar Water Heater Subsidy Program

This program was the result of an agreement in **2009 between the BDL, the United Nations Development Program (UNDP), and the United Nations Environment Program (UNEP).** It was launched in October 2010 by the BDL, through subsidized loans, granted to **small residential units,** for the purchase of **solar water heaters**. The loan, capped at $5,000, was at 0% interest. At the same time, loans at 0% interest have been granted to companies for the purchase of solar water heaters, each of which benefits from a subsidy of $200 which would be provided by the Ministry of Energy and Water. This project aimed at subsidizing **7,500 water heater systems installation in companies**, a figure that was **reached at the end of 2018**. Indeed, thanks to this subsidy program, the surface area of

solar water heaters rose in Lebanon, from **212,000 m2 at the end of 2010**, **to 700,000 at the end of 2019, i.e. an increase of 14.9% on average per year**[24].

4. The Financial Mechanism of the "National Action for Energy Efficiency and Renewable Energies" (NEEREA)

As discussed under the sub-section **"Regulations and Incentives for Energy Efficiency",** NEEREA is a financing mechanism that allows the **private sector (individuals and companies)** to benefit from **loans grants**, granted through commercial banks in Lebanon, to finance **energy efficiency and renewable energy projects, and the implementation of green buildings**. It was created in 2010 through **circular 236 of the BDL**, and alongside the latter, the **Ministry of Energy and Water Resources, the United Nations Development Program (UNDP), the European Union (EU), and the Lebanese Center for Energy Conservation (LCEC).** All subsidized (industrial, agricultural, tourism, IT and research) and non-subsidized (residential, commercial, and non-profit organizations) sectors were eligible for these loans, to finance either **new environmentally friendly projects or transform existing projects**, so that they could **become environmentally friendly**.

The NEEREA mechanism was **one of 14 "initiatives" that were included in the National Energy Efficiency Action Plan (NEEAP 2011-2015)**, which was approved by the government in November 2011. at a national level, NEEREA aimed at raising the share of renewable energies to 12% of the national energy consumption by 2020, and to 30% in 2030, according to the electricity plans that were developed after 2010. Similarly, this mechanism should reduce energy consumption by 5% between the entry into force of this mechanism and 2014. The measure in NEEAP II and NREAP extended NEEREA till 2020 and it also included the new credit line facility (LEEREFF) signed between the European Investment Bank (EIB) and the Agence Française de Développpement (AFD) on one side and the Lebanese Government on the other side. The available fund for NEEREA in 2016 was around 400 Million USD. NEEREA was boosted by a new credit line by EIB (50M) and AFD (30M) with a total value of 80 Million Euros[25]. It was expected that by end of the year 2020, around 300 projects related to EE would be financed thanks to national financing mechanisms (existing and new buildings). Noting that the EE measures were classified as follows: EE measures in

[24] **LCEC, THE SOLAR WATER HEATER SUBSIDY PROGRAM https://lcec.org.lb/our-work/MEW/SWH**
[25] **LEEREFF (Lebanon Energy Efficiency and Renewable Finance Facility) -2018**

existing facilities (buildings, industry and agriculture); EE measures in new facilities (buildings, industry and agriculture); and EE measures in certified Buildings (LEED, BREAM and HQE). The targeted energy saved for the NEEREA (2016-2020) was estimated 49.2 GWh.

4.1. NEEREA Loans

This loan is capped at **$20 million, an interest rate of 0.6%, and a maximum term of 14 years**, including the grace period which varies from 6 months to 4 years. Similarly, the NEEREA mechanism grants households' loans at 0% interest and for a period of 5 years for the purchase of solar water heaters. In addition, other loans of $2,000 were granted, for an interest rate varying from 0.3 to 1.075%.

4.2. NEEREA Subsidies

Alongside the loans, NEEREA has provided for a grant scheme which has been the subject of an **agreement between the BDL and the European Union (EU).** Projects with a maximum amount of $5 million benefit from these subsidies. 59 projects in several sectors benefited from these subsidies.
Similarly, households that would have obtained a loan at 0% interest, for a period of 5 years for the purchase of solar water heaters would benefit from a subsidy of 200$, as previously indicated, if the installed water heaters meet specific quality standards.

4.3. The NEEREA Loan Procedure

To benefit from the NEEREA loan, the procedure to follow includes the following steps:

- First step: The loan applicant prepares a technical report (in accordance with the report templates prepared by the LCEC), including a feasibility study, and a complete financial and technical analysis. The report must also include the total amount of the loan requested.
- Second step: The loan applicant chooses a commercial bank that studies his loan. If this loan is greater than $20,000, the bank in question submits the technical report to the BDL for approval, which in turn forwards it to the LCEC for technical verification. However, if the loan amount requested is not more than $20,000, it does

not assume the prior approval of the BDL, and the commercial bank sends the relevant report directly to LCEC.

- Third step: Once the report is studied by the LCEC, it is returned to the commercial bank (if the amount of the loan is equal to or less than $20,000), or to the BDL (if it is greater than this amount) for review, and make the results of the study available to the commercial bank.
- Fourth step: The commercial bank informs the customer whether the loan is granted or refused. In case of agreement, the client can then start his project. This procedure usually takes about 3 months, if the required data is ensured, and the number of applications is not very high. If the project carried out proves to be non-compliant with its initial plan, disciplinary measures are taken against the beneficiary of the loan.

4.4. NEEREA Balance Sheet

Among the main achievements of NEEREA:

• Until July 2015, more than 260 loans, for a total amount of 380 million dollars were granted through the NEEREA plan, creating more than 6,000 jobs in Lebanon, according to the governor of the BDL; while this figure was still 117 at the beginning of May 2014.

• As of June 2020, more than 1,000 projects have been approved by the NEEREA funding mechanism, for a total amount of more than USD 600 million, according to LCEC.

• About 76% of these projects were for solar PV, **while 42% of the overall loan amount went to green buildings**, according to LCEC.

• All of these projects have contributed to reducing Lebanon's energy bill by an average of $73,253,210 per year, and reducing annual energy consumption by 260,163,325 kWh, equivalent to 281,245 tons of CO2, according to the LCEC.

• The first three beneficiary sectors of the NEEREA mechanism were: the commercial sector (hotels, shopping centers, etc.) with 52% of loans, the residential sector with 31% and the industrial sector with 8%.

• By Mohafazat, Mount Lebanon received the highest number of loans, while the highest amount of loans went to Beirut, according to LCEC.

• Renewable energy and energy efficiency projects were carried out mainly in photovoltaic systems, LED lighting, **certified green buildings**, and biomass boilers.

• Thanks to NEEREA, 76 energy companies have been created until June 2020, creating permanent jobs, according to LCEC[26]. However, since 2021, this NEEREA financing mechanism has been in a state of hibernation, due to the banking crisis, and that of the BDL, which continue to rage.

5. The Green Bond Market in Lebanon

Bonds are financial securities issued by banks or companies or States, to borrow money on the financial markets, at any interest rate called "coupon", and for a specific maturity. Thus, the buyer of the bonds, who is the lender, is repaid his money at maturity, as well as the interest due to him, as is the case with Treasury bonds issued by the States.

The world's first green bond was issued in 2007 by the European Investment Bank (EIB), which was followed in this area by the World Bank in 2008. The capital raised through the issuance of green bonds should serve loans to finance projects to combat global warming. In October 2020, the cumulative amount of green bond issuance crossed the critical threshold of $1 trillion (EIB)[27].

The **green bond market in Lebanon** was **created in 2017** on an initiative of the **International Finance Corporation (IFC),** a member of the **World Bank Group**. This market was the first of its kind in the Middle East. The IFC had helped the authorities of the Lebanese financial markets (the Beirut Stock Exchange) to develop draft laws to regulate the issuance of green bonds in Lebanon. As for the first Lebanese bank to issue green bonds, it was Fransabank in 2018. In these bonds, the IFC invested **$45 million**, to encourage other Lebanese banks to enter this capital market. Thus, the funds raised on these bonds would be lent to companies wishing to invest in renewable energies and energy efficiency, in solar installation projects, wind farms, green buildings, etc.

Indeed, this green bond market has been strongly affected by the banking crisis that has been going on in Lebanon since the last quarter of 2019.

[26] **https://lcec.org.lb/our-work/partners/NEEREA**
[27] **EIB Climate Bond Assessment, April 2021**

6. The Lebanese Environmental Action (LEA)

In 2015, following the implementation of the National Energy Efficiency and Renewable Energy Action (NEEREA), the Central Bank of Lebanon (BDL) tailored a more detailed mechanism dedicated to environmental projects: **The Lebanese Environmental Action (LEA).** LEA is dedicated to **support the financing of new and existing environmental projects**. It offered soft loans to eligible and feasible projects and allowed private sector entities (individuals, SME's, or corporate bodies) and non-profit organizations to apply for subsidized loans for environmental projects with the covered measures. The loan was eligible for new or existing projects. Having a ceiling of 20 million USD, the loan was offered for a period that should not exceed 14 years including a grace period of 6 months to 4 years with low interest rates (c. 2.5%). Note that BDL had recently updated the circular and the loan ceiling for the year of 2019 is at 10 million USD. The environmental loans were provided through any of the Lebanese commercial banks to directly reach the end user before the crisis. Through financing environmental projects, LEA could improve environmental conditions across all regions in Lebanon. LEA aimed to increase the share of environmentally sustainable projects in all sectors in Lebanon (excluding transportation), and improve access to clean potable water, preserve landscapes, improve air quality, among other direct or indirect benefits such as decreasing greenhouse gas emissions and consequently contributing positively to the welfare of the environment and the society.

From mid-2015 until December 2019, 162 projects proposals were submitted under the LEA financing mechanism, among which 146 were approved, 11 cancelled, 3 rejected, and 2 ongoing reviews. The total loan amount granted for the approved projects is 104 Million USD, 18.7 Million USD for the year of 2019 only, and the total loan amount requested is 150 Million USD[28]. Many guidelines were prepared by LCEC for LEA, the list of the most relevant to green building application are listed here after: The Guidelines on Preparing Technical Proposal for Indoor Water Reduction for Residential and Commercial Applications, the Guidelines on Preparing Technical Proposal for Stone Cladding and Retaining Wall Application, and the Guidelines on Preparing Technical Proposal for Roof Tiling Application.

Same as the other mechanisms, access to the information about the Green Building projects that took advantage of LEA loans was not achieved.

7. The CEDRO I-II-III Programs

The first three phases of the CEDRO-UNDP project (2007-2013), funded by the Spanish Government via the Lebanon Recovery Fund, supported more than 100 renewable energy applications, including photovoltaic (PV) and micro wind systems, large-scale solar hot water, and ground source heat pump projects. Some results:

- Implementing the first **hydroponic green roof on one of the main buildings of the Central Bank of Lebanon's Hamra branch.** The green roof is providing additional insulation and helping to regulate air conditioning, while reducing associated costs and lowering carbon emissions;
- Piloting a **pico-hydro system to power a public school in Ramliyeh**. A 10 kW turbine was installed with battery storage, enabling the school to do away with their diesel generator.

8. The CEDRO IV Program

To support Lebanon in achieving the Sustainable Development Goals (SDGs), as well as make progress against national climate commitments, UNDP, together with the European Union, Government of Lebanon, and members of the private sector, were supporting the CEDRO IV project, which aimed to support energy access, efficiency and sustainability, more specifically:

- Lower public and private financial burdens related to energy expenditure;
- Assist in scaling up renewable energy use to 12 percent of the national energy mix by 2020;
- Assist in increasing energy efficiency by 5 percent;
- Promote small-scale renewable energy sources;
- Enhance the drive towards a green economy.

Towards renewable energy and energy efficiency goals for the private sector, with a European Neighborhood and Partnership Instrument project entitled MEDSOLAR, CEDRO IV implemented nine power generation schemes that combine solar energy on the national

[28] **LCEC official Website**

grid with existing diesel and battery storage (capacity of each: 130-300 kW_p), with a total of 1.44 MW of power installed. The outcome of this stream was devoted to increased energy access and reliable power supply, while also a reduction in fossil fuel based energy requirements and support to the local solar market. The nine projects were completed by the end of 2016.

In addition to working with local, community-based organizations, CEDRO IV was also dedicated to helping improve energy efficiency among Lebanese companies, helping them to decrease emissions and increase profitability. One large partner and beneficiary is LibanJus, a juice manufacturer in Baabda. The company has been using diesel generators to ensure continuous electricity, a measure that increased production costs and raised the selling price of its product. A hybrid power system has been installed in LibanJus, which reduced energy costs and made the company more competitive (356 MWh of green electricity generated annually). Similar systems are being implemented in other Lebanese companies in Bekaa and Bikfaya, as well as in two universities in Kaslik and Beirut. A second project is being undertaken at the MEDRAR Medical Center (MMC) facility in the Caza of Nabatye, aimed at putting in place a geothermal energy system that includes 180 vertical boreholes of 100 meters each supporting at least 25,000 people per year.

9. The CEDRO V Program

The **“Country Entrepreneurship for Distributed Renewable Opportunities V” (CEDRO V**), was launched **in 2017**, by the **United Nations Development Program**, in partnership with the **Ministry of Energy and Water Resources and the European Union, and in cooperation with the Lebanese Industrialists Association (ALI), The Lebanon Green Building Council (LGBC) and the International Renewable Energy Credit Institution (I-REC).**

The essential objective of this program is **to help Lebanon with the energy transition**, by **financing pilot projects, particularly industrial ones, in this field.** As part of the financing of this project, **the European Union and the United Nations Development Program (UNDP),** have since 2019 disbursed nearly **9 million $ to finance green projects in Lebanon**, and **USAID has released 29 million.**

10. Green Economy Financing Facility (GEFF) – 2018

The GEFF was a facility amounting to US$100 million, from **EBRD to Bank Audi** to finance **green projects (renewable energy, energy efficiency, water, material efficiency and climate adaptation)**. Donor was **Taiwan ICDF**. The Green Economy Financing Facility (GEFF) offered another potential pathway. With **4 billion euros** in funding from the European Bank for Reconstruction and Development (EBRD), the project aimed to reduce greenhouse gas emissions by financing green energy projects around the world. In Lebanon, specifically, the facility was targeting to provide up to $190 million to local commercial banks to finance energy efficiency, renewable energy, and resource efficiency projects. After the collapse in the banking sector, there is no clear evaluation of the achievement of this financing project.

11. Housing Bank Loans

Following an agreement between the **BDL and the Banque de l'Habitat**, the latter announced on **30.05.2022 that it grants loans capped at 75 million LL ($2,727)**, against an interest rate of 4.99 %, for the financing of acquisitions in the field of **solar energy**.

VII. Certified Green Buildings in Lebanon

The following section discusses **the status of green building constructions and certification in Lebanon** in order to **evaluate their sustainable achievements** using several criteria ranging from the design point of view to the construction implementation. **Lessons learnt** will also be presented in addition to the **best practices** implemented by **assessors/consultants/developers** in order to better assess the current status of sustainable development and the corresponding public awareness in the Lebanese green building construction market. Finally, **managers and occupants'** feedback will be analyzed in order to **evaluate the occupants' satisfaction and the facilities' performance**.

1. Assessment

Even though the concept of green building is relatively new in Lebanon; nonetheless, various green projects, both renovated buildings and newly built ones, have already been implemented since 2009. In the educational sector for instance, **the International College Elementary School (ICES) in Ras Beirut** is the first building in Lebanon to get the **Gold LEED certification** attributed by US Green Building Council (USGBC). The Lebanese Central Bank (BDL) took an active role in the construction of this "intelligent" building by lowering the interest rate on expenses directly attributable to making the building a "green building". The International College demonstrated the importance of environmentally-friendly and energy efficient buildings paving the way for future Lebanese green buildings (please see Table 9 for additional technical details on ICES green building in the educational sector).
As of May 2022, the number of conducted green building certification projects is around **45 projects** with almost half of them being residential buildings (please see Table 8 for additional details). It is worth noting that **33% of these projects obtained the LEED certification**, while **51% obtained the BREEAM certification** despite the difficulties to satisfy the highly demanding requirements of those rating systems. Indeed, some projects took several years before their certification request was approved. For instance, the **Tower 44 located in Beirut** applied for a **LEED CS 2009 certification in 2014 and was certified LEED Gold in 2021**, almost 7 years after its submission (please see Table 11 for other examples). Furthermore, it is to be highlighted that most of the certified buildings are **new constructions** since the cost of renovating existing buildings to meet the criteria of the certification rating systems is very expensive. However, the **renovated buildings** comply with a high standard of energy efficiency requirements. Referring once again to the educational sector, the **Notre Dame de Louaizeh school**, founded/constructed back in 1960, has been recently renovated in order to comply with green buildings standards going from building envelop to technical building system. The school replaced all the aluminum windows as well as the lighting systems. In addition, a new HVAC system and a roof insulation was installed (for technical details, see Table 9). Unfortunately, the economic crisis has slowed down the development of this sector, which is reflected in Table 10, showing that the **last project submitted for certification was in 2018**.

In addition to the long processing/waiting time to obtain the certification, the certification fees of the aforementioned international rating systems are relatively high. For instance, the LEED Gold certification fees of various buildings of different scales during the same period are as follows:

- The certification fee of the **LOS office building project in 2019** is equal to 3 555€ which represents around 0.2 % of its total construction cost,
- The certification fee of the **J. Jabbra Library & R. Nassar CA project, at the Lebanese American University LAU, in 2020** is equal to 100 500 € which represents 0.5 % of its total construction cost,
- The certification fee of the **Associated Consulting Engineers Headquarters project, in 2017** is equal to 15 000 € which represents 0.2 % of its total construction cost.

(please see Table 11 for additional details).

Finally, it should be noted that the number of projects that applied for **the renewal of their certification is negligible** given that the perceived benefits of the certification renewal is very low and that recertification is not deemed as mandatory by any of the certification rating systems.

It should be noted, and as discussed in previous paragraphs, the Lebanese laws/regulations do not impose any criteria on the construction of new buildings in reference to green building certification requirements. Moreover, the certification requests are mostly voluntary demands coming directly from the client himself and not based on any consultant recommendation as expressed in the surveys conducted with consultants/assessors/developers.

Therefore, in order to identify the main drivers for these certifications, consultants/assessors/developers were asked to rank, according to significance, a list of options that most likely reflect the client's reasons/motives for green building construction/certification. Results show that **financial aspects such as subsidized loans/financial benefits/reduced maintenance costs/higher return on investment/increased property value** are the main drivers to construct an energy efficient building; while **company and social image** come in the second place before taking into consideration any **environmental benefit or social responsibility**.

Based on the results of the survey conducted with consultants/assessors/developers of green building projects, Figure 2 shows the **impact of various drivers on the clients'**

decision to build/certify green buildings in Lebanon ordered from extremely influential to slightly influential.

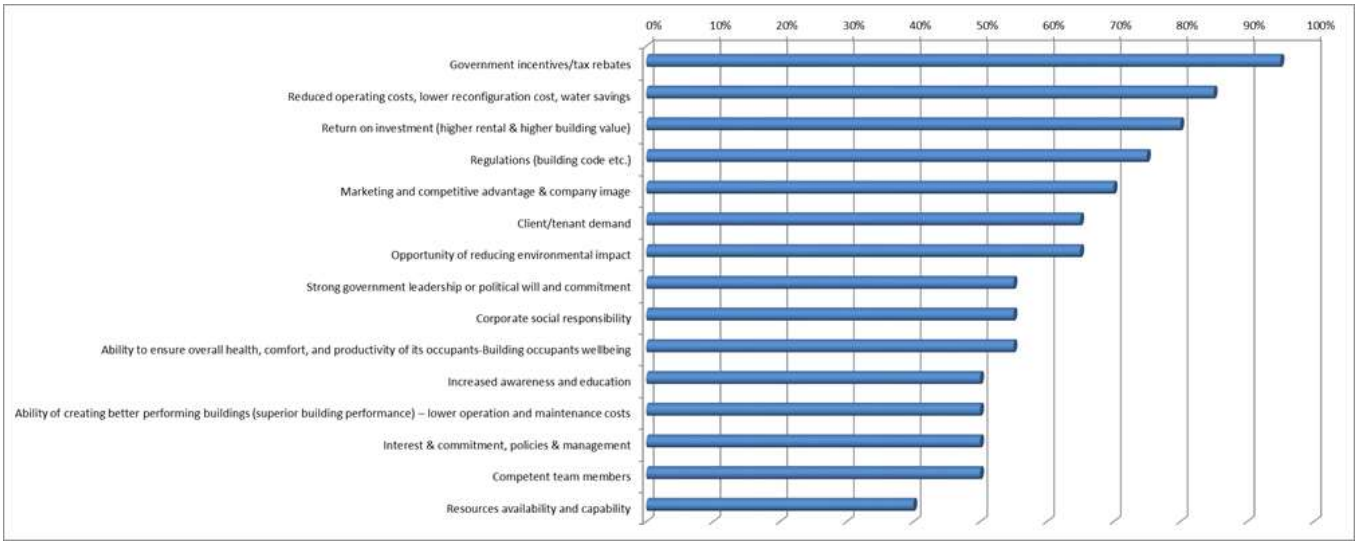


Figure 2 - Weighted average of the influence of various drivers on the decision of constructing/certifying a green building

Similarly, Figure 3 shows the impact of various barriers on the clients' decision to build/certify green buildings in Lebanon ordered from extremely influential to slightly influential.

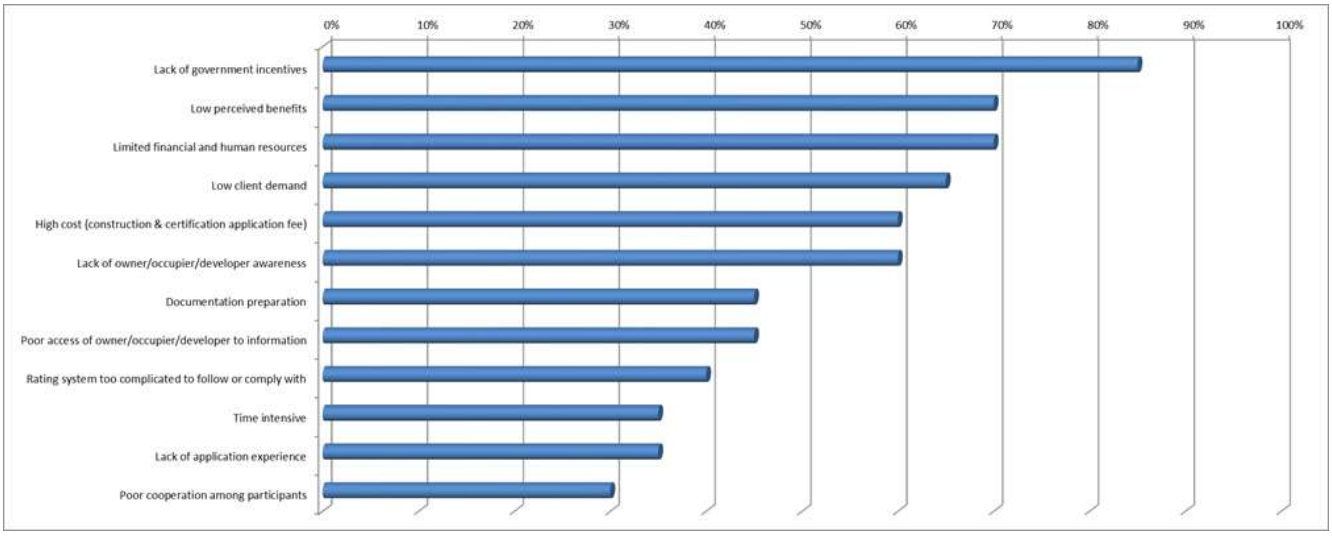


Figure 3 - Weighted average of the influence of various barriers on the decision of constructing/certifying a green building

It is important to note that the decision to build/certify green buildings remain the sole decision of the clients/owners as aforementioned, hence the interest in soliciting the feedback and the opinion of the occupants of these green buildings about the consequences of ecological construction on their quality of life. Presented hereafter the findings of the second survey conducted with managers/occupants of green buildings in Lebanon.

The **second survey** assesses the **satisfaction of occupants of green buildings** according to three major axes namely, **the indoor environment quality, the esthetical design of the building, and the management and maintenance of the building**. For this purpose, the survey started by collecting information about the control of thermal comfort and air quality, the use of acoustic noise and heat insulation techniques, and the management of lighting and energy in order to qualify their satisfaction of the indoor environment quality. Then, it collected additional information in order to assess their satisfaction of the overall building design, use of spaces, and building image. Finally, it assesses their satisfaction of facilities management and the effect on their daily behavior.

The outcome of this survey is presented in figures 4, 5 and 6. In general, the survey shows a high satisfaction of the occupants along the three investigated axes. Thereupon, the impacts of green building go beyond economic and environmental benefits, as they bring positive social impacts as well. These additional benefits concern the health and wellbeing of people who work in green offices or live in green homes as they reported an enhanced productivity and a better physical and mental health. Around **60% of the occupants claim a high decrease in their electricity bill** and a **moderate decrease in the maintenance and operational costs** compared to their previous experience in conventional building. The same percentage revealed the **positive impact** of ecological construction on their daily behavior as they **apply more personal control** on the indoor environment and try to find passive ways to reach their **comfort zone**.

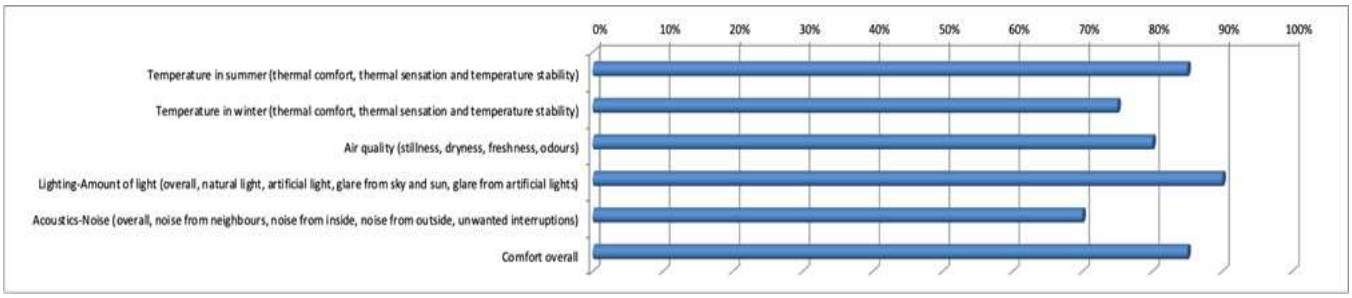


Figure 4 - Occupants satisfaction with indoor environment quality

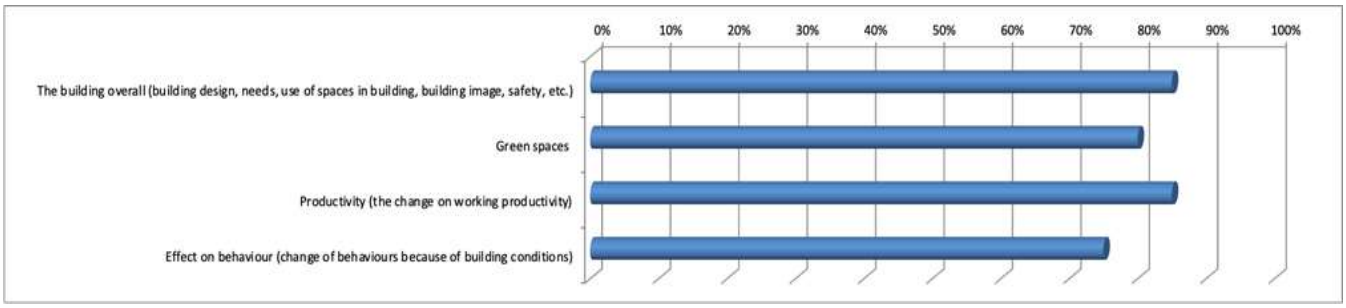


Figure 5 -Occupants satisfaction with building design

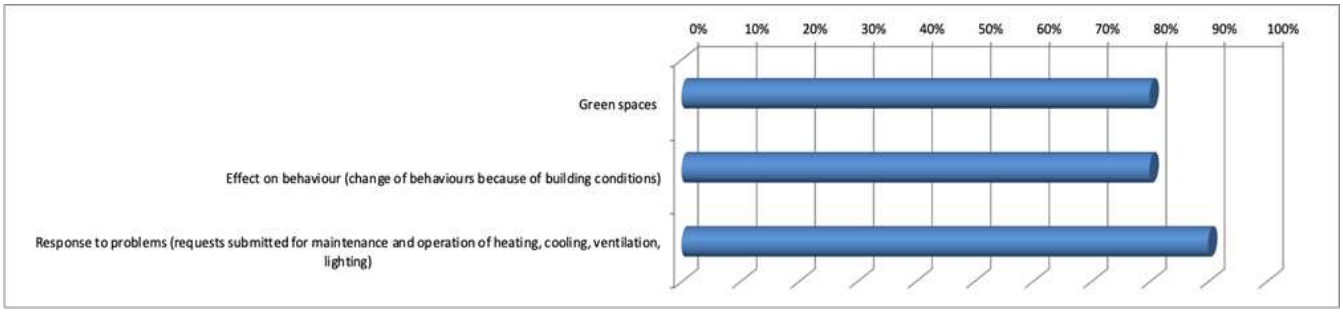


Figure 6 - Occupants satisfaction with facilities management

2. List of Certified Green Buildings

Table 8 - Certified Green buildings in Lebanon

Project name	N° of projects	Building type	Construction year	Building Rating & Certification	Certification year	Funding sources/institutions
RCG Headquarters	1	Nonresidential/ Office		LEED Gold	2022	
Tower 44	1	Residential		LEED Gold	2021	
Water Front City WFC - Promenade Résidences	1) Blocks 1 to 4 2) Blocks 5 to 8	Residential/ Apartments	2019	1) BREEAM Pass 2) BREEAM Good	1)2018 2)2020	Majid Al Futtaim & Societe Joseph G.Khoury Et Fils Holding
WFC-Plaza residences	Blocks 1 to 3	Residential/ Apartments	2019	BREEAM Pass	2018	Idem
WFC-Magnolia Court	1	Residential/ Apartments	2019	BREEAM Pass		Idem
WFC-Marina Vistas	1	Residential/ Apartments	2019	BREEAM Good	2019	Idem
WFC-The marina promenade	1	Nonresidential/ Restaurants		BREEAM Certified		Idem

LOS office building	1	Nonresidential/ Office	2019	LEED Gold	2019	Own & Loan from NEEREA
Rive Gauche	1	Nonresidential/ Office		LEED Silver	2018	
LAU-J. Jabbra Library & R. Nassar CA	1	Educational	2018	LEED Gold	2020	Own & Loan
International College IC	1)Elementary school 2)Preschool & Middle school	Educational	1)2013 2)2018	1- LEED Gold 2-LEED Gold	1)2013 2)2019	
AUB-Penrose Hall	1	Educational		LEED Gold	2019	
AUB-IOEC building	1	Educational		LEED Gold	2015	
Y Zone Yarze	1	Residential		BREEAM Pass	2019	
Yarze 1561 Residences	1	Residential		BREEAM Pass	2019	
Yarze 1674 Residences	1	Residential/ Apartments	2017	BREEAM Very good	2018	Own & Loan from NEEREA
La brocéliande Yarze	2	Residential	2009-2011	BREEAM 1)Very good 2)Pass	1)2012 2)2015	2)GreenStone Real Estate developer
B11 Beirut (Beirut International Exhibition & Leisure Center-BIE&LC)	1	Residential/ Commercial		LEED Silver	2018	International Hotel Investment Company
M1 building (BIE&LC)	1	Commercial/ Office	2016	LEED Platinum	2016	
ABC Verdun	1	Commercial/ Retail/trade	2017	LEED Certified	2018	Own & Loan from NEEREA + Two local banks
Associated Consulting Engineers, ACE Headquarters	1	Nonresidential/ Office	2012	LEED Gold	2017	Loan from IBL Bank
Mina1394	1	Nonresidential/ Office		LEED Gold	2014	Investor Lona Co Office
Beirut City Center	1	Commercial/ Retail/Trade		LEED Gold	2013	Majid Al Futtaim
Caza Batroun	1	Residential	2014	BREEAM Excellent	2014	Own Family House
Bkerzay Eco-village	1	Residential/ Hotels	2017	BREEAM Very good		Own & Loan from NEEREA
Beit Misk Phase III	1	Residential		BREEAM Pass	2015	
Lot 1031 Rmeil	1	Residential		BREEAM Good	2016	

Lot 1031 Rmeil PCR	1	Residential		BREEAM Good	2019	
Lebanese Water Front City LWFC	1)Phase 1 2)Phase1 1A 3)Phase 3 type 2 SP5 4) Phase 3 type 2 SP6	Residential		1)BREEAM Pass 2)BREEAM Good 3) BREEAM Good 4)BREEAM Good	1)2013 2)2015 3)2016 4)2016	1) Majid Al Futtaim 2) Majid Al Futtaim
LWFC Gym	1)Phase 1 1A 2) Phase 1 1A PCR	Retail		1)BREEAM Pass 2)BREEAM Pass	1)2015 2)2020	
LWFC SP3 Sea Gardens	1	Nonresidential		BREEAM Good	2018	Majid Al Futtaim
BLC Headquarters	1	Nonresidential/ Bank		ARZ Bronze	2011	
Beta Engineering offices	1	Nonresidential/ Office		ARZ Bronze	2013	
WFC Offices	1	Nonresidential/ Office		ARZ Bronze	2015	
Order of Engineers &Architects	1	Nonresidential/ Office		ARZ Bronze	2017	
Reuters offices	1	Nonresidential/ Office		ARZ Certified		
Tohme Rizk Office-AUB	1	Educational		EDGE	2020	
Kesrwen Medical Center	1	Nonresidential		EDGE	2020	

3. Certified Green Buildings Technical Data

Table 9 – Some Building Technical data

	International College -Elementary School	**Collège Notre Dame de Louaize**
Address	Beirut	Zouk Mosbeh
Construction Year	2013	1960
Building Type	Education	Education
Construction Phase	New construction	Renovated
Building Rating and Certification	LEED Gold	Not applicable
Building Envelope		
External walls//U value W/ (m2.K)	Plaster-Hollow Block-Air Cavity-Hollow Block-Mech.Fixed stone Cladding//0.56 W/(m2.K)	Double wall (15 cm-3cm gap-10 cm) with cladding//1.21 W/(m2.K)
Roof//U value W/(m2.K)	Flat Roof/Rubber Finish-Isolator Pads-Cement Board-Concrete Slab//0.68 W/(m2.K)	Double Pitch Roof/Brick 5 cm - Sandwich panel 5 cm. The additional insulation to the roof

		structure has reduced the cooling load to 56.65 kW and resulted in a total savings of 4.2% of the total electricity bill//0.37 W/(m2.K)
Openings and windows//U value W/(m2.K)	Double glazed-Solarban 70 XL-Low-e Coated//1.47 W/(m2.K)//0.278	Double Glazed-Aluminum- The previous thermal load was estimated around 369.74 kW, but with the new double glazed installations, a reduction of 130 kW is achieved. The new windows are double glazed with an aluminum frame//resulting in a U-value of 2.78 W/(m2.K) compared to 5.8 W/(m2.K) of the previous windows.
Basement Floor//U value W/(m2.K)	Plaster-Concrete -Sand Mortar-Tile//1.47 W/(m2.K)	30 cm concrete//1.92 W/(m2.K)
Technical Building Systems		
Ventilation system	Mechanical ventilation system with heat recovery	Free ventilation (windows)
Space Cooling system	Centralized chiller |Usually a central system located in the basement (VRV system) &(VAV with electric reheat, centrifugal chiller with variable speed primary and secondary pumps)	Mounted single-split or window air conditioner; Usually a visible smaller system mounted outside the wall or above the window just supplying one Room-Inverter type AC unit with different capacities. The use of inverter AC units will save 7.06% of the total electricity bill.
Space Heating system	Oil non-condensing (Diesel boiler)	___
Water Heater system	Dedicated electric heater (dedicated = just hot water generation)	Dedicated electric heater (dedicated = just hot water generation)
Lighting system	LED (Light emitting diode lamps) with BMS control /Efficiency 100	Linear fluorescent lamps (LFL)/Efficiency 60-The old system was based on obsolete fluorescent T12 lamps with magnetic ballasts. The new system will use T18 fluorescent lamps with electronic type ballasts, which leads to energy savings and higher lumens output. The changes to the lighting system will lead to 1127 $/year savings.
Shading Devices	Static (fix) shading systems as part of the building architecture (e.g. Maschrabiyya, porch roofs, pergolas- Setback and Fins	Static (fix) shading systems as part of the building architecture (e.g. Maschrabiyya, porch roofs, pergolas)

4. List of Green building project Certification in progress

Table 10 - Green building project certification in progress

Project Name	Building Type	Building Rating & Certification	Registration Year
Eastwood International School	Education	LEED v4 BD+C SC	2018
Beirut City Museum	Public Assembly	LEED v4 BD+C NC	2017
K Galeria	Retail	LEED Retail NC 2009	2016
Alveo Business Park	Nonresidential/Office	LEED CS 2009	2016
Beirut Embassy Campus: Chancery	Nonresidential/Office	LEED v4 BD+C+NC	2015
Business Park SP2	Nonresidential/Office	LEED CS 2009	2015
North Souks Department Store (Beirut International Exhibition & Leisure center)	Nonresidential/Retail	LEED CS 2009	2013
Olive Residence	Residential	LEED NC 2009	2012
District//S CC	Public Assembly	LEED NC 2009	2012
Saifi 178	Residential	LEED CS 2009	2012
District //S	Neighborhood Development	LEED ND 2009	2011
Aya Tower	Residential	LEED NC 2009	2011
Aramex Warehouse Beirut	Warehouse & Distribution	LEED NC 2009	2010
Badaro Gardens	Residential	LEED CS 2009	2010
Beirut Terraces	Residential	LEED CS 2009 LEED NC 2009	2010 2009

5. Sample of the Certification Fees

Table 11: LEED Gold NC 2009 Certification fees of various buildings of different scales during the same period

	LOS Office Bldg	LAU-J. Jabbra Library & R. Nassar CA	Associated Consulting Engineers Headquarters
Construction Phase	New construction	New construction	New construction
Building Type	Office	Education	Office
Construction Year	2019	2018	2012
Construction Cost	1 700 000 €	18 704 000 €	6 535 982 €
Building Rating and Certification	LEED Gold (NC 2009)	LEED Gold (NC 2009)	LEED Gold (NC 2009)
Certification Year Registered/Awarded	2016/2019	2013/2020	2010/2017
Certification Costs	3 555 €	100 500 €	15 000 €

VIII. Education and Awareness for Green Buildings in Lebanon

According to "*Green building literacy: a framework for advancing green building education", by L. Cole,* despite the increasing square footage of green buildings worldwide, green building education remains a background of experience that is largely restricted to the domain of building industry professionals. After twenty years of civil war and continued political and economic turmoil, concerns for ecological matters are not a priority to most Lebanese. As per a Lebanese case study done at the Lebanese American University, (LAU), "*Sustainability and Design Education",* Lebanese students in higher education, engineering and architectural programs, are hardly ever exposed to the sustainable design science and several can't even answer if they really comprehend or are even familiar with the term sustainability. Green building awareness is expanding and can create opportunities to integrate green building themes and environmental literacies into the classroom.
In order to determine how to make educational changes towards sustainability in Lebanon, it is first essential to examine how Green Building and design sustainability is being taught in Lebanon. This report will look into the reality of green buildings education in engineering and architectural faculties across Lebanon, the extent of scientific research available, the entities and organizations responsible for spreading awareness through seminars and workshops, and the need to grow the green building sector / field.

1. Education on Academic Level

1.1. Engineering and Architectural Schools in Lebanon

Engineering and Architectural universities in Lebanon have a long history of excellence. From the ESIB (Ecole supérieure d'ingénieurs de Beyrouth) which was founded in 1913, to the Faculty of Engineering and Architecture of the American University of Beirut (AUB), which were both founded in 1951 and 63 respectively, to the Lebanese University, faculty

of engineering (ULFG), founded in 1974, and followed by many reputable universities after that, it is clear that Lebanon has its fair share of high-quality engineering education.
Engineering faculties in Lebanon can teach the following majors in bachelor, masters and PhD levels in different capacities:

- Electrical and computer Engineering
- Civil and Environmental Engineering
- Mechanical and Industrial Engineering
- Mechatronics Engineering
- Petroleum Engineering
- Chemical Engineering

Architectural schools are often found under the faculty of Arts and Sciences and can teach the following majors in bachelor, masters and PhD levels in different capacities:

- Architecture
- Urban Planning and landscaping engineering

Many private owned universities have diversified their education and achieved the ABET (Accreditation Board for Engineering and Technology, Inc) accreditation. ABET accreditation provides assurance that a college or university program meets the quality standards of the profession for which that program prepares graduates. This gives their students a sense of security that they are receiving a quality education program that satisfies requirements of professional organizations.

1.2. Existing Course Material in Engineering and Architectural Universities related to Green Buildings

Embracing the principles of green building in development is crucial in creating a sustainable environment. According to the Lebanese Green Building Council, constructing a Green Building can achieve the following benefits:

- Increase return on investment
- Increase sales and leasing potential of building
- Boost occupant health and productivity
- Reduce energy use

- Reduce natural resources use

Looking at these points, it is clear that all engineering fields are related to the successful implementation of a green building design. Renewable energy related majors and courses are starting to make their way shyly into Lebanese engineering and architectural universities, mainly in the civil and mechanical faculties as well as in architectural faculty, where undergraduate levels are including elective material related generally to energy audits and green buildings, if any, and graduate level masters projects are including fields of concentration covering environmental and water resources, applied energy and energy studies, urban planning and sustainable architecture.
Listed below is Table 12 including the universities that have been researched and where suitable data has been gathered to highlight the course material that current engineering and architectural students learn in different levels of the major. This data was analyzed here after.

Table 12: Existing Course Materials related to Green Building

University	Course Material	Level at Which Course is Given
ESIB	• « Bâtiments Écologiques à Basse Consommation Énergétique »-Technical Electives	Masters "Energie Renouvelable"
	• « Evaluation de projets à énergies renouvelables » - Technical Electives • Building Thermal Design • Environment and Sustainable Development	Bachelor in Civil Engineering-Option Buildings and Engineering Management
AUB	Core, Building, Water, Energy and elective courses	PROGREEN
	Air Quality Management-Core Courses	Masters in Civil and Environmental Engineering
	Air Pollution Modeling-Technical Electives	
	Environmentally Responsive Buildings-Technical Electives	

	Moisture and Control of Humidity Inside Buildings-Core Courses	Masters in Mechanical Engineering- Applied energy
	Energy Efficient Buildings with Good Indoor Air Quality-Core Courses	
	Renewable Energy Potential, Technology, and Utilization in Buildings-Core Courses	
	Passive Building Design -Technical Electives	
	Green Building Basics and LEED Practices-Technical Electives	
	• Energy Efficient Buildings with Good Indoor Air Quality-Core Courses	Masters in Mechanical Engineering- Energy Studies
	• Sustainable Building Design and Construction- Technical Electives	
	Environmentally responsive buildings	Bachelor of Landscape Architecture (BLA)
	• Renewable Energy Potential, Technology, and Utilization in Buildings- Technical Electives Energy Efficient, High Indoor Air Quality Buildings-Core Courses • Innovation and Knowledge Transfer in Renewable and Building Service Systems- Technical Electives • Principle of Integrative Building Design, Construction and Operation for Sustainability- Technical Electives	Building Energy Systems (Graduate diploma), applicate should hold an undergraduate engineering degree
LAU	Core, Building, Water, Energy and elective courses	PROGREEN
	Passive Building Design- Technical Electives	Masters in Mechanical Engineering
	Sustainable Architecture-Technical Electives	

	Environmental Systems I- Core Courses	Bachelor in Architecture
	Environmental Systems II-Core Courses	
ULFG	"Bâtiments Écologiques à Basse Consommation Énergétique »- Technical Electives	Masters "Energie Renouvelable" (ESIB/ULFG)
	"Evaluation de projets à énergies renouvelables »-Technical Electives	
	• « Construction Durable » (5th year – 9th Sem.– "Structures et Bâtiments ») - Core Courses	Civil Engineering Diploma
	• "Diagnostic environnemental" (5th year - 9th Sem. – « Hydraulique et Environnement")- Core Courses	
	"Isolation Acoustique » (Mechanical - Energie , 5th Year)-Core Courses	Mechanical Engineering Diploma
	Heating, Ventilation, and Air Conditioning (4th Year 4 – 8th Sem.)- Core Courses	
BAU	Green Buildings and LEED	Bachelor of Engineering in Renewable Energy Engineering
	Indoor Environmental Controls -Core Courses	Bachelor of Architecture
	Environmental Design- Technical Electives	
	Architecture Design and Decision-Supporting Tools- Technical Electives	Masters in Architecture
	Advanced sustainable Architecture- Technical Electives	
USEK	Sustainable Architecture Workshop - Technical Electives	Bachelor and Master in Architecture - combined program
	Sustainable Construction-Technical Electives	Masters in Civil Engineering and Bachelor in Civil Engineering
	Building: Energy and Environment- Core Courses	Masters in Civil Engineering

NDU	Sustainable Architecture -Core Courses	Masters of Architecture in Sustainable Architecture
	Green Architecture for the MENA Region-Core Courses	
	Human Comfort and Wellbeing in Passive Architecture- Core Courses	
	Case Studies in Passive Energy Design - Core Courses	

1.3. Analysis of Results

Given that the concept is relatively new in the country, Green Buildings in Lebanon are still an ambition. This report shows that the adoption of green building course material in engineering institutions is very low currently in Lebanon and only restricted to special programs, a limited number of general core materials (obligatory) as well as a few bachelors masters' programs with technical electives (non-obligatory).

1.3.1. Special Programs

The table above shows all course material that are being taught in the country's top engineering and architectural universities. Looking at the data, it is clear that only a few universities namely, AUB and LAU have collaborated in a joint diploma program, that is separate from their respective undergraduate and graduate engineering majors, called PROGREEN which targets the study of green building design. It is an online diploma between these two universities. The PROGREEN as per the universities description "helps working professionals in fields related to natural science, mathematics, engineering, and architecture further develop skills and compete in the emerging and rapidly expanding green energy market." Thus, the educational requirements for admission to the PROGREEN program don't oblige the candidate to be solely an engineer or an architect. In this spirit, the program caters to all types of professionals and includes management, energy, buildings and water courses. AUB has, in addition to the PROGREEN, another program called Building Energy Systems (Online Graduate Diploma), which is also not a masters, but where it is a requirement for the candidates to have a bachelor in engineering.

1.3.2. Engineering and Architectural Masters Programs

The ESIB/ULFG have a full joint research master program concentrated on renewable energies as a whole science and have two courses in the curriculum that are related to green buildings. The Notre Dame University (NDU) has one masters that is under the school of architecture which is concentrated in Sustainable Architecture, where four green building related courses are given in addition to other core courses. The AUB has two Masters in Civil and Mechanical Engineering Concentrated on Environment, Applied Energy and Energy Studies, that give all directly related green building courses as electives.

1.3.3. Engineering and Architectural Bachelors Programs

As can be noticed in the list of course in the Table 12, for each of the universities researched, at undergraduate level (bachelors), nearly all Green Building courses fall under Technical Electives where the student has the choice to study them or not depending on their own personal preference and on their future aspirations. Thus, there is no obligation or a proper formation in green building related courses. Very few are considered as core material and they tackle one aspect of green buildings, for example: Moisture and Humidity Inside Buildings, Indoor Air Quality, Durable Construction, Acoustic Isolation.

1.4. Existing Scientific Research Related to Green Buildings

Due to the fact that there is little exposure to green buildings in education in Lebanon, very few scientific research and papers are published in journals and conference proceedings. Below are the papers and researches that were found:

- **Osama Omar "Near Zero-Energy Buildings in Lebanon: The Use of Emerging Technologies and Passive Architecture" Sustainability 2020, 12, 2267**

Abstract: *Architecture always aims to find solutions for problems around the world. One of the major trends at present relates to energy consumption and climate change. Construction is responsible for 18% of CO2 emissions. However, continuing to use fuel as a main source of energy consumption for economic reasons, as it is the cheapest raw material and most easily available material for most of the Arab countries, results in a negative environmental impact on the quality of life in these countries.*

This paper investigates a new design concept and decision-supporting tools for zero-energy buildings. Based on critical thinking as a new mechanism to create a hierarchy of designing a building, the research presents the experience of the author in teaching architecture courses for postgraduates for five years (ARCH 662: Architecture Design and Decision-Supporting Tools and Arch 663: Advanced Sustainable Architecture). The result of this research could be new methodologies that help and guide the architect in creating more zero-energy buildings in their countries. In addition, the spread of knowledge in the future generation of architects in architecture schools will mean that new designers believe in protecting and taking care of their environment, which will increase awareness of environmental issues and improve the quality of life in these countries.

- **Adel Mourtada, Farah Mneimneh, Haneen Hamdan," GRASS, A New Building Rating System for Lebanon", ALMEE-ADEME**

Abstract: *Being more aware of global warming and climate change, the world today is shifting toward a more environmentally friendly style of living. Buildings are considered to be one of the main contributors to CO2 emissions and thus to climate change. The market place of the design and construction of high-performance buildings, also known as green buildings, is dynamic and evolving. In order to evaluate the level of sustainability, countries all over the world have established building rating systems to evaluate and rate green buildings. Lebanon is in an urge to introduce more energy efficient and environmentally friendly techniques in the building construction industry. This paper intends to introduce a new building rating system for Lebanon to serve as a step forward towards sustainability in this country. This rating system, GRASS, can be applied on both commercial and residential buildings. Throughout this paper, the minimum requirements of the credits will be illustrated as well as the criterion to be followed in order to earn the certification.*

- **Nabila Al Ghabra," Legislation and Incentives and Incentives", BAU Journal - Health and Wellbeing: Vol. 1: Iss. 3, Article 51.**

Abstract: *The world's nations encourage creating a health-friendly and sustainable environmental development, to achieve a balance between the economic development and environmental protection. Governments around the world settled regulatory frameworks for the development and usage of green building technology; they should adopt an appropriate legislation to protect people's health as well as the environment and its natural resources, by establishing a mandatory Green Buildings Regulations, green attractive incentives and Initiative to improve our building performance, encouraging all inventors to build with green. Energy efficiency and renewable energy incentives have attracted serious attention; it promotes sustainable development. In some countries the municipality has made the Green Building standards mandatory for governmental buildings only and*

optional for private ones, but in others they are establishing a strategy, making it mandatory for all the new buildings. This research highlights on the problem and detail the government incentives and initiative, its effectiveness on promoting green building development. The paper draws attention on the shortage of the Lebanese government to protect its natural resources, since the environmental issues have reached dangerous levels. Some ministries are improving the rules for healthier environment, but it is still not enough. More effort should be done in order to achieve an acceptable level of environmental quality. It also provides an international and local review of the implementation of environmental incentives and financial schemes in order to have a better perspective of the Lebanese sustainability effort. The methodology used mostly an inductive methodology with an intervention of deductive and analytical methodologies.

- **Mohammed Farouk Al Aby, "Towards a Green Building: Opportunities and Challenges in Lebanon", Advanced Material Research Vol. 935 (2014), pp 27-33.**

Abstract: *Due to the current resource depletion rates, as well as the growing need toward energy and water efficiency. Governments and the private sector adopted the concept of the Green Building, given the fact that buildings are responsible for energy and raw material on a large scale. That need is clearly manifested in the developing countries facing energy efficiency challenges. Hence, this research highlights the efforts of the governmental and the non-for-profit organizations; represented by the Lebanese Ministry of Environment, Ministry of Energy and Water. Lebanon Green Building Council (LGBC) and funded by the International Finance Corporation of the World Bank. The research summarizes the opportunities and challenges of adoption this concept to the benefit of Lebanon and a other countries undergoing the same circumstances and facing the same challenges. In the process of reaching a conclusion, the researcher adopted the analytical and the case study methods through two main axes. The former attends to the theoretical studies which include the definition, the principles, the benefits and the global and local rating system of the Green Building. The latter axis addresses the Lebanese experiment through the review of the Opportunities and the Challenges facing the Green Building in Lebanon, and the ARZ Building Rating System. It also Illustrates and analyzes a pioneering project in Lebanon that employed the green building patterns, the Ammiq Eco-Restaurant in Bekaa Region. This Paper concluded by a set of recommendations that can be the foundation for similar experiences aspiring for adopting the green building as a cornerstone in the arena of sustainable development.*

- **Rita Awwad , and Karim El Khoury ,"Assessment of sustainable construction in Lebanon", submitted to the Journal of the International Society of Gerontechnology (2012).**

Abstract: *One of the most critical contemporary issues is achieving and maintaining sustainable development, adapting the use of natural resources to provide for the needs of our rising populations without threatening the survival and quality of life for future generations. Sustainable construction, in particular, is a concept that is gaining importance all over the world and is gradually improving life for populations that recognize its importance. The current environmental degradation in Lebanon due to limited natural resources, population increases, and inefficient urban management, threatens the economic growth and the wellbeing of the people and thus dictates the urgent need for planning and taking action on a comprehensive environmental sustainability strategy. The main purpose of this research is to explore the Lebanese construction industry in order to evaluate sustainability achievements on both design and construction levels. This research also studies sustainability standards and practices implemented in some developed countries and in the surrounding region in order to better assess the current status of sustainability development and corresponding public awareness in the Lebanese construction market with respect to foreign industries. Based on the aforementioned, this research addresses challenges to sustainable construction in Lebanon and provides recommendations to enhance the use of energy-saving materials and the application of environmentally-friendly construction methods. Method This assessment is done through two complementary approaches: (i) a comprehensive literature review of all pertaining governmental regulations, public policy, and guidelines that have been enacted to promote building sustainability in Lebanon, as well as a survey about existing green buildings and ongoing green projects along with the implementation challenges; and (ii) conducting interviews with Lebanese parties that are key players in achieving sustainable development such as local experts, public agencies, municipalities, architectural and contracting firms, private agencies dealing with environment protection, and real-estate companies. Results & Discussion The concept of sustainable production and construction is still very primitive in Lebanon and the role of the government in promoting sustainability is not yet well established. Some public entities including, but not limited to, the Ministry of Industry, the Ministry of Environment, the Ministry of Energy and Water, the Council for Development and Reconstruction (CDR) have put some effort through internationally funded projects and campaigns by UNDP and the European Commission aimed at promoting sustainable production and consumption in Lebanon. However, these efforts were not enough to have a significant impact on these industries and resulted merely in voluntary guidelines rather than serious measures to reduce energy usage and pollution. Another finding of this research is that major efforts need to be made towards enhancing public awareness of sustainability issues. Hence, this research analyses the observed deficiencies in the Lebanese construction market and provides some recommendations that, if turned into action plans, constitute a promising transition from a short-sighted construction focusing on short-term goals of profit making and fast growth and lacking concern for the environment to a global*

long-term sustainable development that ensures the welfare of the current and future generations.

- **Adnan Jouni, Rita Najjar, and Adel Mourtada, "Evaluation of National Energy Action Plan: The Case of the Lebanese NEEAP (2011-2015)", REDEC 2016, IEEE- 10 1109**

Abstract: *The Energy Efficiency Directive EED defines the EU energy saving target as a maximum primary energy consumption (in Million Tone oil equivalent, Mtoe), that can be monitored with statistical data. Different energy savings methods can be used if data needed to measure the energy saving in an accurate manner are available (econometric models, bottom up, top down based on indicators, etc.). As an alternative to measuring energy consumption, efficiency progress in the different sectors can be monitored by using energy efficiency indicators (e.g. Odyssee). In Lebanon Odyssee's indicators are available since year 2000 (developed by the Lebanese Association for Energy Saving and for Environment, ALMEE, in the frame of the Energy Efficiency indicators database initiated by the Mediterranean Association of the National Agencies for Energy Conservation, MEDENER). The National Energy Efficiency Action Plan 2011-2015 (NEEAP) for Lebanon was approved by the Council of Ministers on 10 November 2010. This paper presents an evaluation of the Lebanese NEEAP. It concludes that its targets were not satisfactory achieved (18.6 GWh/year of energy saving achieved from 2087.6 GWh/year targeted). The first Lebanese NEEAP was not designed as a strategic document according to the requirement of the Energy Saving Directive. This paper presents in concise manner what should be included in a "good" NEEAP to help in the preparation of the second NEEAP (2016-2020). The paper argues that new NEEAP (2016-2020) should define energy saving target as maximum primary energy consumption (Mtoe) able to detailed assessment (by independent evaluator) of the energy savings through top down or bottom up calculation methods and ALMEE/MEDENER Odyssee's indicators.*

2. Sustainable Development and Green Building Awareness Education

There are several governmental and non-governmental entities and organizations in Lebanon that are taking care to spread **awareness on sustainable development** as a holistic approach, and on the **concept of green buildings**. One major resource is the **Ministry of**

Environment (MoE). The key actions related to the environment which the Ministry takes on include: events, activities, international projects, publications, reports and forums. The MoE also places emphasis on awareness on protected areas and reforestation. Another significant contributor to the environment in Lebanon is **USAID** which, focuses on water management. By protecting the environment USAID also encourages rural tourism.

Another public entity attached to the Ministry of Industry is the **Lebanese Standards Institution (LIBNOR)**. One of its strategic goals is to develop national standards, in addition they **provide training sessions** in critical fields including sustainable construction. LIBNOR have participated in the International Beirut Energy Forum (IBEF) and was granted an award of recognition for its consistent work in the fields of energy and environment, which contributes to promoting sustainable development.

Several NGOs can be named that are more involved in a sustainably built environment where they promote awareness, education and legislative issues regarding environmentally responsible construction. **Lebanon Green Building Council (LGBC)** is one major contributor in such an industry. They launched many events to educate on and introduce green buildings, as well as several publications and the ARZ building rating system. Most recent events are:

1- LGBC Education and Awareness Activities at LYCÉE NAHR IBRAHIM SCHOOL
2- Meet Lebanon Green Building Council (LGBC) at UN-HABITAT-ESCWA's #NUFLebanon.
3- Workshop under the "Renewable Energy and its Role in Achieving Sustainable Development"; at the Order of Engineers and Architects in Tripoli
4- Several seminars like, The building Green, March 2019, Green Week, may 2019, World Green Building Week, October 2017.
5- Webinars like, "Beirut: A Vision towards Resilient Net-Zero City" September 2020.

Another significant contributor in this domain is **The Lebanese Association for Energy Saving and for Environment, ALMEE**, which is involved in a wide range of activities related to sustainable practices. It is committed to better handling of multiple issues and technologies associated with Energy and Environment, not just in Lebanon but also across the Mediterranean Basin and worldwide. ALMEE's main goal is building awareness and support for better management – and to keep the business community apprised of the tremendous growth potential exhibited by this new and exciting sector.

ALMEE is a main contributor/partner in MEETMED project and is part of their regional expert network. It has been involved in the latest MEETMED workshops to promote energy

efficiency strategies and raising awareness by tailoring and launching special campaigns to disseminate the project results, avail training materials and promote EE in buildings and appliances.

ALMEE have also created several practical tools to study thermal compliance in buildings TSBC and developed the GRASS building rating system. The organization also prepared and edited so far 25 bulletins as well as many brochures on the ozone depleting issues, energy saving, renewable energy, energy auditing, state of the energy in Lebanon and others.

In the first phase of SOCLE project, ALMEE conducted a list of webinars for the Lebanese local authorities' environmental units that aimed to raising awareness, building capacities and transfer knowledge in the terms of Energy Efficiency and Renewable Energies in public buildings.

In addition to the above mentioned, it is worth mentioning the following organizations. The **UNDP** who has always strived for to make sustainable development a worldwide goal, with a share for Lebanon. UNDP is adamant on **creating awareness** among the masses by several methods. They have a many **newsletters and publication** that are related to their efforts and they have established their UNDP's sustainable development blog that is written by experts working in over 170 countries and territories. The UNDP Lebanon project entitled **"Together towards Sustainable Development"** is a big effort to bring Lebanon forward in sustainable future.

The **Order of Engineers and Architects (OAE),** a very important cornerstone and the house of Lebanese Engineers and Architects, is always **supplying workshops and seminars to distribute awareness among engineering professionals**, in addition of having a complete team of experts that cater to sustainable projects. Such recent workshops and seminars, "The Sponge City" April 2022, "The Energy Strategies Summits 2020", December 2020, "Advancing the ARZ Building Rating System" May 2021.

The **Lebanese Center for Energy Conservation (LCEC)** is a not-for-profit organization that gives technical support to the Lebanese Ministry of Energy and Water (MEW). The main role of LCEC is to setup national action plans and strategies to develop the sustainable energy sector in Lebanon. LCEC is also responsible for the development, implementation, and regular update of the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP) for Lebanon. The work of LCEC includes a multi-layer approach, which included **awareness raising in the manner of workshops, guidelines and publications.**

The **Industrial Research Institute (IRI**), as a Lebanese nonprofit institution declared of public utility since 1955, linked to the Ministry of Industry, has been worked for several years to share the green education and awareness with the trainees' engineers of the Lebanese Faculty of Engineering, through researches in their multiple related laboratories.

Last but not least, **Eco Consulting** is a specialized sustainability and circular economy consultancy. They try to find cost-effective solutions to environmental issues through greater energy-efficiency, better resource use. Part of their services is offering **conferences, courses and workshops that can be customizable**. Some of their ongoing activities are: SwitchMed Green Entrepreneurship Program and Eco-Building, Eco-Design, Biomimicry, & LEED Green Associate Seminars, Beirut, Lebanon. In the past they were involved in the Build It Green Lebanon conference in all its version.

IX. Analysis and Evaluation – Lessons Learnt

Adhering to the reported findings, it can be concluded that Lebanon needs to build the right framework for eco-friendly construction in order to move towards Green Building Certification in its perfect status and in all its aspects. In this section, the report will be completed by analyzing and evaluating the current fiscal incentives, regulatory, technical and financial framework available in Lebanon that promote green building rating and certification with special highlights on the level of green education and awareness in the country. This assessment is the principal resource upon which the roadmap for promoting green buildings in Lebanon for the near future will be based (deliverable 3 of this project), apart from the good practices in Green Building industry in five other countries (deliverable 2 of this project). It is of utmost necessity as well to rely on the recommendations of the interviewees – main actors in the Green Building sector in Lebanon.

1. Regulation Aspect

The Lebanese legal and political landscape is complex. Lack of regulations is the larger problem for construction practices in general and the green ones in particular. The evaluation is done below by themes.

1.1. Building Code

In the local environment, many engineering and architectural practices, plans and applications can be seen that need a basic review in order to meet the conditions and requirements of green and sustainable buildings. This is especially true in the capital, Beirut, in cities and vast, overcrowded residential communities, which are responsible for the largest area of environmental damage, and some of them can be referred to:

- Adhesion between buildings is in conflict with green building systems;
- Air pollution from the use of household chemicals and emissions from electricity generators installed in the streets between buildings: Building plans and retreats must help the movement of air and not stagnate inside homes. The engineering and architectural plans must take into account and abide by the standards of air traffic and its transmission between adjacent buildings;
- Architectural and engineering plans must take into account allowing natural light to enter the building and pass through to the surrounding buildings;
- The creation of green spaces, especially on the ground floor of the building and on the roofs and facades, must be adhered to;
- Additional basements must be noted for car services and parking;
- The use of lightweight and insulating materials in interior and exterior walls should be encouraged;
- Care must be taken to implement the insulation of the building on all facades and surfaces;
- Air conditioning methods should be studied using high-efficiency equipment and the conventional systems should be banned;
- Modern efficient lighting systems and lighting control and operation systems must be approved;

- Solar energy systems must be adopted for water heating, waste water treatment, purification and reuse;
- The additional cost, investment and environmental impact bill should be considered and published.

Greening the Building Code was the goal for decades: a group of engineers and architects, including but not limited to many LGBC members, OEA members, etc.… worked on authorizing a systematic body of standards and codes, that promote environment-friendly sustainable planning and design serving as auxiliary design guidelines to professionals; the National Plans targeted the development of this Code. Yet, no Sustainable Building Code has been developed and adopted to date.

An important note taken from some interviewees should be highlighted as a main barrier: "in the elaboration process of new codes and standards, some inactive stakeholders such as public entities are not collaborating, the organization between the different stakeholders is inefficient".

Orders and associations must seek and pressure the relevant authorities in the Standards and Specifications (LIBNOR) and the government to issue a decree making environmental specifications for sustainable construction mandatory, and the Parliament must update and approve the Building Code to be more sustainable.

1.2. Energy Efficiency

After a meticulous look at of the local energy market in comparison to the global market, it is incontestable that the improvement of energy efficiency, especially in the domain of green buildings, has opened a wide door to achieving tangible savings in energy demand at the national level. However, the lessons that could be drawn from the above concerning regulations and incentives corresponding to **energy efficiency** can be summarized: several costly studies have been carried out in this area; more than one plan, policy and regulations have been developed; various tax and monetary incentives in favor of compliance with energy efficiency standards have been provided by public bodies, such as the ministries of Energy and Finance, the BDL, etc.;

Nonetheless, **actions in favor of energy efficiency remain relatively rudimentary**. As evaluated, only 18.6 GWh/year were saved after NEEAP I, while 2087.6 GWh/year of savings were targeted, and not all of the energy saved were achieved from NEEAP

initiatives. They are limited to the distribution of LED lamps, a few hundred subsidized loans for the purchase of solar water heaters, and the construction of certified ecological buildings. As for the evaluation of NEEAP II, it will be published by LCEC in the first part of the National Action Plan intended for 2021-2025. One of the main identified gaps in this NEEAP was the **lack of a clear baseline for energy savings** as reported by the World Bank Group[29].

Moreover, "given the high energy consumption of heating and cooling for both space and water, integrating efficient and sustainable heating and cooling applications also needs to be strengthened" as per the same report. "Building Envelope" measure represented 45 percent of total measures, which emphasizes the urgent need for promoting and deploying support programs to realize the full potential of efficient equipment (SWHs and heat pumps replacing the electric boilers and heaters) and boost efficiency and sustainability in Lebanon's heating and cooling sector.

Similarly, **the public has not been sufficiently informed of the regulations, plans, policies, and what they entail in terms of fiscal, and especially monetary, incentives in the field of energy efficiency**; and consequently, it has **not been made aware of it to take advantage of it** and contribute to the achievement of the objectives of this efficiency, as if the financial advantages provided for this purpose were reserved for the privileged.

1.3. Renewable Energy

Deductions can be drawn from the above, concerning renewable energies in Lebanon, that the legal ingredients (exploitation, privatization, fiscal and monetary incentives, electricity regulatory body, BOT, Net-metering, etc.), that are supposed to promote the utilization of these energies, are dispersed over several types of regulations. Instead, they should be the subject of a single coherent, integrated and strong law; especially since **most of these regulations are not applied and have fallen into disuse.** There has been, for decades, a lack of a stable regulatory framework for renewable energy deployment and incomplete implementation of Law 462. On top of that, high subsidies and low tariffs of the national grid (when available), the limitations of enabling schemes for small-scale RE

[29] **Lebanon-Power-Sector-Emergency-Action-Plan_World Bank Report**

applications are considered additional barriers for the renewable energy outlook[30]. It goes without saying that this set of regulations in no way encourages the private sector to invest in these energies, when the country strongly needs this kind of investment, to provide electricity to citizens, at a time when the State withdrew its investments in the electricity sector due to its deep financial crisis.

2. Technical Aspect

2.1. Rating Systems and Green Labeling

A 'green' building is a building that, reduces or eliminates negative impacts and can create positive impacts, on the climate and natural environment, in the phases of its design, construction or operation. How do you verify that your construction is green? Why do you certify it under a green label of course! Green certification is an important market instrument of sustainable development strategies. The main purpose of ecolabels is to alleviate the environmental burdens of human consumption, thus slowing the depletion of the natural environment[31]. Green Labeling is a voluntary method of environmental performance certification and labelling practiced around the world.

In Lebanon, international labels like LEED and BREEAM have been adopted for certifying a few commercial and residential buildings but have not been extensively embraced on a national scale. Unfortunately, green labeling has not taken off in Lebanon as hoped and the main barrier standing in the way of more adoption of green certifications being mostly the **high prices of registrations and reviews of these international labels**. A drawback that gives **locally developed and administered certification schemes** which are tailored for the Lebanese context in the building sector, a clear benefit. The local certificate's main target is to **make registrations more affordable as well as make the process of achieving certification less complicated for project owners**. ALMEE are currently working on perfecting their own green label GRASS Med in collaboration with other entities from the Mediterranean. LGBC have already developed their own local label ARZ 1.0 back in 2011,

[30] **IRENA_Outlook_Lebanon_2020**
[31] **EPA, 1994**

and is currently updating it to ARZ 2.0 GBRS. ARZ 2.0, in particular will be a web-based public portal that will be accessible to a wide community of users. It will enable project owners to **evaluate their project and assess their status free of charge, before attempting to register for certification process, while adapting to the local context**. Furthermore, the assessor reviews will be of minimum charge if requested by project owner. This **innovative approach will assist project owners to understand their projects requirements and will also give awareness guidelines to be able to achieve a better road towards a higher certification, both economically and sustainably.**

Looking at all labels together, this report is aimed at introducing, comparing and evaluating all points pertaining to each and putting down a table (Table 6) that can be considered a practical comparative tool.

2.2. Technical Standards, Codes and Norms

There are many technical challenges/barriers/gaps faced by professionals and institutions working in the Green Building industry in Lebanon, and are listed here below:

- **Greening the building code** is a project that has been stopped although it is a necessity as per almost all the related stakeholders interviewed.
- The current building code **does not tackle existing buildings** because of their various ownership status (owned, rented, old rent).
- **Standards and criterion are still optional**. To mention that, as per one of the interviewees, the lobby of interest is a big barrier: Some people with conflicting interest, real estate companies for example, have the connections to decisions makers and hinder making the codes mandatory.
- The absence of implementation and verification scheme that ensures proper installation. **Inspection is a challenge to the responsible entities**, namely OEA and Urban Planning, and must be done at different stages of the construction;
- Buildings or houses of 250 m2 or less does not need an engineer signature, which means that the drawings and the design are **not verified by a competent engineer** registered at the Order of Engineers and Architects.
- The **lack of specialist in the technical execution** of the Green Building measures;
- The **lack of data** about the energy efficient products and green materials available in the local market.

3. Financial Aspect

As a result, there was **no shortage of project funding mechanisms** in the areas of green buildings, renewable energy, and energy efficiency. However, **almost all these mechanisms are frozen today**, because of the banking crisis and that of the BDL, although their refinancing is foreign for the most part. As mentioned before in this report, it was not possible to access to the loans for Green Buildings from LCEC nor BDL, yet it might be published in the new National Action Plan 2021-2025 as mentioned in the interview with LCEC.

As per the survey conducted in this project, it is necessary to highlight that the existing financing mechanism mainly targeted medium and large projects with little interest in small projects. Creation of the NEEREA financing mechanism was the most successful achievement of the plan[32]. Distribution of NEEREA loans indicates that some sectors are not sufficiently participating in EE & RE national roadmap. As such, implementation of EE and RE measures across all sectors need to be reinforced, with special focus on the buildings sector, which is the main source of savings on the end-user side (up to US$46 million of savings per year) as per the same report.

In a more general view, and as per the World Bank Report, building a better Lebanon requires **swift and decisive action, particularly on reform**. In the immediate term, Lebanon needs to adopt and implement a credible**, comprehensive and coordinated macro-financial stability strategy within a medium-term, macro-fiscal framework**…The extent and speed to which aid and investments are mobilized will depend on whether **the authorities and the Lebanese Parliament can act swiftly on the much-needed fiscal, financial, social and governance reforms.** Without these, recovery and reconstruction cannot be sustainable, and the social and economic situation will continue to worsen, also as per the World Bank Report[33].

Reinforcing the NEEREA financing mechanism and other incentives and grants is essential. To make effective any law **for EE, RE, and green buildings**, the respective existing

[32] **World Bank GROUP: Lebanon Power Sector Emergency Action Plan**

[33] **Retrieved in: https://www.worldbank.org/en/country/lebanon/overview**

financing mechanisms should be competitively rebooted, and new credit lines and grants should be established. The public sector should also participate in conservation, which could be aided by, enforcing payment discipline for their EDL consumption as a start, taking the lead by certifying their own buildings and creating financing mechanisms that **encourage investment in EE and RE projects**.

4. Market Aspect

Lebanon needs to create the **right framework for developers and users**, real estate buyers, and building occupants. This is how the market could be given an incentive to invest more in green buildings. If users are channeled toward buying green buildings, it will certainly influence the developers.

It is necessary to mention that lots of people have been using green certification to promote their projects and they are not delivering green certification at the end. Above that, there are no proper penalties that are applied to those people. This issue has become very widespread as reported by many interviewees-professionals in this field.

The electricity sector price reform is an essential part of any strategy which intends to provide an enabling environment for Green Building investments in Lebanon, yet the unavailability of the electricity nowadays became one of the essential reasons pushing towards thinking of renewable energy resources solutions and consequently eco-friendlier buildings.

5. Education and Awareness Aspect

With all the political and financial concerns weighing down on Lebanon, ecological issues were not a priority to most Lebanese, until recently. Literature shows that only a handful of NGOs, global corporations and the Ministry of the Environment are currently addressing ecological issues in Lebanon, but only enough to scratch the surface. From the current state-of-affairs, the following questions arise: How can sustainable energy and green building education be integrated into current curriculums, and how can Lebanon's education on a larger spectrum be modified to encourage sustainability? Looking at the

current situation, it is clear that the challenges and barriers holding back Lebanon are many. This could be attributed to matters like migration of professional and academic brain power, and the political crisis which has caused the education sector to close down several times in the past few years, problems with financing green projects, or green education programs that are too expensive to students and professionals alike. With that being said, the biggest barrier is the absence of a serious national view for the green education in Lebanon which can be easily amended by more and more awareness to ordinary citizens, educators, technicians, professionals and experts in engineering and architecture. Analyzing the interviews results, all interviewees agreed on the fact that awareness efforts are still lacking and to a large extent. On a positive note, Lebanon has some of the finest schools and engineering and architectural faculties in the region, as well as professionals who are striving to reach the goal of sustainable construction. With the right financing, both private and public, early awareness in schools and educational institutions, municipal campaigns, and hands on workshops, the future generations can be encouraged to look at things with new eyes and more responsibility, to fully understand sustainability and green construction and potentially enroll in those programs during higher education. This can also be an incentive for universities to offer mandatory, not only elective course, and to create more affordable programs.

In addition, the Government should increase awareness, build capacity and gain trust of all stakeholders working in the EE, RE and Green Building sectors through regular communication, consultations, and information disclosure. One of the primary objectives of laws is to formulate a specific social consciousness. Therefore, it is the responsibility of those concerned stakeholders to spread awareness on the impact of sustainable construction on the environment and human lives.

6. Recommendations as per stakeholders

Finally, presented are some action **recommendations** that could possibly increase the number of applications and buildings certified in Lebanon **based on the lessons learnt and the best practices reported by the actors in this sector.** These recommendations are put in decreasing order of importance from the most important to the least one:

- Create fiscal incentives, rebates and long-term/low interest rate loans for green building and certification, efficient equipment and green materials which would be oriented toward the rights of the poor and the responsibilities of the rich.
- Combine public and private financing through Public Private Partnerships.
- Prioritize green building and sustainability at the policy level; implement legislative measures and building regulations.
- Adopt the local adapted rating tools that take into account the characteristics of the country specifically for small projects, reduced/free of charge.
- Develop a national strategy for awareness and education centered around green buildings.
- Publicize the merits of green building certification.
- Train professionals and engineers to manage building projects and certification.
- Train and build the capacities of the decision makers for regulations about Green Buildings and all related themes.
- Enforce a minimum level for green building certification for public service buildings.
- Conduct and disseminate academic research to the industry.

Climate change can harm human health and societies, and it is human's responsibilities to lift this damage off the environment and nature. Individual responsibility, as the responsibility of public and private institutions, orders and associations, and a general commitment to environmental applications and green systems, are necessary to alleviate the burdens of environmental degradation. Buildings are the largest consumers of natural resources and the main cause of pollution. Buildings can contribute in reducing environmental damage and creating healthy residential environment if green architectural and construction systems are adopted. Green architecture is becoming a global movement. This is thanks to the use of assessment tools for green buildings (Rating Systems – Green Building Tools), which began by studying the environmental impact of energy, water and waste uses. But today it includes the study of social and economic measures. It may be essential to move beyond the word "Green" to describe buildings, and "Sustainable Building" may be the answer.