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BEST PRACTICES FOR GREEN BUILDINGS AROUND THE WORLD

August 2022

ALMEE

ARZ
BUILDING RATING SYSTEM

LGBC
lebanon green building council
مجلس لبنان للأبنية الخضراء

Best Practices for Green Buildings Around the World 2022

Editorial
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Acronyms and Abbreviations

A	
ACTE	**Alliance des Communes pour la Transition Énergétique**
AFD	**French Development Agency**
ANME	**National Agency for Energy Management (Agence nationale pour la maîtrise de l'énergie)**
APEET	**Support for the Promotion of Energy Efficiency in Tunisia**
ANPA	**National Environmental Protection Agency**
B	
BCA	**Building and Construction Authority**
BIS	**Bureau of Indian Standards**
BEE	**Bureau of Energy Efficiency**
C	
CFL	**Compact Fluorescent Light**
D	
DEF	**Economy and Finance Document**
DT	**Tunisian Dinars**
E	
EE	**Energy Efficiency**
EEBs	**Energy Efficiency Building codes**
EBRD	**European Bank for Reconstruction and Development**
EIC	**Energy Information Centre**
ESCO	**Energy Service Company**
EU	**European Union**
ECA	**Energy Conservation Act**
ECBC	**Energy Conservation Building Code**
Eerg	**End-use Efficiency Research Group**
EIB	**European Investment Bank**
ENEA	**National Agency for New Technologies, Energy, and Sustainable Economic Development**
EPBD	**Energy Performance in Buildings Directive**
F	
FTE	**Energy Transition Fund**
FAR	**Floor-to-Area Ratio**

G	
GEM	**Green & Ecofriendly Movement**
GPP	**Green Public Procurement**
GRIHA	**Green Rating for Integrated Habitat Assessment**
GIZ	**German Agency for International Cooperation**
H	
HPE	**High Energy Performance**
I	
ITACA	**Institute for Innovation and Transparency in Procurement and Environmental Compatibility**
IGBC	**Indian Green Building Council**
INBC	**India's National Building Code**
INAIL	**National Workers' Compensation Authority**
JJGBC	
JGBC	**Jordan Green Building Council**
JGBG	**Jordan Green Building Guide**
JGBGRS	**Jordan Green Building Guide Rating System**
JNBC	**Jordan National Building Council**
JTIC	**Jordan Thermal Insulation Code**
M	
MATT	**Ministry of the Environment and Land Protection**
MEC	**Minimum Environmental Criteria**
MEMR	**Ministry of Energy and Mineral Resources**
MENA	**Middle East and North Africa**
MoEFCC	**Ministry of Environment, Forest and Climate Change**
MSME	**Micro, Small and Medium EnterprisesNational Action Plan on Climate**
N	**Change**
NDC	
NEEAP	**National Determined Contributions**
NECP	**National Energy Efficiency Action Plan**
NERC	**National Energy and Climate Plan**
NMEEE	**National Energy Research Centre**
P	**National Mission for Enhanced Energy Efficiency**
PACS	
PAT	**Performance Appraisal Certification Scheme**
PSTLES	**Perform achieve and Trade**
PRGFEE	**Public Sector Taking the Lead in Environmental Sustainability**
PMC	**Partial Risk Guarantee Fund for Energy Efficiency**

PMRDA	Pune Municipal Corporation Pune Metropolitan Region Development Authority
R	
RE	Renewable Energy
REC	Renewable Energy Certificates
Rev'ACTE	Network of Allied Cities for climate and Energy Transition
R&D	Research and Development
RPO	Renewable Purchase Obligation
S	
SIDBI	Small Industries Development Bank of India
SDG	Sustainable Development Goals
SGBMP	Singapore Green Building Master Plan
SLE	Super Low Energy
STEG	Tunisian Company of Gas and Electricity
T	
Toe	tonne of oil equivalent
TRB	Thermal Regulations of the Buildings
TSP	Tunisian Solar Plan
U	
UDH	Urban Development and Housing
V	
VECFEE	Venture Capital Fund for Energy Efficiency
W	
WB	World Bank
Z	
ZED	Zero Effect, Zero Defect

Context

This report presents a descriptive study detailing what instruments and/or regulation are present to incentivize green building certification (and their respective effectiveness) in five countries: Jordan, Tunisia, Singapore, Italy and India. The objective of this report is to highlight best international practices in the adoption of regulatory, fiscal and/or other incentives and instruments to successfully promote green building certification and activities/actions for better/greener certification but also the gaps, constraints and technical, institutional and legal insufficiency limiting the success of those strategies (if existing) in those countries.

Each country case is concluded by describing the key points generating success/failure of those stories, putting in front the different challenges that prohibited this industry in those countries.

SECTION A: JORDAN

I. Introduction

As part of the MENA Region, Jordan faces significant energy challenges. In order to ensure reliable power, Jordan imports natural gas to satisfy approximately 78% of electricity needs, while renewable energy (RE) sources account for 20% of power generation. [1] The evolution of standards of living, the increased needs for heating and cooling, the ever-increasing energy prices (as of July 2022) and the global economic crisis

[1] Ministry of Energy and Mineral Resources, "Annual Report 2020," 2020

have impacted low-income households and slowed down poverty reduction[2]. As the second most water scarce country in the world according to UNICEF, Jordan is already impacted by climate change, and following the Paris agreements, the Kingdom has doubled its efforts to address climate mitigation and adaptation. Recently, Jordan's National Determined Contributions (NDC) were updated and the new GHG emission reduction national goal was raised from 14% to 31%[3]. To face those challenges, Jordan counts on national policies, programs and actions and international support and finance. In 2019, 80% of the Jordanian population were living in cities. The residential sector in Jordan accounted for 21% of the final energy consumption and 46% of the total electricity consumption[4]. Green Building offers the advantages of reducing energy and water consumptions and the environmental impact of buildings while raising health and safety standards. International (LEED, BREEAM, etc.) and Regional (Qatar GSAS, etc.) building certification schemes compete or complement The Jordan Green Building Guide Rating System (JGBGRS) on the Jordanian Green Building market, but the numbers of accredited buildings are unfortunately low (7 LEED certified Buildings in 2017 according to Jordan GBC[5]).

The following sections will focus on Green Building to see how, in this context, the Jordanian Government has taken action to face its challenges by formulating and strengthening national policies, changing legislation, creating an Energy Efficiency Building Code (EEBC), creating incentives and financing schemes, and sharing information to the concerned stakeholders.

II. Local Green Building Rating System in Jordan

Efforts started in 2009 to develop a rating system for buildings that will reduce the energy and water demands and provide an efficient and healthier environment. Jordan has several LEED registered buildings, since 2009. One of them is LEED Silver and two

[2] United Nations Development Program UNDP & The Government of Jordan, "Jordan poverty reduction strategy, final report," 2013

[3] Ministry of Environment, "Updated Submission of Jordan's 1st Nationally Determined Contribution (NDC)," 2021

[4] Jordan Green Building Council, "Developing an Energy Benchmark for Residential Apartments in Amman," 2019

[5] Jordan Green Building Council, "Your Guide to green Building in Jordan - Green Building Informative Booklet," 2017.

are LEED Gold, and around 20 more building are registered online and are in the process of applying for LEED. The energy crisis started in Jordan in 2008 after the sharp increase in energy prices. Subsequently, attention to energy consumption in buildings increased, and the building officials started implementing the local building codes related to energy. About twenty-seven National Building Codes in Jordan are directly related to building envelop, natural ventilation, natural lighting, mechanical and electrical systems. International references from leading sustainability rating systems were used as references such as LEED and BREEAM, with emphasis on the local conditions in Jordan pertaining to energy and water scarcity for the development of the Jordan Green Building Guide (JGBG). This green building guideline and rating system for Jordan is referenced to Jordan 's Related Building Codes (as compulsory requirements), and international green rating systems such as LEED from the United States, BREEAM from the United Kingdom, ESTIDAMA from Abu Dhabi, Dubai green building rating system, QSAS from Qatar, and many more.

This Guideline is attached to a voluntary rating system that is connected to an incentive scheme given by the government. The chapters of the Guideline contain credits that are divided into three requirement levels:

- Mandatory Requirements (MR): Requirements that are subtracted from related Jordanian Codes and related to the green application of the credit, and it has no points rewarded.
- Obligatory (rewarded) Requirements (OR): Requirements that are not mentioned in Jordanian codes of practice as mandatory minimum requirements, but are essential for the green building practice. Therefore, these requirements are obligatory for a building to pursue the green building certification, and they are rewarded with points when achieved.
- Voluntary Requirements (VR): Requirements that are totally voluntary for precise building types and specifications, attached to rewarded points.

Since green buildings have a profound impact on the natural environment, economy, health & productivity, the guideline assesses building designs in six key areas:

- Green Building Management
- Site Sustainability
- Water Efficiency

- Energy Efficiency
- Healthy Indoor Environment
- Materials and Resources

Owners and developers that adopt the JGBG rating system will be entitled to an increase in the Floor Area Ratio (FAR). The JGBG has four levels:

- Level A (25% increase in FAR allowed)
- Level B (20% increase in FAR allowed)
- Level C (15% increase in FAR allowed)
- Level D (10% increase in FAR allowed)

The Greater Amman Municipality (GAM), Green Building Unit, is in charge of managing the registered buildings under the JGBG.

The Jordan Green Building Council (JGBC), a non-profit and non-governmental organization and member-based association, took the responsibility of advocating for the adoption of green building practices and actions. It aims to drive such change by providing internationally certified training programs and generating sustainable projects and business opportunities for its members to be a part of. Furthermore, the Jordan GBC provides a powerful, collaborative platform of active members and partners on a local, regional and international level; who share interests and encounter similar challenges and opportunities in the green buildings sector. This platform enables networking opportunities, maximizes business, exchanges knowledge, and generates new ideas to achieve results faster and more effectively, allowing members to be at the frontline across all segments of the building sector, for a green and sustainable industry and economy. Additionally, Jordan GBC partners with public sector agencies, to create and establish a stronger policy level, that would promote and enhance the existing programs and projects of national sustainable growth.

The Jordan Green Building Guide Rating System's objectives are:

- Introduce basic Green Building concepts, thought to be comprehensive and adapted locally.
- Provide guiding for an optimal use of solar energy in Buildings
- Maximize Building occupants' comfort
- Preserve Building occupants' health

- Increase Thermal efficiency
- Enhance energy consumption efficiency via thermal insulation
- Review Building materials and installation techniques
- Increase thermal efficiency, enhance energy consumption efficiency via thermal insulation
- Review most of building materials and installation techniques
- List air influx and ventilation requirements in occupied indoor spaces, and methods for utilizing natural ventilation.

The first buildings under the JGBG requirements are under development.

III. National Plans and Programs

The Ministry of Energy and Mineral Resources (MEMR), in cooperation with the National Energy Research Centre (NERC), has developed an **Energy Efficiency Strategy (April 2004)** to define energy savings targets and goals[6]. The strategy targets reducing energy consumption without negatively impacting living standards in Jordan. It also identifies several policies related to energy subsidies, taxations and custom duties to achieve the target goals.

The **National Energy Strategy (2007-2020)** aimed to achieve ambitious energy savings targets and increase the contribution of renewable energy sources within the national energy supply[7]. It indicated that EE and small-scale RE projects are to be implemented within the various energy consuming sectors in order to achieve a reduction of 20% of Jordan's energy consumption by 2020[8]. Law no 73 (approved in Nov.2012) announced the EE policy and it regulates the procedures and means of conserving energy and improving its efficiency.

[6] **Shahin, 2010**
[7] **Energy Charter, 2010**
[8] **MEMR, 2007**

The **first National Energy Efficiency Action Plan (NEEAP)** was published by the Ministry of Energy and Mineral Resources in **2013**. Table 1 lists the NEEAP's Energy Efficiency Measures toward the Building Sector, their completion rate and the estimated energy savings made as described by the Ministry of Energy and Mineral Resources[9].

Table 1: NEEAP's Energy Efficiency Measures toward the Building Sector in Jordan

Measure (as numerated in NEEAP)	Completion (Energy Consumption Reduction)	Description
Measure 1 Residential	Rate of completion 20% (49.2 GWh over 246 GWh).	Replacement of 1.5 million incandescent lamps with energy efficient lamps, CFL. The implementing agency was the Ministry of Energy and Mineral Resources together with distribution companies.
Measure 2 Residential	Rate of completion 100% (91 GWh)	Energy Label program for four home appliances. Standards and labelling for household appliances were adopted on 2014, as Jordan refrigerators; freezers; air conditioners; washing machines Mandatory were adopted in 2014.
Measure 3 Residential	Rate of completion 10% (14.7 GWh over 147 GWh)	Installation of 30,000 Solar water heaters. About 10% of the planned Solar Water Heaters (SWHs) were installed regarding the target for this measure.
Measure 5 Residential	Rate of completion 70% (17.5 GWh over 25 GWh).	Installation of 5,162 Solar water heaters in cooperation with Jordan River Foundation. According to JREEEF, a total of 3600 SWHs were installed.

[9] **Ministry of Energy and Mineral Resources, "The Second National Energy Efficiency Action Plan (NEEAP 2018-2020) for the Hashemite Kingdom of Jordan," 2017**

Measure 6 Industrial	The rate of completion was achieved to 100% (80.4 GWh).	Mobile Energy and Environment Clinic Program. The program provides full energy audits to any entity whose annual energy consumption exceeds 50 toe per year and offers support to cover 90% of energy audit costs.
Measure 7 Commercial	Rate of completion 30% (15 GWh)	Replacement of conventional Ballasts by Electronic Ballasts for fluorescent Lamps
Measures 10	Rate of completion 30% (9.9 GWh over 33 GWh).	Exemplary role. Reduce the consumption of public buildings by 10% + Replacement of 50,000 of incandescent lamps with compact fluorescent lamps, CFL
Measure 11 Public Helath	Rate of completion 10% (0.9 GWh over 9 GWh)	

Source: Ministry of Energy and Mineral Resources, 2017

In 2017, The Second National Energy Efficiency Action Plan was released for the **2018-2020** period and introduced more measures, a considerable number of which targeted Buildings. The successive NEEAPs' broad strategy goal was to improve Energy Efficiency by 20% by 2020 based on baseline average consumption of the 2006-2010 period, implying an important effort of 17.5% of energy savings based on the same baselines for the new period, the biggest part of which are to be made in the Building Sector (22.4% for Residential, 12.7% for Industrial, 20% for commercial).

Table 2 shows the measures intended in the 2nd NEEAP[6]:

Table 2: Measures in the 2nd NEEAP toward the Building Sector in Jordan

Measure (as numerated in NEEAP)	**Estimated Energy Savings (GWh)**	**Description**
Measure 1 Residential	155	Replacement incandescent lamps with LED for low and medium households income classes (<600 kWh/month)
Measure 7 Public Buildings	2	1 million LED targeting 250000 consumers Replacement of Fluorescent Tubes in public buildings 80,000 of 10-watt Tube- LED Lamps Replacement of Fluorescent Tubes in commercial buildings by LEDs
Measure 9 Commercial and Service sector	66	Replacement of 250.000 units of Fluorescent Tubes 4x18 watt with LED 60 cm Tubes.
Measure 2 Residential	400	Enforcement of Energy Label and standards program for 4 home appliances Air conditioning - Refrigerators - Freezers - Washing machines
Measure 3 Residential	401	EE building codes enforcement in residential sector (just insulation) About 66000 new households during the next 5 years.
Measure 11 Commercial and Service Sector	249	EE building codes enforcement in tertiary sector (Just insulation) About 5700 new units during the next 5 years.

Measure 4 Residential	41	Program for roof insulation of existing building in residential sector 15000 houses with around 2 million m² of roof. (1 and 2 floor houses) pilot program for the period 2018-2020
Measure 6 Public Buildings &	36	Jordan public building energy efficiency program of public building retrofitting
Measure 8 Commercial and Service Sector	12	Energy efficiency in health centers 300 to 400 small and medium hospitals in all Jordan
Measure 10 Commercial and Service Sector	11	Energy efficiency in existing small and medium hotels 100 to 120 small and medium hotels in all Jordan
Measure 11 Industrial	383	EE program in industrial Sector Energy Efficiency measures implementation, 50 industries annually

Source: Ministry of Energy and Mineral Resources, 2017

The Ministry of Energy and Mineral Resources (MEMR) launched **Jordan Energy Strategy (2020-2030) in July 2021**. For improving energy efficiency in various sectors, the strategy recommends a 9% improvement by 2030, compared to 2018 levels. The strategy proposes reducing carbon emissions by 10% by 2030. It also aims to increase renewable energy's share in the energy mix from 11% in 2020 to 14% by 2030. This increase is less than what Jordan achieved in the period 2015-2020 where renewable energy's contribution rose from 2% to 11%.[10].

[10] **The Jordan Times (20 July 2020)**

In October **2021,** Jordan published a revised version of its **first Nationally Determined Contributions (NDC)** in which officials reassert their commitment to address climate change mitigation and mostly adaptation through a set of measures among which the reduction GHG emissions and formulating the Green Building legislation. The retrofitting of the existing Building stock, taking into account energy and water conservation according to Green Building standards, is believed to hold a major potential for GHG emission reduction[3].

IV. Standards and Regulations

In Jordan, there are no Green Building Code per se. However, there are parts of the Building Code that are directly linked to Green Building concepts, notably the Jordan Thermal Insulation Code (JTIC), the Energy Efficiency in Buildings Code (EEBC) and the Jordan Green Building Guide (JGBG). The code compliance could reduce the energy use in buildings up to 40%[11].

The Jordan National Building Council (JNBC) has authority on the development of the Building Codes in Jordan. The JNBC is considered a division of the Ministry of Public Works and Housing (MoPWH). The Sustainable Building Center (CSBC), part of the Royal Scientific Society, as well as technical advisors from a panel of experts and researchers from both the private and public sectors, took part in the technical advising and design of the EEBC and JGBG.

Other Building related codes have been issued, and are listed subsequently.

1. The Jordan Thermal Insulation Code (JTIC)

The Insulation code is mandatory since 2000. This code aims at defining the building thermal design principles, and the methods for calculating the thermal characteristics of different structural elements. Additionally, furnish the minimum thermal requirements for these elements to facilitate the best selection by the engineers to achieve thermal

[11] **Improving the Energy Efficiency of the Residential Buildings in Jordan, 2018**

comfort in buildings. This code was issued in 1985 and updated in 2008. It is updated to reduce the energy consumption through the application of specific requirements and provisions. Although mandatory, no real efforts were made in implementing the first Insulation code. It's only after the energy crisis of 2008 and consequently a sharp rise in energy prices that Building officials began the implementation of the Insulation code. However, although Mandatory, 77% of Jordanian dwellings lack insulation and only 9% comply with the code[12].

2. The Energy Efficiency Building Code for Jordan EEBC

The Jordan National Building Council (JNBC) contracted the Building Research Center at The Royal Scientific Society (RSS) to develop a new Code of Practice, titled **"Energy Efficiency in Buildings Code" (EEBC),** for improving thermal performance and minimizing energy consumption in buildings. This code was developed in 2010 and approved by the Ministries Council under the Renewable Energy & Energy Efficiency Law # 13 in 2012 (REEEL), in order to become experimented and later to be obligatory for all types of buildings in Jordan (This code was mandatory in the beginning only for the **residential buildings** when the ratio of the net floor area is less than four times the roof area). This code was updated and issued in 2015 and still waiting to be approved by the Ministries Council in order to become experimented and later to be obligatory for **all buildings** in Jordan. On the energy level, the code compliance could reduce the energy use in buildings up to 40%. EEBC has a similar structure as ASHRAE 90.1 and addresses: Envelope, lightings, HVAC, Hot Water, etc. The Code is now in the process of being updated[13].

The Government in Jordan requires all new buildings to meet mandatory energy efficiency building code (EEBC) that aim to minimize the life-cycle costs of buildings' energy use. EEBC is taking a holistic approach that includes the building envelope and the lighting, heating ventilation and cooling systems within the building.

[12] I. A.-H. &. H. Al-Sallami, "Potentials and Barriers of Energy Saving in Jordan's Residential Sector through Thermal Insulation," Jordan Journal of Mechanical and Industrial Engineering, pp. 141 -145, 2017

[13] Royal Scientific Society, "Jordan National Building Codes - Energy Codes and Manuals," 2020.

The typical EE measures taken into consideration are as the following:

- For residential
  - Thermal insulation and double glazing
  - LED lighting
  - SWHs and PVs
- For non-residential
  - Thermal insulation and double glazing
  - LED lighting
  - PV systems
  - VRF HVAC systems

3. The Jordan Green Building Guide (JGBG)

The Construction and Sustainable Building Center (CSBC) at the Royal Scientific Society with the help of specialists in the public and private sector leaded the development of the Jordan Green Building Guide (JGBG) that was issued in 2013, and became available to everyone to use. The Green building guideline contains parameters and credits that are suitable for Jordan's climate, resources, legislation, policies, building techniques and strategies. This Guideline is attached to a voluntary rating system that is connected to an incentive scheme provided by the government. It is for the use of energy efficient Green Building Rating System along with a green project checklist for the use of candidates that apply for the green building assessment process. In addition to the need for reducing Jordan's energy consumption in buildings, and ultimately decreasing the burden of the energy on the economy. For the development of the Jordan Green Building Guide (JGBG), International references such as LEED and BREEAM were used as base models and adapted to the local conditions of Jordan regarding Energy and Water Scarcity. The country is divided into three climatic regions.

4. The Synergy between EEBC, JTIC, and JGBG

The Jordan Thermal Insulation Code, Jordan Energy Efficient Building Codes and the Jordan Green Building Guide are complementing each other toward improving energy use in Buildings.

The Thermal Insulation code and the Energy Efficiency Building Code call for the mandatory requirements in Thermal Transmittance for the envelope of U-value = 0.57

W/m².K for walls and U-value = 1.60 W/m².K for the overall U-value for walls with all openings. The Jordan Green Building Guide will give one point for the buildings with walls U-value below 0.50 W/m².K and two points for buildings with walls U-value = 0.40-0.50 W/m².K as shown in the Figure 1.

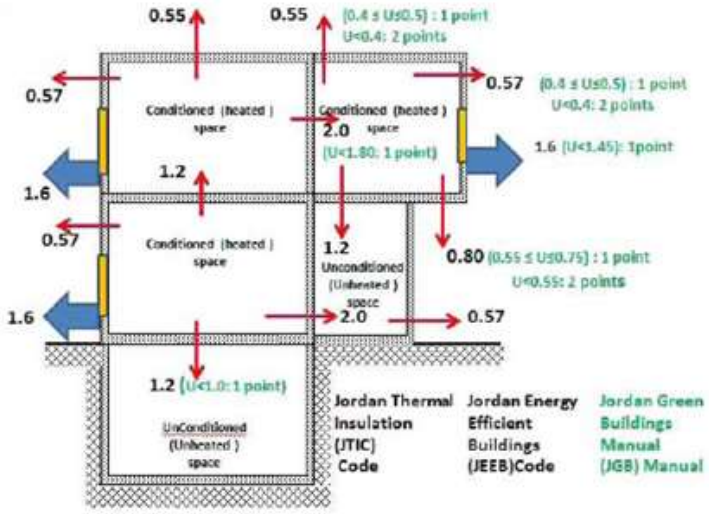


Figure 1: Requirements of EEBC and JGBG
source: JNBC

5. List of relevant codes in Jordan

In order to help users understanding codes requirements, the RSS is developing and updating user guides explaining Building regulations and their applicability. Below, the relevant codes in Jordan are listed.

Table 3: List of relevant codes in Jordan

Code	Code Manual Available	Description
Thermal Insulation Code	yes	Defines the Building Thermal design principles and the methods for calculating the thermal characteristics of different structural elements. Sets the minimum thermal requirements for these elements to facilitate selection by engineers

Jordan Green Building Guide (JGBG)	no	The Green Building Guideline and rating system for Jordan is Referenced to Jordan's Building Codes (as compulsory requirements), and contains concepts from LEED, BREEAM and other regional GBRS. The Green building guideline contains parameters and credits that are suitable for Jordan's climate, resources, legislation, policies & policies instrument, building techniques and strategies. This Guideline is attached to a Voluntary rating system that is connected to an incentive scheme given by the government
Natural Lighting Code	no	Gives data for specialists and engineers and designers about the importance of daylight in design, methods for calculations, methods for control, and energy saving from using natural light instead of artificial electric lighting with regards to the energy efficient building code. All requirements mentioned in this code are applied to: - new public and private buildings, - existing buildings modification, - existing building extension.
Interior Illumination Code	no	The code objective is to provide buildings with air flow, without air currents, with capability of control, by utilizing outside wind, temperature differences between inside and outside the building, external openings design, and the building spaces. New buildings, extensions on existing buildings, and adjustments to existing buildings (without energy consumption increase), are required to apply the requirements.

Energy Efficiency Building Code	yes	The code aims to provide minimum requirements for energy efficiency in buildings excluding the low-rise residential buildings (two floors or less). The draft contains seven sections dealing with the most important information the engineer needs to carry out the design, implementation and operation of buildings in accordance with the requirements of the minimum energy efficiency. The requirements in this draft apply on the following: (A) New public, private, and multi-purpose buildings and their systems. (B) New parts of public, private and multi-purpose buildings and their systems. (C) New systems and devices in all existing buildings. (D) New systems and devices used in manufacturing and industrial processes. This code also includes a mechanism to verify the application of the code requirements.
Solar Energy Code	yes	The purpose of this code is to indicate the minimum requirements that have to be met in solar energy systems, whether they are solar photovoltaic systems or solar thermal systems, in order to ensure the protection of public health and safety and the public good. This drat also indicates the specific specifications for the type of materials and their quality, which must be referred to when designing the components of these systems. The requirements and conditions in this draft are applied to the construction, installation, modification, restoration, relocation, replacement, addition, use, and maintenance of solar thermal systems and solar PV systems. Currently being updated.
Central Heating Code	yes	This code aims to provide the minimum requirements for comfort, public health and safety, and to achieve ways to reduce energy consumption and its means, by organizing design, construction, installation, quality of

		materials, location, operation, maintenance and control in central heating systems in hot water. The code includes everything related to the design, implementation and operation of central heating systems that use hot water, and the use of devices and equipment such as section radiators and underfloor heating systems.
Mechanical Ventilation and Air Conditioning Code	yes	This code aims to provide the minimum requirements for comfort, health, general safety and security resulting from mechanical ventilation systems and air conditioning for space while achieving energy saving and environmental conservation, through organize and control of design, planning, installation, quality of materials used, examination, operation, maintenance and safety of mechanical ventilation and air conditioning systems. It includes the most important information needed to carry out the work of designing mechanical ventilation and air conditioning systems for buildings and facilities, implementing, installing, testing and operating them

Source: Royal Scientific Society, Jan 2020

6. Relevant Laws

The **Renewable Energy & Energy Efficiency Law # 13 in 2012 (REEEL)** marks a turning point in the country's Green Building history, as it not only tackled EEBC enforcement, but also established a framework for major measures and incentives.
The installation of PV systems is encouraged with the article 10 of The REEEL No. 13, which allows solar systems owners and small electricity producers to be connected to the grid (net metering).

There is a statutory **obligation to install SWHs**, starting April 2013, to improve energy performance in the building sector by integrating renewable energy sources (as SWHs) in the building system, Jordan requires mandatory installation of SWHs in new

residential buildings exceeding 250 m2; in apartments exceeding 150 m2; and in offices exceeding 100 m2 (**Article 10, Bylaw No 73, 2012).**

Any entity of the **industrial sector**, whose annual energy consumption exceeds 50 toe per year, shall be subject to the **mandatory and periodic energy audit** carried out by the licensed entities. (**Article 18, Bylaw No 73**). In addition, the program "**Mobile Energy and Environment Clinic Program**" was initiated by Amman Chamber of Industry and provided **full energy audits and offers support to cover 90% of energy audit costs.**

V. Incentives and Financial Mechanisms

1. Incentive program for the adoption of green building in Jordan

An incentive program for the adoption of green building in Jordan based on the JGBG rating system was approved in 2015 and it was launched on the 3rd of September 2015.

2. The Renewable Energy and Energy Efficiency Fund (JREEEF)

The government of Jordan has established the Renewable Energy and Energy Efficiency Fund (JREEF) to provide the necessary investment needs for the development of renewable energy and energy efficiency projects. It was created in 2012 by the EE and RE Law N°13 (articles 12, 13, 14, 15 and 16) and became operational in 2015 after the promulgation of the By-Law N° 49 of 2015. The Fund was designed with five main components, referred to as "windows". Each window provided support to one or more of the various development stages of EE and RE activities. The fund supported technical assistance studies, interest rate subsidies and guarantee facilities to facilitate the deployment of EE and small-scale RE measures. As per the master strategy of the energy sector (2007-2020), the total required investments to improve energy efficiency in Jordan by 2020 has been estimated at USD 80-150 million.

The investments included are loan interest rate subsidy, revolving funds, financial risk mitigation, credit guarantees, equity participation, subsidy to investment in innovating projects and soft investment such as, energy audits, feasibility studies, and public awareness campaigns. The JREEEF could provide a partial subsidy to the households

(20% to 30%) and the remaining part will be paid through bank loans using a specific credit line with soft conditions.
For the second NEEAP, and in order to support the national objective of implementation of roof insulation in the building sector, the JREEEF looked to partially subsidize the improvements (20% to 30%), while the remaining costs will benefit from a credit line through commercial banks.

3. The exemption of solar technology

In April 2008, the Government approved the exemption of imported solar technology both from a 16% national sales tax and 23% customs duties. Combined with high oil prices, this has already boosted renewable energy investment and the shift by some Jordanian businesses to solar energy[14].

4. The exemption of RE and EE equipment

The By-law No. 13 of 2015 states that RE and EE Equipment are exempt from customs fees and sales taxes.

5. Promoting Green Investments

The European Bank for Reconstruction and Development (EBRD) and the European Union (EU) in Jordan are promoting green investments in the private sector by introducing the first internationally supported comprehensive green economy program in the country. The EBRD aims to build green, low carbon and resilient economies through its Green Economy Transition approach with the goal of becoming a majority green bank by 2025 and helping reach net annual greenhouse gas emission reductions of at least 25 million tons over the next five years. The European Union's support for green growth in Jordan will be in line with the EU Green Deal, Europe's main policy direction towards sustainable economic development, and climate action in Europe and the world.

[14] The Jordan Times 2008

VI. Education and Awareness

1. Codes Enforcement Office (EO)

A 'codes Enforcement Office - EO' has been established as a department within the Ministry of Public Works and Housing. It has signed a framework agreement with the RSS for the training of the EO staff, including also awareness campaign and support of dissemination of new codes.

2. Environmental Education for Sustainability (EEfS)

The Ministry of Environment launched the "Build-the-Foundation Strategy: Environmental Education for Sustainability" (EEfS), which encompasses a significant development towards sustainable environmental education and achieving sustainable development.

3. Education and Awareness for a Green Path and Sustainable Development in Jordan Project (2018-2020)

This project aimed to contribute to Jordan's target for 2020 through an effective and responsible program of awareness and knowledge and empower NGOs to advocate for a green economy. This will be achieved through implementing the International Eco-Schools Program as an incentive for sustainable development to raise awareness and knowledge about energy efficiency and energy conservation. This project was funded by the European Union, in partnership with Future Pioneers and Horizon for Green Development.

Outstanding Achievements:

- Involvement of 60 schools from Amman and Aqaba participating in awareness and educational sessions on renewable energy and energy efficiency techniques to raise their knowledge and change their attitude and behavior.
- Install 1,200 LED lights in government schools to contribute to energy saving and to mitigate the effects of climate change.

- Perform a play in three major city theaters (Aqaba, Amman and Jerash) aiming to raise awareness of renewable energy in an interactive way and engage students effectively as ambassadors to their communities.

VII. Analysis

In order to reach its national objectives in reducing its GHG emissions, Jordan has taken clear steps toward the promotion of Energy efficiency and Renewable Energies. They have committed to update their policies periodically and the legislative framework of the building sector is evolving in the process as it adds more concepts of Green Building to the Housing and the residential sector alike. Jordan continues to foster the Building sector in particular although there are financial burdens facing the country's economy. Energy efficiency in this particular sector is planned to be further enforced which will reflect positively on a cost cut-down on the overall energy bill for the country. However, although the insulation code, the EEBC, the JGBG were introduced, they are not enforced on the ground. This harsh finding is mainly due to political, structural, economical and legislative factors. There is an overlapping in Ministries duties and responsibilities, and the lack of communication brings confusion and hinders the development of necessary common actions and mechanisms. The regulatory framework is not adapted to promote green growth, applicable laws lack proper inspection mechanisms and monitoring, and sanctions are not enforced, therefore not achieving their dissuasive purpose. The regulatory framework needs adaptation in many aspects. There is a need to update building codes (need for higher land coverage ratio, narrower setbacks, and an increased height limit), as current parameters are outdated. This would allow for more number of housing units to be built on a plot of land, therefore spreading the land costs across more units in order to address the challenge of rapid urbanization and shortage of affordable housing. The Greater Amman Municipality encourages proper roof and wall insulation by using the density bonus, and this could be extended nationally. Engineers are struggling with a stringent Building code for the aforementioned reasons. The EEBC and JGBC and Insulation codes also happen to be somewhat rigid and can be a barrier to creative design, and there is a need to extend mandatory requirements further than the Building envelope.

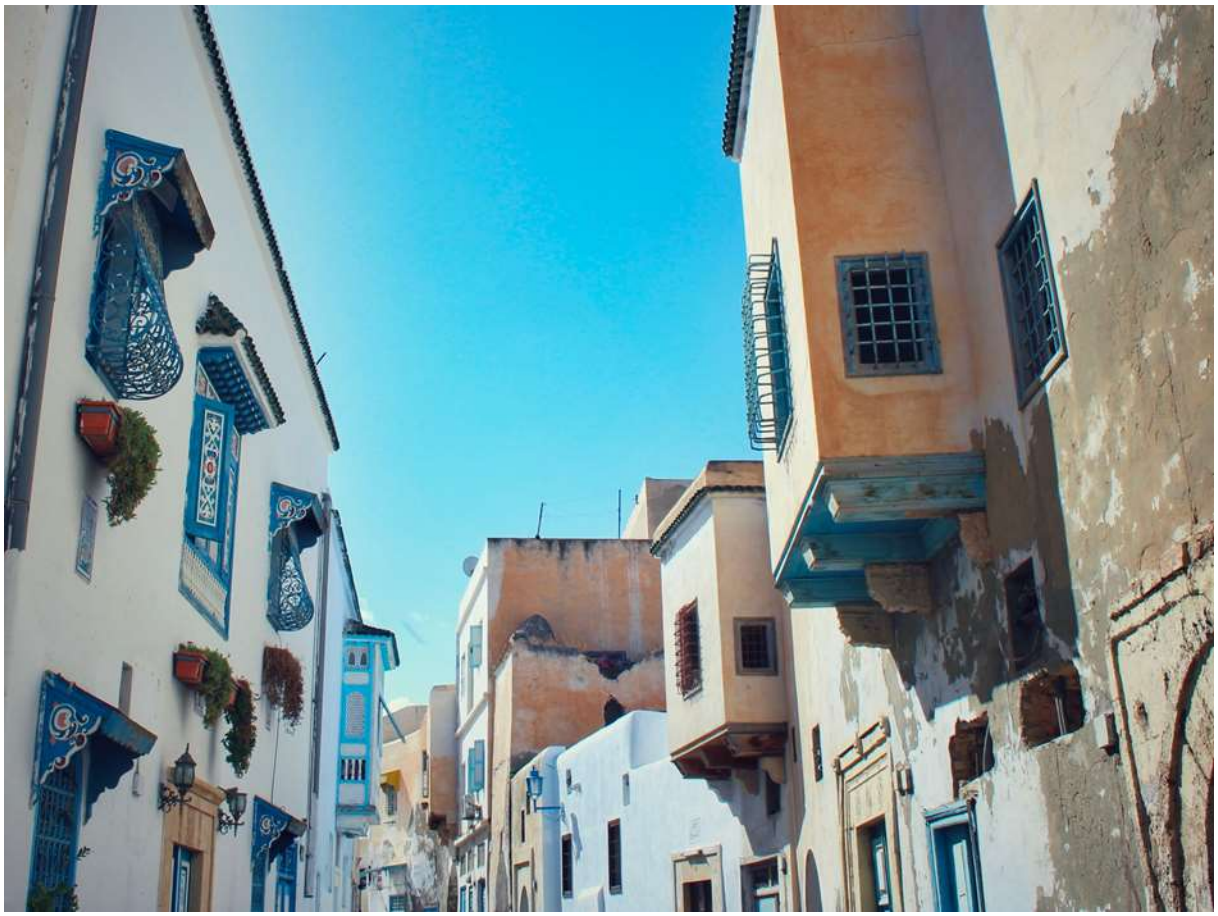
Moreover, there is a gap in the regulatory framework concerning a clear enforcement body. The National Building Law no. (7) of 1993 demands compliance to the building codes by engineering companies and contractors in the design, supervision, maintenance and implementation and states that in the event that a violation is found, the Engineering Association should be informed to take action accordingly. However, it does not cover the supervision and enforcement processes, both crucial in the development of green building in Jordan.

Overall, there is a clear lack of public trust in government strategies and policies[15]. There is a clear lack of communication and little to no awareness on regulations, laws and requirements relative to Energy Efficiency. Professionals lack training and don't have the technical knowledge to build according to regulations. When Building laws are followed, they are too rigid regarding land coverage ratio, setbacks and height limit for example, which, coupled with a shortage of land, contribute to the rise of costs in housing development, and both clients and contractors are reluctant to pay the actual or perceived extra costs in materials design and equipment. Moreover, Energy and Water subsidies are the main barrier to Energy Efficiency and Renewable Energies and Green Building more broadly, and thus it is crucial they are lifted for Green Building market growth. Last but not least, the Jordan Renewable Energy and Energy efficiency fund mostly finances pilot projects, or small to medium scale measures, and needs to include new financing mechanisms and find other sources of funding in order to have its intended national impact.

In its second NEEAP, Jordan is committed to tackle the aforementioned issues by implementing the Energy Conservation By-Law (no. 73 of 2012), and developing the adequate Legal, Regulatory and Incentives framework. Among the measures the country is willing to take are assigning relevant responsibilities to competent entities, implementing the general policy of energy conservation and improving its efficiency as well as issuing compliance certificates, encouraging investments in the field of Energy conservation, monitoring energy audits and implementation of systems related to energy conservation as well as licensing auditors and controlling contractors and the spreading of awareness and information on energy conservation.

[15] T. Awadallah, "Buildings energy issues, policy and institutional framework in Jordan," 2019.

SECTION B: TUNISIA



I. Introduction

In Tunisia, the energy consumption of buildings and constructions is constantly increasing, driven by urbanization and demographic growth. Tunisia has a total population of 11.8 million with 69.5% of the total population living in urban areas[16] ().

[16] World Bank data, 2020

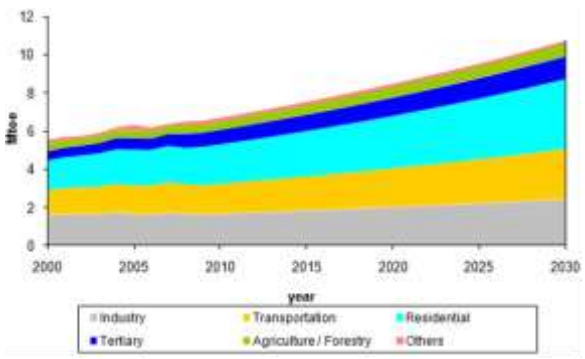
The total existing residential building stock is about 2.6 million dwellings and around 0.6 million dwellings are expected to be built in Tunisia by 2030[17].

The residential sector is the largest energy consuming sector and accounts for approximately 31% of Tunisia's total energy consumption (Figure 2). This share of energy consumption has prompted the introduction of an ambitious energy efficiency policy program for the residential housing sector. Furthermore, in the public sector, the 36000 public buildings have an energy efficiency potential of 39,667 toe (tonne of oil equivalent), which represents 21% of public sector consumption[18]. Thus, the enhancement of energy efficiency in buildings is at the core of national strategies and action plans for reducing CO_2 emissions and mitigating climate change. For Tunisia, it is also a matter of reducing its trade deficit and bolstering its energy independence. A recent study, conducted in 2017, analyzed the various sources of energy consumption (air conditioning, heating, lighting, refrigeration, office equipment, …) in both private and public residential and office buildings. It turned out that the total electricity consumption for the residential sector as a whole is equal to 5176.2 GWh (13.07 kWh per m² over the year), which represents an increase of around 27% compared to 2014[18].

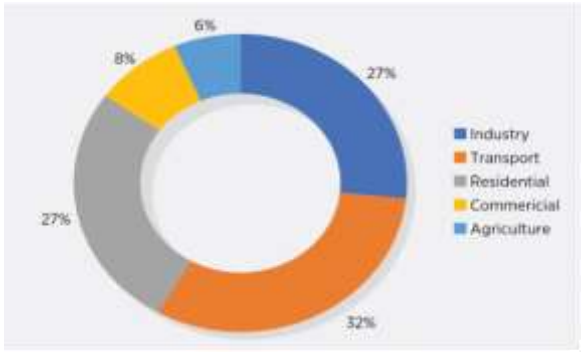
Adding to their role of managing part of the public buildings, local authorities are one of the main stakeholders in urban development policies. First, they are responsible for planning urban development on their territory. Second, they are in charge of the regulation of construction projects and must therefore ensure the implementation of national regulations. Finally, they are responsible for the animation of the communal territory and thus have different means to stimulate local dynamics and foster energy efficiency in buildings at the local level. For all these reasons, key actions were conducted during the period 2013-2020 and the contribution of local authorities in Tunisia was essential in order to achieve national objectives at the territorial level. The developed actions for efficient buildings are organized around three axes. The first axis, entitled PROMO-ISOL, targets existing buildings and aims at renovating 55,000 housing units and 5,000 tertiary units over the period 2014-2016; that corresponds to more than 8 million square meters of buildings. This should be reinforced over the period 2017-2020, where around 264,000 residential and commercial tertiary units are planned to be covered. The second axis consists of labelling hotels, healthcare units, offices, and multi-

[17] **Plan Bleu, 2011**
[18] **ANME, 2020**

family residential buildings. The goal is to certify 37 million square meters by 2020. The third axis proposes to modify thermal and energy regulations for new buildings in Tunisia in order to raise the minimum level of energy performance of collective residential buildings and private offices from class 5 to 4 (reader may refer to Figure 3), and that of public offices from class 3 to 2. The goal is to cover 7.5 million square meters by 2020. These actions include incentives for constructing new class 1 buildings.



(a)



(b)

Figure 2: **(a)** Total final energy consumption patterns and urban development, Tunisia, 2000-2030[19]. **(b)** Total final energy consumption by sector, Tunisia, 2018[20].

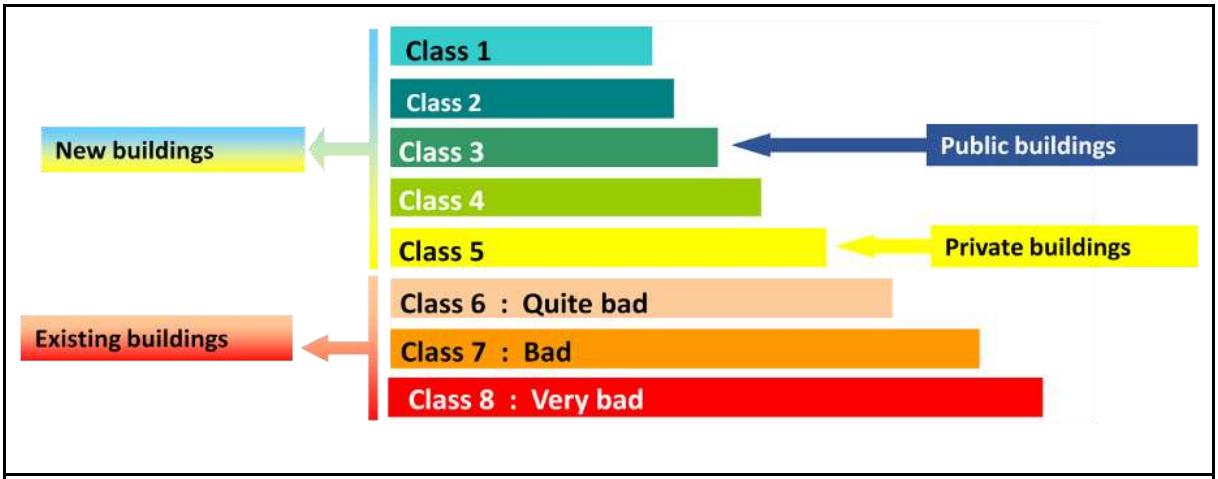


Figure 3: Scale of classification of building energy performance[21].

[19] FEMIP, 2013
[20] IEA, 2019, MISME 2019b
[21] MEDbeX Live, 2020

II. Local Green Building label in Tunisia

ECO-BAT, a voluntary label developed in Tunisia for renovated and new buildings, enables energy efficient buildings to be identified under a "High Energy Efficiency" classification. It is developed and managed by the National Agency for Energy Management (ANME).

ECO-BAT describes the requirements and performance criteria to be achieved in different key areas to qualify for certification. It includes the following topics: energy and environmental performance, building comfort, health quality, choice of materials, construction project management, etc. The level of performance required to achieve these certifications must exceed the legal minimum required by the national building regulations.

The certification is based on the following three factors:

- The envelope of the building,
- The building technical equipment,
- The resources management (energy, water, and waste)

The envelope and technical equipment account for 90% of the marks. The label is granted when a building's score exceeds the maximum performance level by 20% for old buildings and 30% for new ones. Several projects are currently in the process of obtaining the label.

Buildings are awarded one of the three Green Mark Ratings:

- ECO-BAT BR
- ECO-BAT AR
- ECO-BAT OR

Building categories that can apply for the ECO-BAT label are the following:

- Residential;
- Office buildings;

- Educational buildings;
- Hotels;
- Hospitals;
- Mixed Commercial

Successful implementation of the certification depends on three interlinked pillars, namely:

- Regulatory and institutional framework
  - Establishment of a structure for the management and certification of projects. This structure will be provided with human and financial resources to ensure its mission.
  - Establishment of clear and transparent legal procedures for applying to the label.
  - Establishment of standard contracts that bind the promoters and the certification agency. The contracts define the obligations and responsibilities of each party.
  - Identification of the advantages granted by the label and the conditions for granting these advantages.
- Capacity building:
  - Training of experts in charge of the certification and the support of the project as well as owners and professionals of the construction sector.
  - Establishment of standardized regulatory and technical documents related to the label.
  - Elaboration of a public documentation that explains the fundamental concepts and parameters used by the label (seasonal efficiency of refrigerating machines, efficiency of lighting devices, specific energy of production of building materials, etc.)
  - Case studies: Simple and practical examples to identify the steps of the certification, the documents to be provided, the score calculation, and the monitoring of achievement.
  - Elaboration of technical datasheets related to materials and equipment (lighting, hot water production systems, climatic equipment, etc.) to be used.

- Lists of suppliers of products that meet the requirements of the ECO-BAT Label.

- Communication and awareness:
  - Setting up an official website promoting the label and disseminating necessary information and awareness. This website contains a resource section where professionals and the general public can access:
    - Forms for submitting and evaluating construction projects
    - Models of contract binding the applicants to the certification agency
    - Documents popularizing information and benefits granted by the label
    - Procedures and phases of certification projects
    - Technical documents for designers and owners

The website is also a place for discussing and exchanging experience between the various stakeholders.

Scheduling information and awareness campaigns within national and regional events and promoting the label in the media. Documents and media support will be available from professional associations, federations, trade unions, and training institutions.

III. National Plans and Programs

As part of their international commitments to climate and energy transition, Tunisia set objectives in terms of promoting energy efficiency - particularly in the building sector - and promoting renewable energies. The building sector is the third largest consumer of energy with 1778 ktoe after the transport sector and the industrial sector, and the largest consumer of electricity with a 57% share which is equivalent to 764 ktoe. If no energy efficiency measures are implemented, the building sector will become the first consumer of energy by 2030 with 5200 ktoe. For example, renovation projects in the health sector (a high priority sector as the country needs new health infrastructures), which consists of more than 5000 buildings, accounts for 5% of building-related energy consumption in the country, with an energy intensity of 464 kWh per square metre per

year. The estimated potential for reducing energy consumption in health buildings is around 50% and highly depends on the contribution of local authorities.

The national programs and plans are the following[22]:

1. **The energy audit [23]and energy audit based on building plan[24]**

Implemented in 2014, the energy audit based on building plan aims at assessing the thermal and energy performance of a construction project in order to design high performance buildings. Buildings with consumption greater than 500 toe per year are obliged to carry out an energy audit every five years. For newly constructed buildings, the limit is set to 200 toe. The new regulations grant 70% for the energy audit feasibility studies and assistance, capped to 30 kDT (Tunisian Dinars) and 70 kDT, respectively. Moreover, the new regulations grant 30% of the material investment with a maximum of 200 kDT.
The procedure is supervised by ANME aiming at carrying out an energy study from the design of a building in order to reach the highest level of energy performance. Furthermore, the Ministry of Energy has implemented decrees for the on-plan energy audit procedure.
The energy audit must be carried out by auditors with expertise in the energy sector. The energy audit based on building plan is a combined work carried out by architects and engineers among the 33 experts approved by ANME.
In order to perform the audit, some energy simulation tools for buildings may be required. For this purpose, ANME has approved a set of software that can be used for this purpose. TUN-eQuest is one of the most effective energy simulation software for buildings that was adapted to the Tunisian context (materials, climatic zones, etc.). With this tool, the user can enter all the characteristics of the construction project and evaluate its energy needs according to the building envelope (facade, glazing, roofing, etc.) and all the equipment (air conditioning, heating, ventilation, lighting, etc.). Simulations can also be carried out to compare the impact of different energy efficiency

[22] MEDbeX Live, 2020
[23] http://www.anme.tn/?q=fr/projets/industrie/programme-daudit-energetique
[24] http://www.anme.tn/?q=fr/projets/industrie/programme-daudit-energetique-sur-plan

measures. In this way, the auditors are able to identify the energy efficiency actions needed to achieve the highest levels of energy performance with reference to national regulations.

Between 2010 and 2020, 256 energy audits on building plans have been carried out. By signing a program contract between ANME and the applicant, the latter is eligible for financial support from the Energy Transition Fund (FTE) through subsidies of up to 70% of the cost of the audit and 30% of the additional cost generated by the energy saving actions, capped to 200 kDT.

2. "ECO-BAT"

The label "ECO-BAT" HPE (High Energy Performance) buildings as introduced earlier.

The scoring system of ECO-BAT label is as follows:

- Buildings are valued differently depending on whether they are new or existing
- The score of innovative techniques is doubled
- Evaluation criteria and indicators are:
  1. Envelope (Needs(kWh/m^2), design and materials, auditor's assistant);
  2. Equipment (Heating installation, cooling installation, hot water, ventilation, lighting, management and metering, renewable energies, water saving;
  3. Resource management (water and waste management, awareness, cadastre and energy register and third-party management).

  Table 4 summarizes the maximum scores by building category and Figure 4 provides the weight of the various criteria by building category in the overall score.

Table 4: Maximum score by building category

	Evaluation criteria			
Buildings categories	**Envelope**	**Equipments**	**Resources management**	**Maximum score**
Hotels	60	68	14	142
Office buildings	60	58	8	126
Hospitals	60	66	16	142
Residential	60	46	8	114

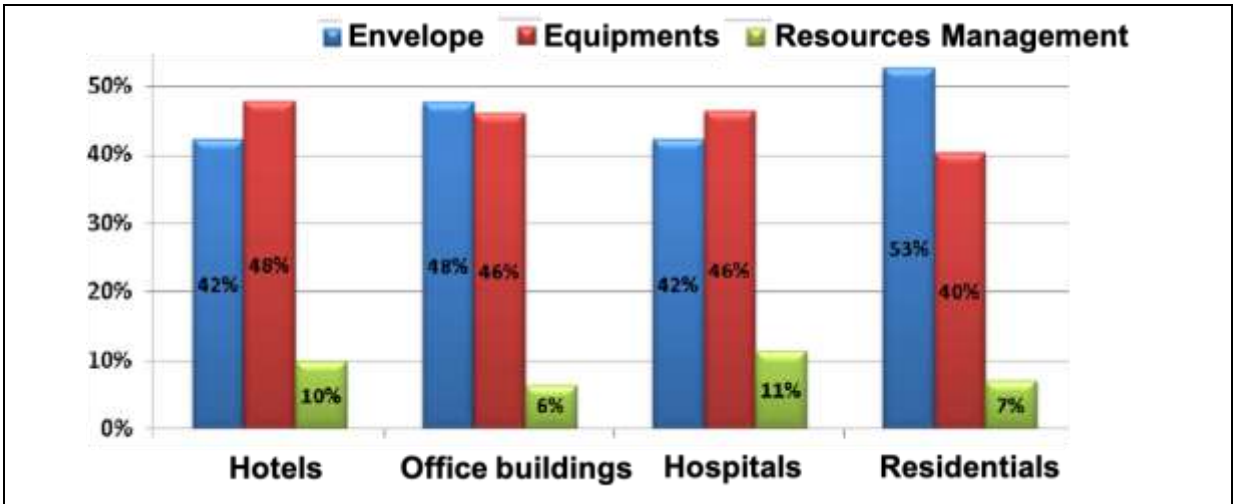


Figure 4: Distribution of scores by evaluation criteria and building category.

- The attribution of the label to a project requires a minimum number of actions to ensure a minimum overall score or threshold for obtaining the label. Depending on the ratio of the achieved overall score to the maximum score, the building will be awarded one of the three Green Mark Ratings as shown in Table 5:

Table 5: Green Mark ratings for new and existing projects

	ECO-BAT BR	ECO-BAT AR	ECO-BAT OR
New project	30% to 40%	41% to 70%	> 70%
Existing project	20% to 30%	31% to 50%	> 50%

4. The "PROMO-ISOL" program[25]

It aims to promote the thermal insulation of the roofs of existing and new buildings in order to reduce energy consumption for heating and cooling.

5. The "PROSOL" Programs

- **The "PROSOL ELEC" program**[26]

[25] http://www.anme.tn/?q=fr/projets/b%C3%A2timent/programme-promo-isol
[26] https://www.steg.com.tn/fr/prosol_elec/presentation.html

The objective of this program is to promote High Energy Performance buildings in the residential and tertiary sectors.

- **The "PROSOL Residential" program**

It is the first project carried out by ANME and is progressing at a steady pace. The project is being implemented jointly with The Tunisian Company of Gas and Electricity (STEG).

- **The "PROSOL Collective" program**

This program is set for collective buildings, especially hotels.

- **The "PROSOL thermique" program**

This program started by the end of the year 2020.

6. **The "Co-generation" program**[27]

The co-generation principle consists in simultaneously producing electricity and heat using an alternator coupled to a heat engine or a turbine. A cogeneration project must respect two main points in order to optimize the use of fuel resources; namely the global efficiency must be higher than 60% and the thermal recovery rate must be higher than 50%. As a result, the ANME delivers to the company a certificate confirming the energy efficient aspect.

This program mainly concerns the industrial sector. However, it includes the airport in Sousse, a number of hotel projects, and about ten projects related to air conditioning using natural gas.Companies opting for cogeneration can benefit from a premium of 70% of the cost of the feasibility study with a ceiling of 30 kDT and a subsidy of 20% of the cost of material investments with a ceiling of 200 kDT.

7. **The "Stockage du froid" (cooling energy storage) program**

This program aims to reduce the electricity consumption peak during summer.

Cold storage is a technology with high potential for saving energy and cost for Tunisian industries[28].

[27] **http://www.anme.tn/?q=fr/projets/industrie/programme-de-promotion-de-la-cogeneration**

[28] **GIZ Tunisie 2021**

Within the program, a training session was provided by ANME with the support of the GIZ through the Support for the Promotion of Energy Efficiency in Tunisia (APEET) project. The purpose of this training for industrial executives and technicians is to convey knowledge on the functioning of cold production systems and energy efficiency solutions. Several engineers gained an in-depth understanding of the principles and techniques of cold and refrigerant fluids. They also became aware of Tunisia's commitments to Kigali's amendment to the Montreal Protocol for the progressive reduction of ozone-depleting substances, and the incentives through the Energy Transition Fund (FTE).

8. The "Energy certification and labelling of household appliances" program[29]

The objective of this program consists in a first step to make energy labelling mandatory for appliances sold on the market in order to inform households about their energy performance. The energy labelling consists of eight energy classes, ranging from the most energy-intensive class (class 8) to the most energy-efficient class (class 1).

The equipment concerned by this program are:

- Refrigerators, freezers and combined appliances;
- Individual air conditioning units;
- Hot water production and storage appliances;
- Lamps and lighting fixtures;
- Washing machines, tumble dryers and combined appliances;
- Dishwashers;
- Ovens;
- Irons;
- Audio-visual appliances;

The household appliances currently covered by this program are refrigerators and air conditioners. This program foresees in a second step the progressive removal of energy-consuming equipment from the market.

9. The "Alliance des Communes pour la Transition Énergétique" (ACTE) program[30]

[29] http://www.anme.tn/?q=fr/projets/batiment/programme-de-certification-energetique-des-equipements-electromenagers

[30] http://www.anme.tn/?q=fr/projets/batiment/programme-acte-alliance-des-communes-pour-la-transition-energetique

This program has been deployed in Tunisia by ANME since 2019. It is based on a national support system for municipalities aiming at supporting local actions and promoting investments in energy management.
The program offers municipalities:

- A capacity building program for municipal officials;
- Simplified energy audits of their assets: public lighting, municipal buildings and vehicles;
- An energy accounting tool allowing municipalities to monitor the energy consumption of their facilities and equipment;
- A national financing mechanism to support municipal investment in energy projects;
- Guides related to key municipal issues.

14 pilot cities currently receive strong support from this program. They follow a quality approach covering 6 thematic areas: urban planning, municipal buildings and infrastructures, diversification of energy sources, urban mobility, internal organisation and governance, as well as cooperation and communication. The ACTE label recognises the efforts of the most committed municipalities in terms of sustainable energy management, based on a catalogue of concrete measures. This label can be viewed as the Tunisian version of the “European Energy Award®” label.

IV. Policies and Regulations

Energy efficiency measures are more effective if implemented during the early stages of the building project. It is therefore important to implement energy efficiency building codes (EEBCs) consisting of minimum standards for energy efficiency for the design, construction and renovation of residential and tertiary buildings. In Tunisia, EEBC development, implementation and enforcement is the responsibility of the government, while their monitoring is carried out by the private sector. An important stimulus to energy efficiency policy in Tunisia was the transition of the country from energy surplus to net importer by late 1990s. Tunisia already had an agency for energy conservation

(since 1985) and a policy in place to manage energy[31]. The existing policy framework for energy efficiency regulates buildings, household appliances, renewable energy sources and behavioral changes across institutions, regulation, technology, finance, tax and communication. The policy has been conceived against a long-term strategy document extending up to 2030. Within this strategy[32], the Tunisian government has set four action plans (Table 6 provides additional information).

Table 6: Energy Efficiency programs in Tunisia

Action Plan	Period	Objective
Triennial	2005-2007	Achieve energy savings of 700 ktoe in 2007 (8% of the annual national consumption)
Quadrennial	2008-2011	Reduce energy demand by 20% by 2011
Presidential	2009-2014	Improve energy intensity indicator
Tunisian Solar Plan (TSP)	2010-2016	Implement 40 projects with the objective to reduce primary energy demand by 24% by 2016

Regarding the progress of the before mentioned energy efficiency programs:

- "The World Bank (WB) and the French Development Agency (AFD), granted to Tunisia, two credit lines dedicated to energy monitoring, coaching and technical assistance for the period 2008-2011. In 2009, energy demand was reduced by 13%"[33].
- Annual savings have been increasing steadily over the 2008-2012 period, starting at only 160 ktoe in 2008, and reaching 673 ktoe in 2012; i.e. a multiplication by a factor of 4 in 5 years, resulting in growth in savings of around 43% per year. Figure 5 presents the energy savings generated by rational energy use actions over the period 2008-2012[34].

[31] Figuiri, 2009
[32] Ayadi, 2010; Bahri, 2010
[33] AllAfrica.com, 2010
[34] ANME, 2013

- Tunisian solar plan was adopted in 2015, aimed to reduce primary energy demand and increase the share of renewables in the electricity production mix to 30% by 2030[35].

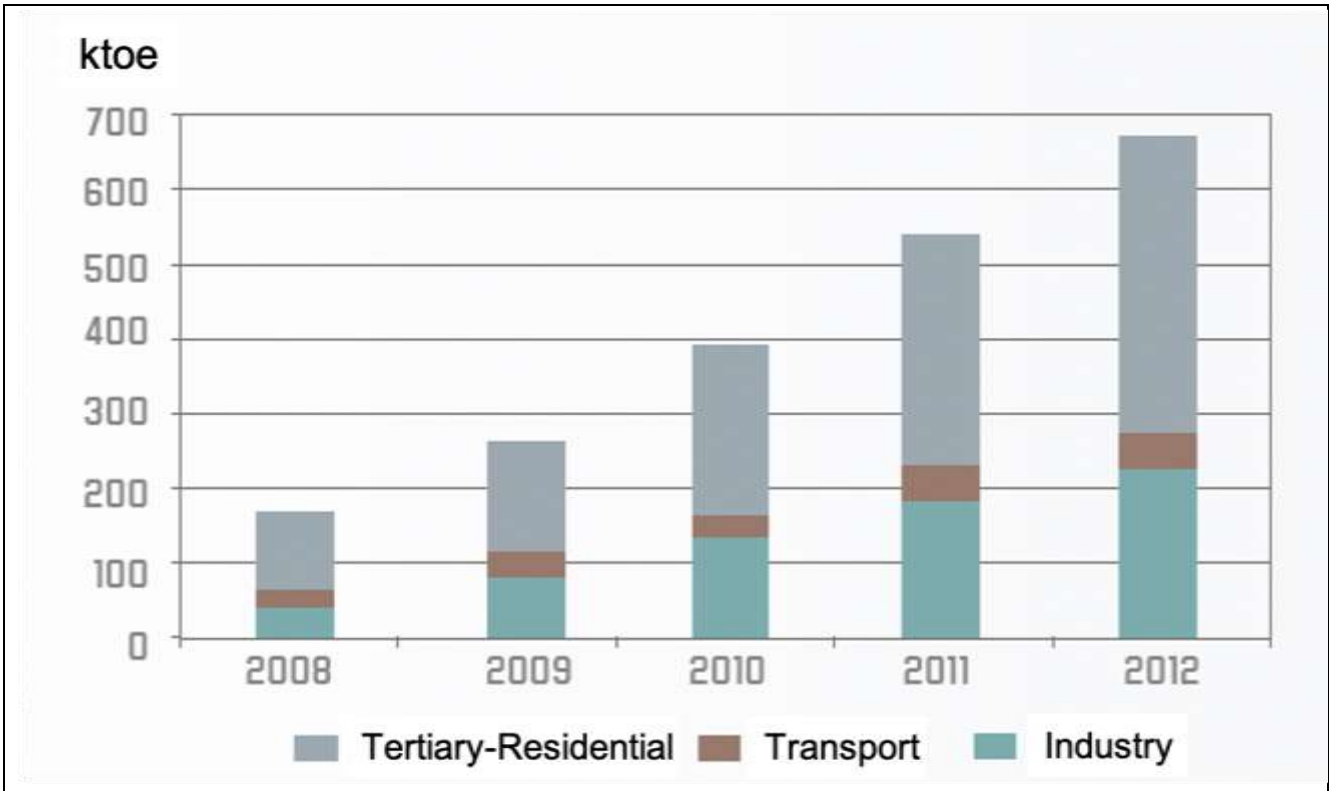


Figure 5: Energy savings generated by rational energy use actions over the period 2008-2012[34].

Law 2009-7 amended by law 2014-72: Article 10 states that new construction projects and expansion of existing buildings must fulfil the minimum technical specifications to meet the energy control requirements set by the joint decree of the Minister in charge of equipment and housing and the Minister in charge of energy.

The decree of 2008 regarding office buildings, promulgated and amended by the joint decree of 2010, sets the minimum technical specifications of thermal performance to which the new construction projects of office buildings use or similar activities must be in conformity. The decree covers both public and private buildings. The technical performance specifications are evaluated through the annual energy needs of the building related to thermal comfort expressed in kWh.m^2/year. For the public building,

[35] Irena, 2021

the decree required that its energetic needs must not exceed 95 kWh.m²/year (class 3). For the private sector, it is allowed to go up to 125 kWh.m²/year (class 5).

To be able to implement this decree, the verification process of provisional consumption should be defined. Any applicant for a building permit or for the construction or expansion of a building for office or similar use (for residential use) must attach to the permit file a technical sheet concerning the building to be constructed or the extensions to be introduced. The building permit is not delivered in case of non-conformity of the data with the minimum technical specifications fixed in the decrees. If the provisional consumption exceeds class 3 for a public building project, the design must be reviewed in order to identify the appropriate solution to improve the energy performance of the building including insulation measures to reinforce the quality of the envelope, orientation, etc. This is the role of the project designer (architect) who needs to add the necessary measures to make the building compliant with the regulations. The decree introduced some flexibility for small or non-complex projects. This is referred to as the prescriptive approach which states that it is not required to carry out a detailed energy study, and it is sufficient to only define the technical specifications depending on the thermal zone of the project. If the project is more complex, the performance approach is mandatory. An energy study should be carried out by an engineering and design office or a specialised consulting firm. The study must prove that thermal comfort needs are lower than the limit stated in the decree.

It should be noted that 90% of the projects carried out by the General Directorate of civil buildings met the obligations of the aforementioned decree. In fact, the General directorate was in charge of the realisation of A1[36] type projects and this category of projects must generally be carried out through innovative architectural competitions during which the architects are asked to share their ideas and their choices based on energy saving criteria.

[36] **Civil buildings are defined, by the Tunisian Governmental Decree number "967" of the year 2017 in its first article, as the building which construction is undertaken by the State, local authorities, public establishments, and public enterprises, excluding some projects intended for strictly military use, inaccessible for reasons of national security, or those carried out within the framework of a concession contract or within the framework of real estate development operations. There are 6 categories of civil buildings from A1 to A6. The classification depends on the size of the project.**

Furthermore, primary action within the national strategy for energy management and energy efficiency in the building sector is to work on active energy efficiency measures, i.e., work on the building envelope. Because once the building is technically constructed, it becomes costly and complicated to modify it in order to improve its performance. For this reason, implementing the thermal regulation for new buildings is considered as a fundamental step. The process started in 1992 and includes 3 phases:

- The study phase
- The demonstration phase
- Implementation of demonstration projects for the experimental validation of thermal regulations: 7 Tertiary and 36 Residential;
- Development of simplified tools to control the thermal implemented regulations;
- Development of 7 technical sector guides;
- Carrying out training and communication activities for the various construction actors.

Concerning the results and achievements of the demonstration project, the additional costs generated were evaluated. Table 7 summarises the additional cost generated as a percentage of the total housing costs.

Table 7: Additional costs generated per sector for the demonstration projects.

Category	Additional costs (%)
Tertiary	8% to 9%
Social residential	9% to 10%
Economic residential	4% to 5%
High profile residential	2% to 3%

For the control application, the software CLIP, after being adapted to the local building specifications, was used to assess the performance of the buildings. Designers were trained to be able to use it as well. This tool is currently being improved with the supervision of ANME. The seven developed technical sector guides are the following:

- Equipped housing;
- Not equipped housing;
- Office buildings;
- Educational building;
- Commercial buildings;

- Hotels;
- Hospitals.

Guides for equipped and non-equipped housings were elaborated because Tunisia is characterised by a fairly moderate climate. Thus, it is possible to design buildings without providing heating and air conditioning equipment by just ensuring a good architecture of the housing.

- The regulatory promulgation phase

The private buildings are requested to meet the requirement level of class 5 (reader may refer to Figure 3) but for the public sector, it has been suggested that the state should impose a higher level than the one adopted for the private sector.
Even though the General Directorate for Civil Buildings has achieved successful projects, many of the projects are still below expectations, especially at the regional level and for public buildings built outside the context of civil buildings.

V. Incentives and Financial Mechanisms

Energy efficiency measures can improve thermal comfort, but the economic profitability of energy interventions is not systematically guaranteed. Even when guaranteed (for instance, in buildings where the adoption of energy efficiency measures limits the use of heating and cooling systems), the initial investment remains high and constitutes a significant barrier for most property owners. Indeed, on the one hand,theenergy consumption of a large majority of buildings is relatively low; most of them are not equipped with heating and/or air conditioning systems, and the thermal comfort is usually insufficient. However, on the other hand, as the living standards have improved over recent years, occupants started relying on heating and cooling systems which resulted in increased energy consumptions and higher energy bills.
Even though the outside temperature may be highly fluctuating (day–night and summer–winter), the perception of this fluctuation is attenuated within traditional building. This is mainly due to the choice of the construction materials. The quality of the comfort is not always guaranteed but the occupant has developed a knowhow in order to accommodate these changes by adjusting their behavior. However, recent buildings in Tunisia suffer from a higher perception of the outside temperature

fluctuation engendered by the very poor quality of the envelope which led to very high energy consumptions.
Therefore, the renovated and new construction buildings and infrastructure have a significant potential for energy savings which could be achieved through appropriate investments in energy efficiency and the development of renewable energy.

1. The Energy Transition Fund (ETF) (Law 2013-54, Law 2014-54 and Law 2018-56)

This fund was created under the 2004 Finance Act and adjusted in 2017. It is fed mainly from taxes on energy products and consumption, and from donations. It stimulates investments in the fields of energy efficiency and in the development of renewable energies.

ANME is in charge of the management of the fund. The fund is accessible to all categories of Tunisian actors (local authorities, private companies, households, etc.) and covers a wide range of energy projects (energy audit, self-production of renewable energy, eco-construction and renovation of buildings, changing light bulbs, etc.).

Municipalities are eligible for subsidies covering up to 70% of the cost of intangible investments (studies, training) and 20% to 30% of tangible investments, with different caps depending on the type of intervention. Subsidies are awarded by decision of the Ministry of Energy after approval by a technical advisory committee.
A program contract is signed with ANME before the investments are made, and the subsidies are paid after ANME has checked that the investments comply with the initial program contract. The payment is done directly to the chosen service provider in order to facilitate the process for the project owner. However, the FTE is still marginally used by the communes. Indeed, in 2019, only 3 communes (out of 350) had signed a program contract with ANME to benefit from this funding.

2. Indirect tax advantages

These measures consist in reducing or even exempting energy efficiency solutions from indirect taxes such as VAT, custom duties, etc. These measures are simple to implement and are often neutral for the public finances. Given the currently limited market for

energy efficiency measures, there is no financial shortfall for the state. In Tunisia, solar water heaters, photovoltaic systems, efficient lamps, as well as all material used in building insulation are exempted from VAT and customs duties.

3. **Financial aid for companies, households, local authorities, and off-grid installations**

    - Grants for intangible investments up to 70% of total cost with a cap that varies between 32 and 208 kDT depending on the action
    - Grants for material investments with a rate that varies between 20% and 50% depending on the action
    - Subsidised loans up to 25% (with a fixed interest rate of 5% to be reimbursed over 7 years with 2 years' grace period) to be used in parallel with a loan from a commercial bank

4. **Means to facilitate the creation of energy management projects (self-production, Energy Service Company ESCO, etc.)**

    - Grants up to 10% of the equipment cost
    - Reimbursable funding/shareholding up to 60% of the private funds/capital to be reimbursed over 12 years with 5 years' grace period and a fixed interest rate of 3%
    - Subsidised loan up to 35% (with a fixed interest rate of 5% to be reimbursed over 7 years with 2 years' grace period) to be used in parallel with a loan from a commercial bank.

5. **Means to finance specific programs carried out by the government or local authorities aiming at reducing the energy subsidy**

    - Customised financing up to 100%

6. **Specific mechanisms introduced earlier:**

- "PROMO-ISOL"

  - Grants of 8.3 DT/m^2 for old buildings and of 6.4 DT/m^2 for new constructions
  - Loan of 2.5 kDT reimbursed over 7 years with a fixed interest rate of 5%
- "PROSOL Thermique"
  - Grants of 200 DT for systems with less than 3 m^2 of collector and of 400 DT for systems from 3 to 7 m^2
  - Grants of 30% of their total cost with a cap of 220 DT/m^2 for collective systems
  - A loan (for residential installations) that varies between 575 and 1200 DT to be deduced from the bills of the Tunisian Company of Electricity and Gas over a period of 5 years with a money market interest rate of 1.2%
- "PROSOL ELEC"
  - Grants of 1600 DT/kWp for photovoltaic systems with a power less than or equal to 1.5 kWp
  - Grants of 1300 DT/kWp for photovoltaic systems with a power superior to 1.5 kWp with a cap of 3200 DT for non-residential buildings
  - A loan (for residential installations) up to 11.5 kDT to be deduced from the bills of the Tunisian Company of Electricity and Gas over a period of 7 years with a money market interest rate of 1.2%.

Prosol's organizational procedures are illustrated in Figure 6.

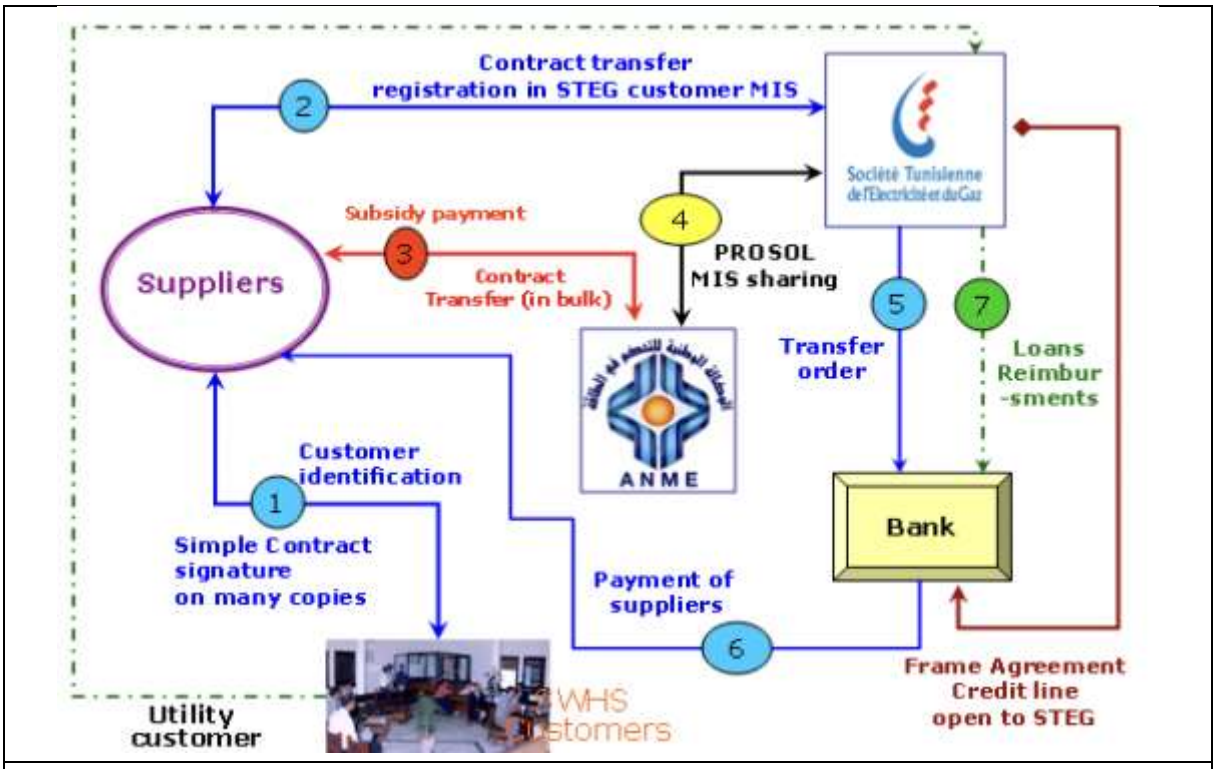


Figure 6: PROSOL organisation procedures[37].

VI. Communication and Awareness

Communication and awareness are essential means for supporting the country's strategy. Two relevant activities to promote and disseminate green building and energy efficiency are presented hereafter:

1. Network of Allied Cities for climate and Energy Transition (RevACTE)

Rev'ACTE was launched in 2019 by ANME with the aim of promoting the transfer of experience, the exchange of good practices and the dissemination of pilot initiatives between Tunisian cities. For its pilot phase (2019 - 2021), seven cities have joined the network, selected on the basis of their commitment to energy transition, experience and willingness to cooperate and to share knowledge. The network is structured around four

[37] ANME, 2009

themes prioritised by the cities: public lighting, eco-construction, diversification of energy sources, and fleet management.

Rev'ACTE stimulates organised and spontaneous exchanges between Tunisian cities committed to energy management in order to create a community of municipal leaders and to initiate a dynamic energy transition process to be adopted by the cities.

In general, the establishment of national or international networks of cities addresses several complementary objectives:

- To stimulate the sharing of experiences and common learning between cities,
- To promote inter-municipal cooperation on energy projects,
- To enable each municipality to position itself in relation to its counterparts
- To enhance the commitment of member cities, and;
- To achieve greater representation to national authorities.

Further, several international cooperation projects have relied on city networks to create thematic learning networks between cities, such as the CoMun program implemented by German Agency for International Cooperation (GIZ) from 2008 to 2018 in Tunisia, as it has a long tradition of exchange and cooperation between cities.

The network has realised the following activities to stimulate exchanges and mutual learning:

- Technical meetings, site visits, and study missions
- Management training for the design, financing, management, monitoring, and communication of municipal energy projects
- Technical training on the topics prioritised by the municipalities
- Sharing of technical documents and tools on a website dedicated to municipal energy management
- Technical support for the transposition and replication of tools and approaches
- Production of educational video clips
- Financing of 3 pilot projects.

2. Energy Information Centre (EIC)

An Energy Information Centre (EIC) supports the local energy and ecological transition by involving the local stakeholders in the development of renewable energy and energy

efficiency, particularly in the building and construction sector through raising awareness, training, advice, and support.

The establishment of an EIC aims to mobilise local actors through various activities:

- Setting up a training site during the construction works of the EIC's building to train local professionals and actors in eco-construction
- Installing the EIC in an exemplary building (newly-built or renovated)
- Raising public awareness on zero cost insulation and energy efficiency techniques to reduce energy bills
- Training and provisioning of tools for local construction professionals
- Contributing to territorial energy planning

Several EIC models are being deployed in Tunisia namely, in Nabeul, Médenine, and Sousse.

VII. Analysis

Tunisia succeeded in elaborating their local rating system for green buildings. However, several elements limiting the adoption of this type of certification were confronted:

- As the minimum energy performance regulations for new buildings are generally not respected, even by municipalities, the commitment to go beyond the regulations seems to be a difficult objective to achieve.
- Limited financial and existing non-financial incentives associated with this certification have been insufficient to nudge project developers to adopt these approaches.
- This certification has a low level of visibility.
- Local companies and experts remain poorly trained; only a limited number are certified to implement this label. Indeed, due to the lack of demand, they are not very interested and do not request training for the implementation of this certification.

For policies and regulations, the shortcomings are mainly caused by a set of factors listed below:

- Low involvement / lack of support from municipalities
- Restricted field of thermal regulation application
- Low legislative weight/power of the TRB (Thermal regulations of the buildings)
- Lack of in situ monitoring of building compliance
- Lack of skills required for the application of the TRB
- Lack of technical working tools
- Lack of awareness and communication

The main challenges faced by Tunisia in ensuring effective enforcement are:

- The significant additional cost of constructing efficient buildings (or even just buildings that comply with the regulations) combined with the weakness or even absence of financial incentives (refer to Table 7) ;
- The establishment of an entity with clear delineation responsible for the enforcement and control process;
- The publication of implementing decrees to define a procedure for enforcing the regulations and define measures to penalise non-compliance;
- The appropriation of the regulation by all stakeholders (architects, politicians, craftsmen, end-users, etc.);
- Lack of training and lack of skills of local actors for the application and control of thermal regulations.

The financing mechanisms are still marginally used by municipalities. The reluctance of local authorities can be explained by the lack of visibility of funding opportunities.

Problems encountered for capacity building and awareness can be summarized as the following:

- The establishment of a technical and financial support system is crucial to enable member cities to realise concrete projects following the capacity building activities.
- Raising citizens' awareness is not a priority mission of the municipality, and the financial resources that a municipality can allocate for the animation of an EIC are

limited. A financing mechanism for the deployment and running of EICs must be defined at national level in order to ensure the sustainability of these bodies.

SECTION C: SINGAPORE

I. Introduction

Singapore's buildings are responsible for more than 30% of the total energy consumed by the country. This value is predicted to increase in the future due to an increasing population[38]. In order to improve efficiencies of the building stock and mitigate their respective climate change impact, the Singapore government embarked

[38] https://opentoexport.com/article/green-buildings-incentives-and-opportunities-in-singapore/

on the green building movement by launching the BCA (Building and Construction Authority) Green Mark scheme in 2005. In 2018, Singapore was ranked second among global cities for green buildings[39]. It is important to highlight on the achievements of this country in green building industry. This section describes the local Green Building Rating Systems used in Singapore, the milestone of the national plans for green buildings, the useful standards, the incentives and opportunities offered by the government to promote green buildings, and the level of education and awareness in the country that led to great achievements in this industry without overlooking the challenges hindering the targeted goals.

II. Local Green Building Rating System in Singapore

Launched in 2005, the BCA Green Mark Scheme is a local Green Building Rating System that promotes the adoption of green building design and technologies that improve energy efficiency and reduce the impact of buildings on the environment. It is a green building rating system designed to evaluate a building's environmental impact and performance. It provides a comprehensive framework for assessing the overall environmental performance of new and existing buildings to promote sustainable design, and best practices in construction and operations in buildings.

The BCA Green Mark Scheme rates buildings according to five key criteria[40]:

- Energy Efficiency
- Water Efficiency
- Environmental Protection
- Indoor Environmental Quality
- Other innovative and green features

Buildings are awarded one of four Green Mark Ratings:

- Green Mark Certification

[39] **https://www.eco-business.com/news/the-missing-piece-in-singapores-green-building-puzzle/**
[40] **https://www1.bca.gov.sg/**

- Gold Award
- Gold Plus Award
- Platinum Award

A Green Mark Platinum building can achieve more than 30% energy savings compared to a code-compliant building.

The BCA Green Mark Scheme is not just applied to new and existing buildings (residential, non-residential, landed houses, data centers, existing schools), but also deployed to promote environmental sustainability beyond buildings, including parks, supporting infrastructures, districts, rapid transit systems, and even occupant-centric spaces within buildings such as in supermarkets, restaurants, retails, laboratories and healthcare facilities. As at July 2014, the BCA Green Mark Scheme[3] has expanded beyond Singapore to 71 cities in 15 countries with more 250 projects marking therefore their leadership in green buildings in the region. The evolution of BCA Green Mark Standards the last decades is shown in the Figure 5:

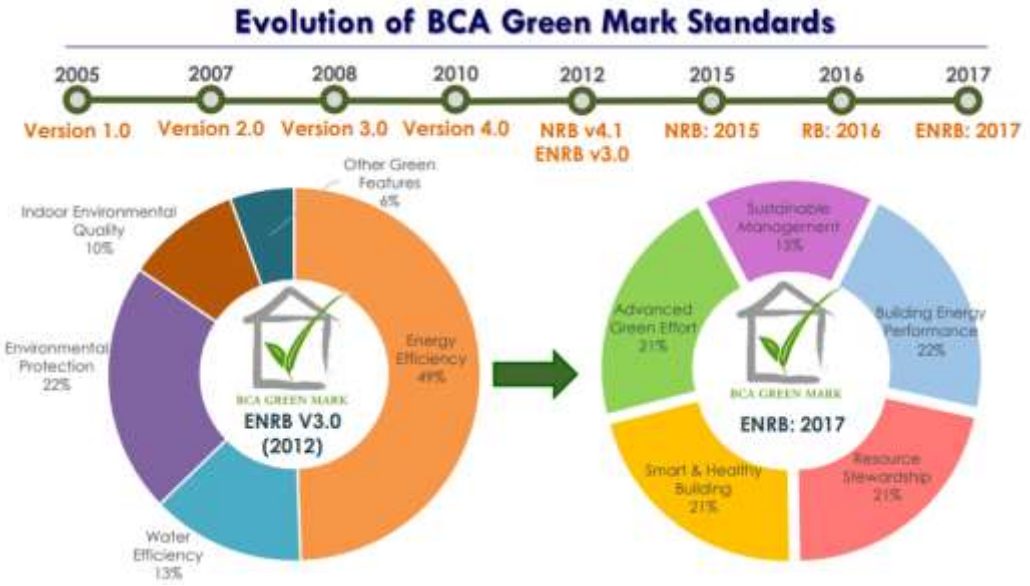


Figure 5: The evolution of BCA Green Mark Standards

Source: Singapore Green Building Journey

The key attributes of the BCA Green Mark are three:

- Strong focus on verification and outcome-based performance
- Periodic energy audit (continuing commissioning)
- Strong business case of green buildings

The Green Cost Premium for new building developments is evaluated from 0.8% to 3.4% for the Platinum Award, 0.7% to 2.6% for the Gold Plus and 0.2% to 2.2% for the Gold, as a percentage of the construction cost. As for the payback period, it is estimated to range from 1.9 to 5.7 years.
For the business case of existing buildings, a study on 147 retrofitted existing buildings showed that an average of 18% of energy savings was reached from these applications with a payback period that ranges between 4.6 years (hotels) to 7.4 years (offices).

III. National Plans and Programs

1. Green Building Master Plans

The Building and Construction Authority (BCA), a government agency in Singapore, launched in **2005 the first Green Building Master Plan** which encouraged, enabled and engaged industry stakeholders in adopting new green buildings. It aimed to encourage developers to embed sustainability as part of a building's life cycle from the onset, and expanded its reach to target the greening of the larger stock of existing buildings and engage building occupants to change their energy consumption behavior. At least 80% of buildings in Singapore were planned to be green by 2030. As of end 2021, 49% of Singapore's buildings have been greened. Taking the lead on environmental sustainability, new public sector buildings, with air-conditioned area exceeding 5,000 sqm, were mandated in 2006 to attain Green Mark certification. In 2008, the Building Control Act was amended so that minimum standards are imposed on environmental sustainability for buildings.

In **the second Green Building Master Plan (2009),** the public sector also continued commitment towards realizing a sustainable built environment by achieving Green Mark Platinum Rating for their new public buildings. The government selected as well new growth areas for land sales conditions to achieve higher Green Mark ratings. As for the existing public buildings, the government required that all existing buildings meet Green Mark Gold Plus standard by 2020. Also in this framework, the Green Mark Gross Floor Area Incentive Scheme GMGFA awarded additional gross floor area to developers that earn higher-tier Green Mark Awards for their new buildings or reconstruction projects.

In the **third Green Building Master Plan (2014),** the BCA Green Mark was developed in its fifth version with advancements in climatic responsive passive design, complemented with smart building management, greater resource efficacy, and an enhanced renewable energy adoption. It encouraged the forging of collaborations and partnerships with key stakeholders including industry players, school communities, building owners, tenants, and the general public in order to drive changes in energy consumption behaviors in the longer term and develop an environment that addresses the well-being of people. Moreover, the legislative controls that take the whole life cycle of buildings into consideration ensured that buildings continue to comply with higher energy standards and operate at an optimal level after retrofitting. After introducing the Environmental Sustainability Measures for Existing Buildings to the Building Control Act in 2012, new legislations were previewed to be effective starting 2014 such as:

- Requirement to achieve the minimum environmental sustainability standard (Green Mark Standard) for existing buildings when installing or retrofitting a cooling system;
- To carry out periodic energy efficiency audits on the building cooling systems and compliance with the design system efficiency;
- Requirement to submit building information and energy consumption data on an annual basis.

It is essential to highlight that by 2020, all public sector buildings met the Public Sector Taking the Lead in Environmental Sustainability (PSTLES) as shown in Figure 6.

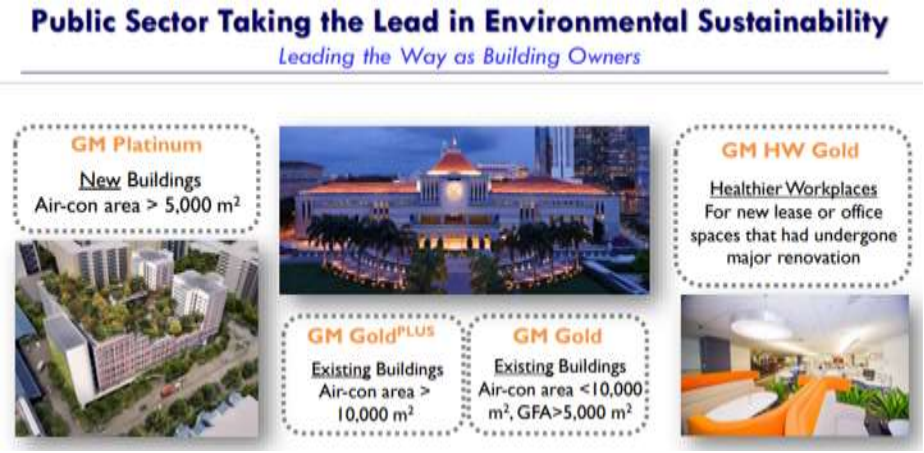


Figure 6: Public Sector Taking the Lead in Environmental Sustainability

In 2020, and based on the recommendations of more than 5000 people on green buildings, the BCA and the Singapore Green Building Council developed the new edition of the **Singapore Green Building Master Plan (SGBMP)** - together with industry stakeholders and the community. Launched in March 2021, the SGBMP was part of the Singapore Green Plan 2030. The SGBMP aimed to deliver three key targets **of "80-80-80 in 2030":**

- Stepping up the pace to green 80% of buildings by 2030;
- 80% of new developments to be Super Low Energy (SLE) buildings from 2030
- Achieving 80% improvement in energy efficiency for best-in-class green buildings by 2030

The journey of Singapore's green building since 2005 is summarized in Figure 7.

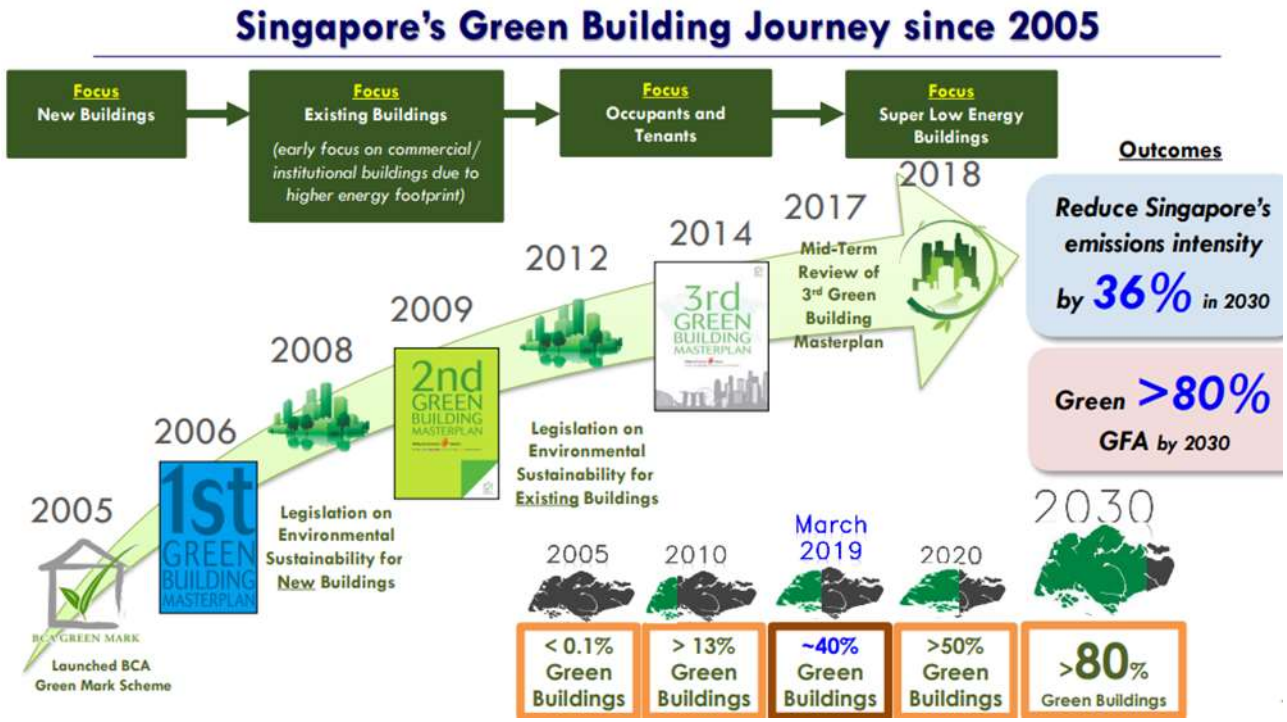


Figure 7: The journey of Singapore's green building

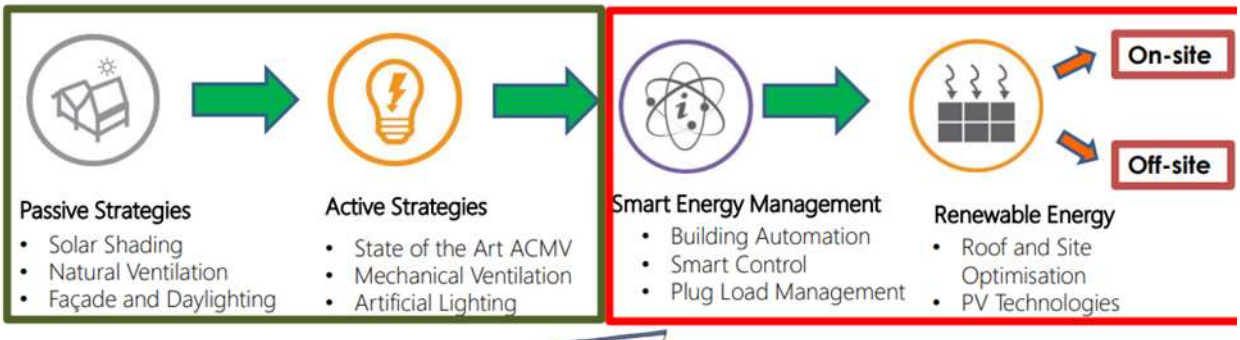
2. Super Low Energy (SLE) Building Program (2018)

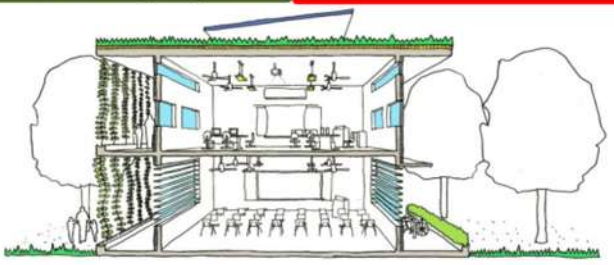
Launched in 2018 by BCA, this program aimed to encourage firms to go beyond the existing Green Mark Platinum standards and push the envelope of environmental

sustainability in Singapore. SLE buildings feature best-in-class energy efficiency, the use of onsite and offsite renewable energy and other intelligent energy management strategies. Certifications are given as per the following:

- The SLE Green Mark certified building is the one that achieves at least 60% energy savings (above 2005 building codes which is being used as the anchor reference for Green Mark energy savings).
- The Zero Energy (ZE) certified building is a super low energy (SLE) building with all energy consumption, including plug load, supplied from renewable energy sources (both on-site and off-site). Building development should maximize the on-site renewable source first before exploring off-site renewable sources, generated accordance with SS 673: 2021 Code of practice for renewable energy certificates through renewable energy generated within Singapore.
- Positive Energy (PE) certified building is a super low energy (SLE) building with 115% of all energy consumption, including plug load, supplied from onsite renewable energy sources.

In Figure 8, the SLE building program is clarified in its main points and criteria:





SUPER LOW ENERGY BUILDINGS

ADVANCING NET ZERO IN SINGAPORE

GM (SLE) Criteria

Super Low Energy (New bdg)
a. Minimum Green Mark Gold Award
b. 60% Energy Savings compared to 2005 code (10% above Platinum)
c. OR Benchmark EUI requirements for Buildings

Building Type	EUI
Schools	25
Office	100
Hotel/ Retail/ Mixed Commercial	160

Super Low Energy (Extg bdg)
a. Minimum Green Mark Gold Award
b. Benchmark EUI requirements
c. OR Demonstration of Energy Savings

Zero Energy (ALL)
a. Minimum Green Mark Gold Award
b. RE ≥ Energy Consumption*
**Note on-site RE shall be optimised prior to use of off-site RE . Use of off-site has SLE conditions*

Figure 8: the SLE building program

IV. Standards and Regulations

Starting 2021, BCA rose the mandatory environmental sustainability standards for new buildings and existing buildings that undergo major retrofit. This includes raising minimum energy performance requirements and introducing mandatory sustainable construction practices. Also in 2021, BCA has updated the Green Mark scheme 2021

(aligned with the United Nations' Sustainability Development Goals) to raise energy performance standards and place greater emphasis on other important sustainability outcomes such as designing for maintainability, reducing embodied carbon across a building's life cycle, and creating healthier environments for building users.
The milestone of standards regulations from 2008 to 2012 is shown in Figure 9,

Figure 9: The milestone of standards regulations from 2008 to 2012 in Singapore

V. Incentives and Financial Mechanisms

The incentives and financial mechanisms used by Singapore to promote green buildings are outlined as follows:

1. Green Mark Incentive Scheme for Existing Buildings 2.0 (GMIS-EB 2.0)

To raise the energy performance of existing buildings, BCA recently launched in 2022 an enhanced $63 million cash incentive scheme, Green Mark Incentive Scheme for Existing Buildings 2.0 (GMIS-EB 2.0), to help building owners lower the upfront capital cost of energy efficiency retrofits who achieve higher energy performance standards

(i.e., Platinum, Super Low Energy, and Zero Energy) for their buildings as shown in the Figure 10.

Figure10. Greening Existing Building Eco-system

2. **Mark Incentive Scheme for Existing Buildings and Premises (GMIS-EBP) - (third GBMP)**

The GMIS-EBO encourages and incentivizes building owners, occupants and tenants to undertake and adopt energy efficiency improvements and measures within their buildings and premises. It applies to existing building owners who are SMEs, with 30% SMEs tenants, or existing tenants who are SMEs.

3. **Green Buildings Innovation Cluster (GBIC) program**

GBIC supported the development and demonstration of innovative energy efficient technologies and solutions with high potential to be widely adopted. In 2022, to push the boundaries of energy efficiency in buildings, BCA provided enhanced funding of $45 million for the GBIC program which targeted key demand drivers, such as building owners and developers, and their value chains to co-create and accelerate solutions and commercialization through industry partnerships.

4. **Green Mark Incentive Scheme for Existing Buildings –GMIS-EB (second GBMP)**

To encourage private building owners of existing buildings to undertake retrofits to achieve significant improvement in energy efficiency, the GMIS-EB was introduced by BCA with S$ 100M.

5. Green Mark Incentive Scheme for New Buildings – GMIS-NB - (First GBMP)

BCA introduced S$20M to spur the private sector towards realizing green buildings. It offered direct monetary incentives to developers that achieve a green building rating above the basic certified level.

6. Building Retrofit Energy Efficiency Financing (BREEF) scheme

The BREEF aimed to aid building owners in overcoming upfront costs of energy efficiency retrofits and in adopting Green Mark standards for existing buildings.

7. Grant for Energy Efficient Technologies (GREET)

GREET aimed to encourage owners and operators of new and existing industrial facilities to invest in energy efficient equipment or technologies. The scheme was co-administered by the National Environment Agency (NEA) and the Economic Development Board (EDB).

8. Energy Efficiency Improvement Assistance Scheme (EASe)

EASe is a co-funding scheme administered by NEA to provide incentives to companies in the manufacturing and building sectors to carry out detailed studies on their energy consumption and identify potential areas for energy efficiency improvement.

VI. Education and Awareness

1. R&D Research Funds

The Ministry of National Development launched multiple R&D Research Funds during the GBMPs to encourage research into developing more viable and cost-effective green building technologies and energy efficiency solutions such as but not limited to the Green Building Innovation Cluster (GBIC).

2. Building Up Industry Capability

The BCA academy launched a training and certification schemes for green building specialists at the PMET (Professional, Manager, Executive, and Technician) in all the GBMPs in order to grow the capability of the building industry in the areas of the design and operation of green buildings.

To meet the increasing demand for green buildings, BCA has revised its target to train 25,000 green building professionals by 2025 (from the previous target of 20,000 by 2020). PMETs have been trained by the Institutes of Higher Learning, BCA Academy and the industry.

3. Singapore Green Building Week

To elevate awareness of green buildings, energy efficiency and the need for a sustainable built environment within the industry and the community, the Singapore Green Building Week has been launched every year in order to feature the International Green Building Conferences and to showcase Singapore's achievements.

4. Academic Programs

BCA also offered academic programs designed to facilitate the career advancements of green professionals through clear and defined academic progression paths in collaboration with reputable universities in Singapore.

VII. Analysis

Singapore is one the best among global cities for green buildings. However, they believe that they can do more to promote the uptake of green building projects. The challenges, described as the missing piece in Singapore's green building puzzle, might be holding the state's green building sector back and be considered as obstacles facing the target of greening 80% of Singapore's building stock by 2030. The fact is that Singapore can do more to promote the uptake of green building projects by facilitating conversation among building developers, designers and operators. Most builders or owners are used to traditional building methods and do not know about the maintenance savings that can come from having good structural foundations. They might also be missing out on energy efficiency solutions due to a tendency to ignore or immediately dismiss small, independent firms who pitch their solutions to them. How to run a building in the most energy efficient way is one of the key challenges facing the industry. One way to overcome knowledge gaps in the industry and foster collaboration between companies working towards common goals is to organize more workshops and events on green buildings and energy efficiency. Such events would not only facilitate the exchange of technology and ideas among solutions providers, it would also promote healthy competition among suppliers to deliver better solutions—which would ultimately be good for end customers. One more time, awareness is essential.

SECTION D: ITALY

I. Introduction

Collectively, buildings are responsible for 40% of energy consumption and 36% of greenhouse gas emissions of the EU, which mainly stem from construction, usage, renovation and demolition. Improving energy efficiency in buildings therefore has a key role to play in achieving the ambitious goal of carbon-neutrality by 2050, set out in the European Green Deal. Today, roughly 75% of the EU building stock is energy inefficient. This means that a large part of the energy used goes to waste. Such energy loss can be

minimized by improving existing buildings and striving for smart solutions and energy efficient materials when constructing new houses[41].

Italy is the fourth-largest energy consumer in Europe, after Germany, France, and the United Kingdom. Italy's primary energy consumption is driven by petroleum and other liquids and natural gas, which accounted for more than over three-quarters of Italy's total consumption in 2016. The remaining shares are coal, hydroelectricity, and other renewable energy sources. Renewable energy sources, excluding hydroelectricity, have increased their share in Italy's energy consumption from less than 2% in 2005 to nearly 10% in 2016. Hydro-electricity was responsible for roughly 33% of the country's electricity production. The government's National Energy Strategy calls for renewables to surpass natural gas as the primary fuel for electric power generation by 2020[42].

In the last decade, Italy has considerably strengthened its national environmental institutions, issued new environmental legislation, and further devolved environmental responsibilities to regional and local authorities while keeping responsibility for strategic planning and legal co-ordination at the central level. In addition, Italy has put in place a set of incentive tools and regulatory measures capable of accelerating the energy efficiency rate of buildings, such as the tax deduction mechanism to which was recently added the 110% Super bonus, to promote energy development actions such as thermal insulation and replacement of existing heating systems. The number of buildings with high energy performance is on the rise, going from approximately 7% to 10% of the total in the period 2016-2019, thanks to major renovations and construction of new buildings, as shown by the Annual Report on the Energy Performance Certification of Buildings[43].

This section will describe the local Green Building Rating System used in Italy, national plans for green buildings, useful standards and codes, incentives and financial opportunities offered by the government to promote green buildings, and the level of education and awareness in the country that led to great achievements in this industry without forgetting to tap into the barriers hindering the targeted goals.

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[41] "European Commission," 17 February 2020. [Online]. Available: https://ec.europa.eu/info/news/focus-energy-efficiency-buildings-2020-lut-17_en.

[42] "U.S. Energy Information Administration," 2017. [Online]. Available: https://www.eia.gov/international/analysis/country/ITA.

[43] ENEA, "Energy: Italy, high energy efficient buildings are on the rise," Italian National Agency for New Technologies, Energy and Sustainable Economic Development, 2020.

II. Local Green Building Rating System in Italy

The most widely used sustainability protocols in Italy are: the LEED protocol in its Italian version of the GBC Italia, the ITACA protocol and the CasaClima protocol.

1. The LEED Protocol, Italian Version

The Italian Green Building Council (GBC Italia), founded in 2009, is the Italian association for the construction sector companies' intent on making buildings more environmentally friendly, sustainable and capable of supporting living communities.
GBC Italia elaborated specific rating systems for the certification of historic buildings (GBC Historic Building), for residential construction (GBC HOME) and for neighborhoods (GBC QUARTIERI).
In addition to handling LEED certification activities, GBC Italy also promotes the development of a 'knowledge supply chain' to diffuse new ideas, concepts and tools, and to raise awareness in the area of sustainability.

2. CasaClima Protocol

Agencia Casaclima, was founded in 2002, has been constantly evolving its standards, and has created a wide range of quality seals for building products and building certifications that describe sustainable construction in a more holistic approach. In 2014, CasaClima was expanded to become the Energy Agency South Tyrol - CasaClima, a public body of the Autonomous Province of Bolzano - South Tyrol. Since then, the fields of action and competences of the Agency have constantly expanded and new initiatives have been started, such as the programs KlimaGemeinde in the field of municipal climate protection or KlimaFactory for improving energy efficiency in companies.
An important area is the constant exchange and institutional cooperation with public and private stakeholders, professional chambers, trade associations, consumer protection offices and other interest groups. CasaClima is also getting increasingly engaged at the international level. For example, it coordinates the energy sector of the European Macro-Regional Strategy for the Alpine area (EUSALP) and is continuously involved in numerous international research projects.

Based on the CasaClima Nature protocol, the Agency has developed an entire group of quality seals that take into account the specificities and needs of various areas of application[44]:

- Nature sustainability seal for residential buildings,
- Welcome and Hotel in the tourism sector,
- Wine for wineries
- Work & Life for office buildings and School for schools and kindergartens.

3. ITACA Protocol

The protocol of the Institute for Innovation and Transparency in Procurement and Environmental Compatibility (ITACA), was founded in 2004. ITACA was among the first to develop an urban-scale protocol in 2016. Then, in December 2020, on initiative of a broad representation of the regions, a synthetic version of the Urban Scale Protocol was approved to simplify its use and encourage its dissemination. Marche Region was one of the main promoters in Italy for the development of the ITACA Urban Scale protocol. The evaluation model of this protocol is strongly dependent on the regional territorial context to which it is applied and therefore its elements change according to the different regions within the Italian territory.

Finally, although the GBC and ITACA protocols are voluntary, the CasaClima protocol is compulsory for the Autonomous Province of Bolzano while it is voluntary for the rest of the national territory. However, although the ITACA sustainability protocol is not nationally compulsory, it relies on the Reference Practice developed by the Italian Normative Institution (UNI) and ITACA on “Environmental Sustainability in Construction” [which is a document that is not normative but rather regulatory and prescriptive]. Moreover, The ITACA protocol also has an aspect related to the regional level: each region in fact provides for its approval and updating[45].

[44] A. Casaclima, "CasaClima Quality Certificate, LIVING COMFORTABLE AND SAVING ENERGY," Casaclima, 2018

[45] F. Abastante, "Pursuing the SDG11 Targets: The Role of the Sustainability Protocols," Sustainabiltiy, 2021

III. National Plans and Programs

Over the past few years, the human and budgetary resources of the Ministry of the Environment and Land Protection (MATT) have been increased very significantly; new directorates deal with sustainable development and protection from flooding, landslides, and other natural disasters. The National Environmental Protection Agency (ANPA), which provides MATT with scientific and technical support, has been growing. There has been important progress on environmental legislation (e.g., water, waste reforms), mainly prompted by EU environmental directives. Listed below are the highlights of the Environmental schemes and programs adopted.

1. Italy's National Energy and Climate Plan

The National Energy and Climate Plan (NECP), published in 2017, is the ten-year plan that the Italian Government drew up to anticipate and manage the change of the national energy system: a document looking beyond 2030, and laying the groundwork for building an advanced and innovative energy model. The document results from a participative process that involved the Italian Parliament, the Regions, and over 250 stakeholders, including associations, companies, public entities, citizens, and representatives of academia. The numerous contributions given to the process testify to the priority that the public opinion assigns to energy and environmental issues. The objective of the Strategy is to make the national energy system more competitive, more sustainable, and more secure. Italy's National Energy Strategy 2017 (the Strategy) lays down the actions to be achieved by 2030, in accordance with the long-term scenario drawn up in the EU Energy Roadmap 2050, which provides for a reduction of emissions by at least 80% from their 1990 levels.

Core targets of the National Energy Strategy 2017 are: reducing final energy consumption by a total of 10 Mtoe by 2030; reaching a 28% share of renewables in total energy consumption by 2030, and a 55% share of renewables in electricity consumption by 2030; strengthening supply security; narrowing the energy price gap; furthering sustainable public mobility and eco-friendly fuels; and phasing out the use of coal in electricity generation by 2025.

The Strategy – a centerpiece of the Energy and Climate Plan – set out measures to achieve sustainable growth and environmental targets, as envisaged by COP21, contributing in particular to a low-carbon economy and to the fight against climate change. Renewables (RES) and energy efficiency will contribute not only to environmental protection, but also to energy security (by reducing the dependence of the energy system) and cost-effectiveness (by favoring the reduction of costs and prices). The Strategy will[46]:

- Further promoting the dissemination of low-emission RES.
- Furthering energy-efficiency projects that maximize sustainability benefits, and keeping system charges low.
- Stepping up the de-carbonization of the energy system.
- Increasing public resources allocated for research and development of clean-energy technologies.

Finally, the 2030 National Energy and Climate Plan introduces the SEA, or Strategic Environmental Assessment, which examined the environmental impact of the plan in 2019 to demonstrate that the fight against climate change for Italy is a concrete commitment.

2. The Green Building Program

In 2004, the European Commission initiated the Green Building Program (GBP). This program aims at improving the energy efficiency and expanding the integration of renewable energies in non-residential buildings in Europe on a voluntary basis. The program addresses owners of non-residential buildings to realize cost-effective measures which enhance the energy efficiency of their buildings in one or more technical disciplines. In a pilot phase in the years 2005-2006, the Green Building infrastructure was set up in ten European countries, including Italy, where the organization involved in the Green Building Program is End-use Efficiency Research Group (eERG) – Building Engineering Faculty - Politecnico di Milano.

In each participating country so called National Contact Points were established for aiding organizations, which consider a participation in the Green Building Project. The

[46] Ministero dello Sviluppo Econimico, "ITALY'S NATIONAL ENERGY STRATEGY 2017"

successful work is now being continued in a 2nd phase - called Green Building Plus - that started December 2007. The Green Building project is supported by the European Commission's Intelligent Energy Europe Program.

The main objective of Green Building is to trigger investments in energy efficiency and renewable energy technologies in non-residential buildings with focus on existing premises on a voluntary basis. Moreover, a summary of the programs main objectives is:

- Green Building is designed to help to open up markets – in particular by increasing awareness, know-how and technical capabilities, the access to finance and energy service offerings – to achieve investments with high benefits and short payback times.
- Green Building wants to initiate energy efficiency investments in non-residential buildings which are clearly profitable and are based only on proven technologies.
- Green Building complements and goes beyond the standards imposed by the European building directive and national building codes in force.
- By encouraging energy efficiency and renewable energy measures beyond the existing regulations which are economically viable, GREENBUILDING does not stop at the implementation of state-of-the-art energy standards but actively contributes to the advancement of the present state-of-the-art in energy saving techniques in the non-residential building sector.
- Green Building intends to provide information and support as well as public recognition to companies, which are ready to make commitments to improve the energy efficiency of non-residential buildings well beyond the legal requirements with measures that are proven and profitable.

3. National Renewable Energy Action Plan

Italy's Renewable Energy Action Plan was adopted in 2010 and its overall target is to achieve 17% of final energy consumption from renewable sources by 2020. It is important to note that Italy met this target and beyond, achieving 20.4% renewable energy share of final energy demand (Enerdata). Its development is among the priorities of Italy's energy policy alongside the promotion of energy efficiency. The objectives of such a policy are: energy supply security, lower energy costs for consumers, promotion of innovative new technologies, environmental protection (including lower GHG

emissions) and therefore, ultimately, sustainable development. In the medium to long term, Italy aims to redress the balance of its energy mix, which remains overly dependent on imported fossil fuels[47].

4. The National Reform Program

The European Union has developed a ten-year jobs and growth strategy known as Europe 2020. It was launched in 2010 to create the conditions for smart, sustainable and inclusive growth within the European Union. As part of the strategy, the EU goals have been translated into national targets and trajectories which, in the case of Italy, are further developed in its National Reform Program, which was launched by Prime Minister Renzi in September 2014. The purpose of the reform program is to guide Italy towards overcoming the deep-seated structural problems that led to productivity stagnating since the end of the 1990s (OECD, 2015). The program identifies high energy costs among the competitive disadvantages facing Italian businesses. An EU review of the Italian program identified a number of areas in which the energy sector could be improved: among them insufficient electricity grid capacity, which hampers the smooth functioning of the electricity market and contributes to higher wholesale prices, and changes to support mechanisms for renewable energy. Italy has identified the categories of infrastructures to be considered as “strategic” but not the individual projects, a step that was foreseen in the 2013 NES (EC, 2015).

5. The Green New Deal

The Green New Deal is the European plan that promotes a sustainable Europe: modern, sustainable and resilient. The goal is to transform climate issues and environmental challenges into opportunities and become the first zero-emission continent in 2050. The Plan therefore encourages investments and projects that guarantee a transition towards a more sustainable economy. The inter-ministerial decree (MISE and MEF) of December 1, 2021 (the MISE Decree), published in the Italian official gazette on February 1, 2022, provides for the granting of incentives to support research, development and innovation projects for the ecological and circular transition

[47] IEA, "Energy Policies of IEA Countries- ITALY," International Energy Agency, 2016.

in support of the goals of the "Italian Green New Deal," with a budget of €750 million. Projects consistent with the intervention areas of the Italian Green New Deal, with particular regard to the following objectives[48]:

- De-carbonization of the economy;
- Circular economy;
- Reducing the use of plastics and replacing plastics with alternative materials;
- Urban regeneration;
- Sustainable tourism;
- Adaptation and mitigation of risks to Italy deriving from climate change.

IV. Standards and Regulations

1. Legislation for the Promotion of the "Green Economy": Law No. 221

On December 28, 2015, Italy passed historic and wide-ranging legislation for the promotion of the "green economy." Law No. 221 entered into effect on February 2, 2016. The Law requires the government to approve a National Strategy for Sustainable Development, to be updated at least every three years, and creates a National Agency for New Technologies, Energy, and Sustainable Economic Development (ENEA, in Italian) to provide services to companies and individuals in those areas. It also establishes the National Strategy for Green Communities. The law covers the following fields[49]:

- General Measures for the Protection of Nature and the Promotion of Sustainable Development
- Marine Environment
- Protection of Natural Spaces
- Greenhouse Gas Emissions and Installations for Energy Production
- Green Public Procurement

[48] Denton, "Guide to Green New Deal: Italy's MISE Decree incentives," 17 February 2022. [Online]. Available: https://www.dentons.com/en/insights/articles/2022/february/17/guide-to-green-new-deal-mise-decree-eng.
[49] FAO, "Access information on Multilateral Environmental Agreements," 2015.

- Incentives for the Generation of Green Products
- Measures on Trash Collection
- Transportation to School or Work

2. Green Public Procurement (GPP)

Green Public Procurement (GPP), i.e., the adoption of Minimum Environmental Criteria (MEC) in public procurement, became mandatory for supplies, services and works of any amount with the new Public Contracts Code (Legislative Decree 50 of 18 April 2016, in particular article 34, later corrected by Legislative Decree of 19 April 2017, no. 56). GPP refers to "the approach whereby Public Authorities integrate environmental criteria into all phases of the purchasing process, encouraging the diffusion of environmental technologies and the development of environmentally sound products, through research and the choice of results and solutions that have the least possible impact on the environment throughout the entire life cycle": adopting GPP means – according to the provisions of the National Action Plan for GPP (the PAN GPP approved by Inter-ministerial Decree 135 of 11 April 2008, subsequently updated by Decree 10 April 2013) – complying with the Minimum Environmental Criteria, by Product category, approved by the Ministry of Ecological Transition, which can be found on the website dedicated to GPP.

The product categories for which to approve the Minimum Environmental Criteria (MEC), according to the provisions of Article 1 paragraph 1127 of Law 296/2006, are eleven: a) furnishings; b) construction materials; c) road maintenance; d) management of public green areas; e) lighting and heating; f) electronics; g) textiles; h) stationery; i) catering; l) hygiene materials; m) transport.

The GPP stipulates that the contracting authorities shall contribute to the achievement of the environmental objectives of the National Action Plan through the inclusion, in the design and tender documentation, at least of the technical specifications and contract clauses contained in the MEC. Furthermore, for the purposes of drawing up tender documents for the application of the criterion of the economically most advantageous offer, contracting stations must take into account the award criteria included in the MEC

approved by the Ministry of Ecological Transition. Design and tender documents that do not comply with MEC are subject to appeal[50].

3. Energy Performance in Buildings Directive (or Code) - EPBD

In Italy, the national government is responsible for implementation and monitoring of broader energy policy, such as implementing the Energy Performance in Buildings Directive (EPBD) and other European directives. Regions have jurisdiction over in environmental, planning and building control matters. Therefore, while several building provisions set by national law aim at guiding and harmonizing the regulatory framework, regional governments are still responsible for building energy codes. The national government has issued decrees implementing EPBD (2005) primarily focusing on minimum energy requirement for buildings, methodologies for calculating energy performance of buildings and national guidelines for Energy Performance Certification (2009). National laws limit energy consumption in buildings according to EPBD. Regional and local governments issued technical guidance for codes implementation and are responsible for design reviews and on-site visits during construction and before occupancy. In July 2015, the national government issued three new decrees to update and harmonize existing regional or local codes by making one single national set of standards[51].

V. Incentives and Financial Mechanisms

Italy offers a number of incentives for building retrofits that would improve energy efficiency in existing buildings. These incentives are listed below[52] [53]:

[50] "Forum Compraverde," 2020. [Online]. Available: https://www.forumcompraverde.it/en/il-gpp-obbligatorio/.
[51] IPEEC, "Building Code Implementation - Country Summary," International Partnership for Energy Efficiency Cooperation, 2015.
[52] IPEEC, "Building Code Implementation - Country Summary," International Partnership for Energy Efficiency Cooperation, 2015.
[53] Idealista/News, "Green Building Incentives in Italy: how to make your home greener in 2020," [Online]. Available: https://www.idealista.it/en/news/financial-advice-italy/2020/01/13/2658-green-building-incentives-italy-how-make-your-home.

1. **National Energy Efficiency Fund:**

The fund aims to support energy efficiency projects implemented by public authorities, ESCOs and businesses in order to increase energy efficiency of buildings, industrial installations and production processes and to improve efficiency of public services and infrastructure, such as street lighting.
It is a revolving fund and is divided into two sections: a) a section for the granting of guarantees on individual financing operations, to which 30% of the resources that annually flow into the Fund is allocated; b) a section for the provision of subsidized rate loans for which 70% of the resources that annually flow into the Fund is allocated. The guarantees section also provides for a 30% reserve for interventions concerning networks or district heating systems, while 20% of the resources allocated for the granting of loans is reserved to the Public Administration.

2. **Financial instruments for school buildings, social housing and hotels**

To encourage investments in public buildings, in particular in school buildings, Decree Law No 104/2013 and the Economy and Finance Document (DEF) of 2014 has enabled Italian Regions to take out loans with the European Investment Bank (EIB), the Council of Europe Development Bank, the Cassa Depositi e Prestiti or other banks, with amortization costs to be paid by the State. The Istituto Nazionale per gli infortuni sul Lavoro – INAIL (National Workers' Compensation Authority) will budget from 2014 to 2016 EUR 100 million per year for projects to improve the safety and energy efficiency of buildings.

3. **Fund for home purchase and/or renovation (Plafond casa):**

Article 6 (1)(a) of the Decree Law of 31 August 2013, converted into Law No 124 of 28 October 2013, allocated EUR 2 billion to support access to home-buying loans. The fund finances through mortgage-backed loans purchase of residential properties, preferably belonging to energy classes A, B or C, and/or supports renovation and energy efficiency improvement projects, giving priority to young couples, families with one or more disabled person and large families.

4. "55% tax credit for energy efficiency improvements in existing buildings"

The measure allows building owners to recover 55% (up to 65% in 2014) of the investment costs (with maximum limits) in 10 years within the income declaration procedure. The program finances measures such as: renewal or improvement of the efficiency of the heating system, and retrofitting of building envelope components and building renovations works that are able to achieve a building energy performance 20% more efficient than the values set by law. This mechanism will be renewed for the whole 2015 with a tax deduction rate confirmed at 65%.

5. Piano Casa

Piano casa'15 is an economic recovery measure, which since 2009 offers support to Italian regions for improvements of existing residential buildings. While there are no mandatory requirements for energy renovation of existing buildings, regions and municipalities set minimum sustainability requirements as criteria to qualify for receiving subsidies from the Piano Casa program.

6. Other green building incentives in Italy

Those who already own a home can take action to make their home more environmentally friendly by taking advantage of the various green building incentives in Italy that have been extended for 2020, namely:

- Eco-bonuses for energy saving
- Renovation bonuses for building redevelopment
- Furniture bonuses linked to renovation work
- The "green bonus"
- Green mortgages for efficient and safe buildings
- The new "facade bonus" for 2020
- Wood and LED lighting

VI. Education and Awareness

The results of the Special Eurobarometer 441 survey performed in 28 Member States during December 2015, on the occasion of the European Year for Development (ECAS, 2015), have shown that only 36% of the Italian people were aware of the Sustainable Development Goals (SDG) as defined in the 2030 Agenda for Sustainable Development. Of the 967 persons interviewed in the various sessions, 63% had never heard of the SDGs, 27% only had a vague idea of them, and only about 9% knew the European 22 SDGs in some detail.

In order to increase knowledge and awareness on Italian citizens and students on the strategies and actions undertaken by the national government and local administrations, a memorandum of understanding has been recently signed by the ASviS (Italian Alliance for Sustainable Development), established on February 2016 with the specific aim of raising the awareness, and the Italian Ministry of Education, University and Scientific Research (MIUR). The document binds the parties to collaborate in the promotion of training initiatives and in the dissemination of all information available on SDGs. The main actions foreseen for the year 2017 are the ones devoted to the development of dedicated e-learning courses for school teachers, the promotion of learning activities in elementary schools, and the setup of programs addressed to middle and high school students for the academic year 2017-2018.

Moreover, Italy participates in several EU-level programs, such as the “BUILD UP skills” program, that aims to align workers operating in the building retrofits with the highest EU standards. The program is helping European countries harmonize their national qualification frameworks, develop a reference model for training paths, provide incentives for hiring qualified workers, as well as set up training workshops at the appropriate scale. The new IEE Build Up Skills 2013 Project “BRICKS - Building Refurbishment with Increased Competence, Knowledge and Skills” (2014-2017) aims at developing tools and methodologies to set up training systems to intensify the introduction of Renewable Energy Sources (RES) and improve Energy Efficiency (EE) in the old as well as in the new buildings, to reach Nearly Zero Energy Building (NZEB) stocks by 2020. Furthermore, agencies like CasaClima offer capacity building courses and seminars for:

- Training and education to planners, craftsmen, maintainers, builders, blower-door test technicians and infrared heat camera experts
- Certification and regular inspection in the building site during and after construction
- Consulting, coordination, contracting
- Periodical (fairs) and continuous communication (website, magazine). Examples of certified houses are also on the web.

VII. Analysis

In the last ten years, Italy has fulfilled most of its domestic objectives and international commitments. However, the overall picture is mixed. Even though Italy has not satisfied a number of its commitments regarding NOx, NMVOCs, ammonia emissions, several water goals and targets, climate change, etc...., It is it worth mentioning that Italy has still continued to make good progress in decoupling environmental pressures from economic growth, through low energy intensity and reduction of SOx and NOx emissions as well as through reduction of phosphate fertilizer and pesticide use. Italy also increasingly depends on environmentally related taxes and environmental charges.

The main barrier facing further progress is that transposition of EU legislation has often entailed significant delays. Despite efforts made, the Italian legal framework remains too fragmented and complex. In many instances, taxes and charges have been set at a modest level and have had only modest environmental benefits. There are important disparities in the environmental institutional capacity and the effectiveness of regional and local authorities. Many urban areas in southern Italy do not have city master plans. Some 15 to 20% of buildings are constructed without permits. Regions and provinces make little use of territorial planning for environmental purposes and risk management. An integrated approach to coastal zone management is lacking. There has been a relatively low level of investment in environmental infrastructure, possibly linked to delayed decisions associated with the devolution process and low spending capacity in the case of allocated funds.

Overall, some excellence points have been achieved by Italy in the field of environmental sustainability, especially in boosting the adoption of renewable energy sources. Based

on the estimated done by Statistica Research Department (Dec 2021), Italy is the leading country worldwide for electricity consumption covered by solar PV and it is among the largest markets in capacity additions reaching a number of residential PV systems of 756916 systems in 2020 and a cumulative installed capacity of PV systems of 20.85 GW, In the EU, the Italian PV sector is only second to Germany. Other forms of renewable energies are also quite widely adopted. According to the data diffused by the World Wind Energy Association (Pitteloud and Gsänger, 2016), Italy is the ninth energy producer by wind power in the world and the fifth amongst the European Union Member States. Another point strength of Italy is the recycling of special wastes, where about 76% of special waste is currently recycled, and this is done to a substantial extent (62% of the total) with de-manufacturing technologies and resource recovery treatments able to selectively sort and reuse secondary raw materials, such as metals used in smelting industry[54].

[54] P. Ciccioli and P. Ragni, "Environmental Sustainability Report Italy," INSTITUTE OF CHEMICAL METHODOLOGIES OF NATIONAL RESEARCH COUNCIL IMC-CNR, Italy, 2017

SECTON E: INDIA

I. Introduction

The Indian green building market is projected to double by 2022 at 10 billion sq. ft, valuing around USD 35-50 billion. According to property consultant ANAROCK, this growth is increasingly attributed to growing awareness level, environmental benefits and government support.

In India, an important shift is occurring and a large part of the population is moving from rural areas to the cities. The country is home to 17.5 percent of the global population and many live in poverty (363 million), without access to basic services such as electricity

(304 million) or potable water (92 million). Rapid urbanization is a dominant trend, it is expected that another 100 million citizens will make the move to the cities in the next 15 years and bring an exponentially high demand on housing, water and energy needs. Over the 1990-2003 period, electricity use increased at 8.25 percent and 7.4 percent annually in the residential and commercial sectors respectively. Electricity consumption in the residential sector is mostly from space conditioning (52 percent), refrigerators (28 percent in summer) and lighting (8 to 14 percent). In the Commercial sector, 60 percent of energy use are for space conditioning when available, and lighting account for 32 percent. However, energy use varies a lot across different income groups, so do the access to air conditioning.

India is committed to reducing the GHG emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 levels[55]. Estimations shows that more than half of India is yet to be built, and the country faces the challenge of improving the living conditions of its inhabitants while tempering the environmental impacts of the rise of standards of living, and notably the impact of Buildings, from the choice of the construction materials, design, equipment and energy use. This section will detail the local Green Building Rating System used in India, the milestone of the national plans for green buildings, useful standards, incentives and opportunities offered by the government to promote green buildings, and the level of education and awareness in the country that led to great achievements in this industry without forgetting to mention the challenges hindering the targeted goals.

II. Local Green Building Rating Systems in India

The beginning of Green Building Movement was done by the Confederation of Indian Industry (CII) in 2001. They formed the Indian Green Building Council (IGBC) in the same year. The Green Building movement in India started gaining momentum in 2003 and received a major impetus when CII – Sohrabji Godrej Green Business Centre Building in Hyderabad became the first green building in India & was awarded with the prestigious

[55] **Government of India, "INDIA'S INTENDED NATIONALLY DETERMINED CONTRIBUTION: Working toward climate justice," 2016.**

and the much coveted LEED (Leadership in Energy and Environmental Design) Platinum rating by the US Green Building Council (USGBS) and also became the world's greenest Building in 2003. The common green building labels used in the Indian construction market are listed below:

1. The India's GRIHA (Green Rating for Integrated Habitat Assessment)

India's GRIHA (Green Rating for Integrated Habitat Assessment) and the LEED India green building rating systems are the most popular building labelling systems in the country. Both rely on ECBC guidelines to assess a building's energy efficiency in the commercial sector. Between the two, the GRIHA system is more closely linked with typical India building operational characteristics such as significantly reduced demand for cooling. The national government and several state governments support GRIHA. GRIHA pre-certification is accepted by the Ministry of Environment, Forest and Climate Change for fast-track environment clearance. Four states require GRIHA rating for government buildings and the national government requires GRIHA compliance in all new national government buildings. In 2019, 500 new projects were GRIHA certified, amounting to a surface of 13 million square feet, a significant improvement on the three years prior to that.

2. The LEED India Green Building Rating Systems

LEED buildings are still more costly than regular buildings. However, despite high costs, LEED received strong initial support and, in 2021, with 30.3-million-foot square registered, India ranked fourth in LEED-registered building floor space only behind the US, China and Canada. The LEED benchmark has been recognized and accepted by most developers, builders, architects and users for constructing core or shell buildings as well as for furnishing buildings in India. IGBC has developed the following green building rating systems for different types of building in line and conformity with US Green Building Council. To date, the following Green Building rating systems are available under IGBC:

- LEED India for New Construction
- LEED India for Core and Shell
- IGBC Green Homes

- IGBC Green Factory Building
- IGBC Green SEZ
- IGBC Green Townships

Prior to June 5, 2014, when GBCI began managing the certification process for all LEED rating systems in India, including the LEED India rating system, which was previously managed by the Indian Green Building Council (IGBC), standards have been customized according to Indian conditions, in terms of the design, construction and operation of buildings for environment-friendly performances. Its rating system is amended regularly to address not only the Indian environmental and climatic conditions but also the sustainability issues of buildings.

3. The BEE's Star Rating System

The BEE's Star Rating System evaluates buildings based on operational energy use and is the only energy-use-specific building label used in India.

4. Zero Effect, Zero Defect (ZED):

The Make in India campaign with ZED is a policy initiative to rate Medium & Small Industries on quality control and certification for energy efficiency, enhanced resources efficiency, pollution control, use of renewable energy, waste management etc. using ZED Maturity Assessment Model. The scheme launched in 2015, envisages coverage of about 1 million medium and small enterprises.

ZED Certification, MSMEs can reduce wastage substantially, increase productivity, enhance environmental consciousness, save energy, optimally use natural resources, expand their markets, etc.

5. GEM (Green & Ecofriendly Movement):

In 2017, ASSOCHAM launched the "GEM Sustainability (Green) Certification Program" with the objective to promote environment friendly green building design and construction. GEM Sustainability Certification Rating Program is based upon BEE ECBC

2017 and NBC 2016. It aims to address the sustainability of a given development throughout its lifecycle from design through construction to operation.

6. Eco-Housing:

The Eco-Housing rating system was initially developed for the city of Pune in 2004. It is now being modified to address the variable requirements of India's five distinct climatic zones. This five-star rating system is specifically designed for residential buildings. Similar to GRIHA, it also focuses on efficient building materials.

7. The Energy Labelling Program for Appliances

An energy labelling program for appliances was launched in 2006, and comparative star-based labelling has been introduced for fluorescent tube- lights, air conditioners, refrigerators, and distribution transformers. The labels provide guidance for consumers through information about the energy consumption of appliances. The Bureau of Energy Efficiency has made it mandatory for 10 appliances including refrigerators and air conditioning (Table 6) and many more are in the process of being enforced. The standards and labelling program for manufacturers of electrical appliances is expected to lead to significant savings in electricity annually.

Table 6: BEE Star Labeling of Equipment in India

BEE Star Labeling of Equipment	
Labeling is Mandatory	**Labeling is Voluntary**
Room Air Conditioners	**Induction Motors**
Frost Free Refrigerators	**Pump Sets**
Tubular Florescent Lamp	**Ceiling Fans**
Distribution Transformer	**LPG-Stoves**

Room Air Conditioner (Cassette, Floor Standing)	**Washing Machine**
Direct Cool Refrigerator	**Computer(Notebooks/Laptops**
Central Heating Code	**Ballast Electronic/Magnetic**
Color TV	**Office Equipment (Printer, copier, scanner, MFDs)**
Electric Geysers	**Chillers**
Variable Capacity Inverter Air Conditioner	**Microwave Oven**
LED Lamps	**Solar Water Heater**

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8. Other Rating Systems for Green Buildings in India

Other rating systems for green buildings in India are the Small Versatile Affordable GRIHA, developed by TERI and Association for Development and Research of Sustainable Habitats (ADaRSH) for small stand-alone buildings; the Eco-Housing rating system developed for Pune; and the Star Rating Program for Buildings of the Bureau of Energy Efficiency. The IGBC also has rating systems for homes, townships, special economic zones factories and landscapes.

Most of the certified green buildings in India belong to the government or private companies, and to date there has been very limited residential demand. One limitation of the rating systems is that there is no systematic means to find out whether certified buildings are meeting their intended standards. The variety of rating systems, and potential competition between them, may also confuse consumers.

III. National Plans and Programs

To mainstream green-building and energy-efficiency practices, the Government of India has several policy initiatives in the form of regulations and voluntary schemes. India's environment policy is anchored in the Constitution of India, Article 48-A of the Constitution states that "The State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country".

1. The National Action Plan on Climate Change (NAPCC)

The National Action Plan on Climate Change (NAPCC), implemented through eight national missions, outlines the priorities for mitigation and adaptation to combat climate change, which are then the main lines for state Governments, NGOs and the private sector. Thirty-two States and union territories have developed or implemented their own State Action Plan on Climate Change[56]. It includes the National Mission for Enhanced Energy Efficiency (NMEEE), and its four initiatives to enhance Energy efficiency in energy intensive industries:

- Perform Achieve and Trade Scheme (PAT), a regulatory instrument to reduce specific energy consumption in energy intensive industries, with an associated market-based mechanism to enhance the cost effectiveness through certification of excess energy saving which can be traded.
- Market Transformation for Energy Efficiency (MTEE), for accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.
- Energy Efficiency Financing Platform (EEFP), for creation of mechanisms that would help finance demand side management programs in all sectors by capturing future energy savings.
- Framework for Energy Efficient Economic Development (FEEED), for development of fiscal instruments to promote energy efficiency.

2. The Energy Conservation Act (ECA)

[56] Government of India, "National Action Plan for Climate Change," 2008.

The Energy Conservation Act (ECA) of 2001 serves as Legal Basis for the implementation of Energy efficiency measures through the institutional mechanism of the Bureau of Energy Efficiency (BEE) in the Central Government and designated agencies in each state. Several measures targeting the industrial sector came from the fact it weighted as much as 31% of GHG emissions (base year of 94), and 9 energy intensive industrial sectors, i.e., thermal power stations, fertilizer, cement, iron and steel, chlor-alkali, aluminum, railways, textile and pulp and paper, are required to employ a certified energy manager, conduct energy audits periodically, and adhere to specific energy-consumption norms that may be prescribed.

3. The National Water Mission and the National Solar Mission

It is to be noted that India has a National Water Mission tasked with a key goal to enhance water use efficiency by 20%. Similarly, a National Solar Mission was launched in 2010 to create conducive policies and conditions for solar energy and notably decentralized distribution of energy and grid-connected solar PV including rooftops.

4. The National Mission on Sustainable Habitat

The National Mission on Sustainable Habitat, launched in 2010, addresses energy efficiency in buildings, the management of solid waste, and the necessary legal and regulatory framework adjustments (extension of the Energy Conservation Building Code for large new commercial buildings, application of incentives to promote the enhancement of existing building stock, developing and promoting of solid waste management techniques, equipment and infrastructure, recycling etc.).

5. The National Mission for Enhanced Energy Efficiency (NMEEE)

The National Mission for Enhanced Energy Efficiency (NMEEE) was launched by the Ministry of Power through the Bureau of Energy Efficiency (BEE). As its name suggests, it aims to promote energy efficiency through various initiatives by creating a favorable regulatory framework for energy efficiency market development. It has helped achieve significant results over the past decade, such as rapid adoption of efficient lighting (CFLs) and plans to replace incandescent lamps with LED bulbs are in motion. It has also

developed Standards and facilitated the labeling of a growing number of equipment, among which are refrigerators and air conditioning. It has also set into motion the enforcement of the Energy Conservation Building Code (ECBC) that sets energy performance minima for new commercial Buildings, and the adoption of India's own Green Building Energy Rating System GRIHA (Green Rating for Integrated Habitat Assessment).

IV. Standards and Regulations

1. The Bureau of Indian Standards (BIS)

The Bureau of Indian Standards (BIS) has laid down a number of standards detailing classification, general quality, dimensions and physical requirements for building materials. For example, IS 1077 establishes specifications for burnt-clay bricks, IS 3951 and IS 3952 for hollow clay bricks, and IS 12894:1990 for fly-ash lime bricks. The Performance Appraisal Certification Scheme (PACS) of the Building Materials and Technology Promotion Council (BMTPC), renewed for a further two years in 2013, provides third-party certification of the performance and suitability of new building materials, components, products, elements, construction system and assemblies that are not yet covered by the BIS. BMTPC has been promoting development, manufacture and use of alternate materials and technologies with an emphasis on environmental protection through use of waste products, energy conservation, development of substitute materials for scarce materials e.g., wood, and disaster resistant construction technologies. In order to give greater impetus to the actual use of such materials and technologies to derive the envisaged social benefits, a scheme called Performance Appraisal Certification Scheme (PACS) has been instituted by Ministry of Urban Development and Poverty Alleviation. The preliminary application includes criteria like environmental concerns, energy concerns and conservation. Technologies are assessed on these criteria before getting certified.

2. The India's National Building Code (NBC)

India's National Building Code (NBC), first adopted in 1970, provides guidelines to regulate construction activities, including structural, safety, and design measures. The latest revision of the NBC implemented in 2005, included aspects of planning, energy conservation and sustainable development. A new chapter entitled 'Approach to Sustainability' is being added, which will provide guidance for ensuring sustainability in the planning, design, construction, operation and maintenance of buildings.

3. The Energy Conservation Building Code (ECBC)

The Indian Bureau of Energy Efficiency (BEE), with the assistance of international consultants, developed a national model energy code for large commercial buildings and very high-end residential buildings. This Code is the Energy Conservation Building Code (ECBC) that was adopted in June 2007. It is each state's government responsibility to enforce ECBC. Up to 2017, 12 states had enforced the ECBC out of 28. By focusing on large new commercial buildings first, the efforts are likely to yield relatively quick progress in compliance if local governments pursue enforcement seriously. The introduction and enforcement of a building code for large commercial buildings in India is very important as it is projected that India will build more commercial buildings in the next 5 – 7 years than exist at present. Some of India's recent buildings have extremely high energy consumption for cooling owing to large glass surfaces with very little sun protection. Since 2017, The code is mandatory for commercial buildings or building complexes that have a connected load of 500 kW or greater or a contract demand of 600 kVA or greater. The code is also applicable to all buildings with a conditioned floor area of 1,000 m2 (10,000 ft2) or greater.

Provisions are made for Building envelopes (when Building is destined for human occupancy), Mechanical systems and equipment (heating, ventilating, and air conditioning, etc.), Water heating, Lighting and Electrical power and are specific to each of the five climatic regions of India (Hot Dry, Warm Humid, Composite, Temperate and Cold). Provisions mostly come from India's national building code and minimum equipment efficiency are from ASHRAE 90.1. Building must follow mandatory provisions through either the prescriptive method (mandatory provisions for all components) or energy budget method (allowing trade-offs when design including mechanical systems and equipment is more efficient and/or cost effective than a simulation of a standard

building compliant to the code through the prescriptive method). There is also a trade-off option for the envelope if its performance factor in the proposed design is less than the standard design.

To improve code compliance, and ensure that building owners understand their building's energy use intensity and designers understand whether their projects comply with the ECBC, three web-based software tools have been developed for use by code officials and building professionals. A partnership among 18 universities is developing a building sciences curriculum that is intended to provide training directly applicable to the ECBC and for related purposes. Some states have made mandatory the installation of solar water heaters in hospitals, hotels and large government and commercial buildings.

4. The ECO-NIWAS SAMHITA, or Energy Conservation Building Code for Residential Buildings (ECBC-R)

In 2018, BEE launched ECO-NIWAS SAMHITA, or Energy Conservation Building Code for Residential Buildings (ECBC-R) in order to improve energy efficiency and thermal comfort in dwellings that are responsible for 75 percent of electricity consumption in Buildings in India. The code is applicable to all residential buildings and residential parts of 'mixed land-use projects', both built on a plot area of ≥500 m2. However, states and municipal bodies have the freedom to adjust these conditions to suit the specificities in their area of jurisdiction[57].

The ECBR-R code mainly aims at reducing heat gains in most areas of the country, and reducing heat losses in the colder parts and for now only addresses the envelope. For each climatic zone, which are the same as for the ECBC, maximum U-values are provided for the envelope (roof U-value is the same for all zones). A minimum Windows-to-Floor ratio is used to validate natural ventilation performance. A minimum visible light transmittance for non-opaque parts of the envelope is used to ensure lighting is considered in the design.

A compliance check tool is available on BEE's website to help architects and engineers design a complaint building. Building Designers must submit the plans for validation in order to get code compliance. Figures 12 and 13 showcase the specific climatic zones in

[57] Bureau of Energy, "Eco-Niwas Samhita," Ministry of Power, 2018.

India suitable for implementing the ECBC and ECBC-R as well as the status of the code implementation across the country.

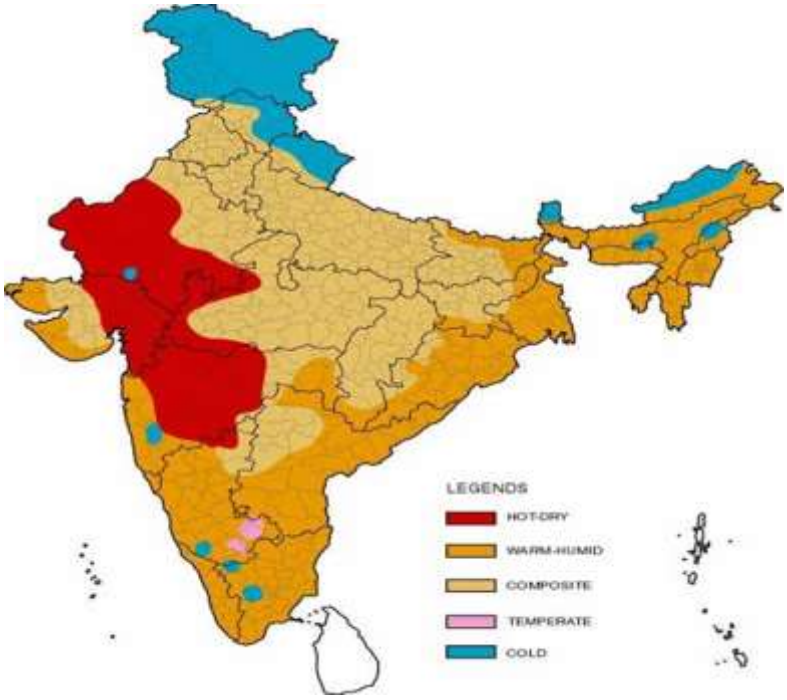

Figure 12: Climatic zones of India for ECBC and ECBC-R (Source: BEE)

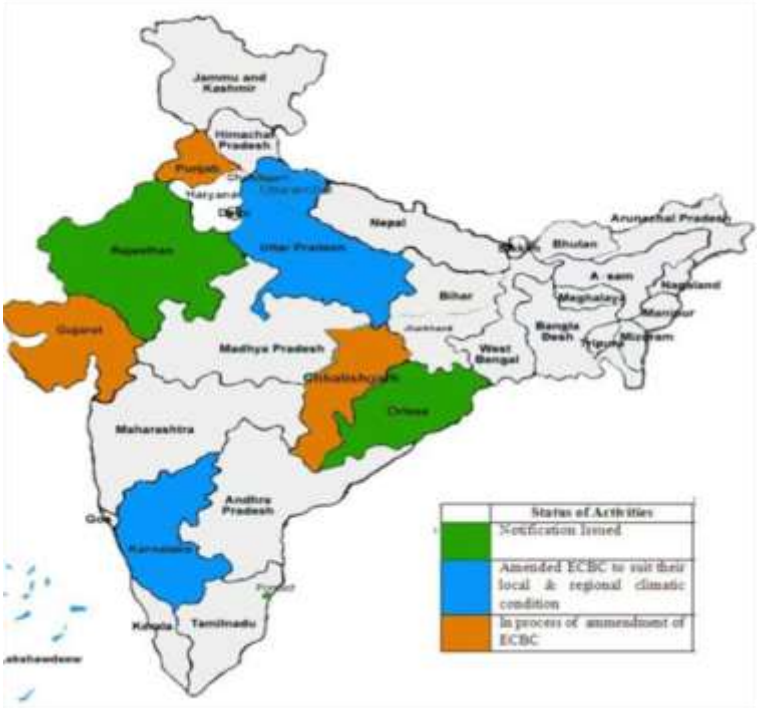

Figure 13: Status of implementation of ECBC in different states (Source: BEE)

5. The ECO-NIWAS SAMHITA Part II

In 2021, BEE launched ECO-NIWAS SAMHITA Part II, adding a Point System Compliance Method and requirements for Elevators, pumps, Comfort systems, Electrical Lighting (interior and exterior) and Renewable Energy Systems, Solar PV and solar water heaters. The envelope must follow provisions of ECO-NIWAS Samhita 2018 (now labeled as Part I), additional points are attributed for going further than provisions. Each compliant system or equipment is rewarded with a certain number of points, and depending on the type of Building (low rise, affordable housing, high rise), a certain number of total points is needed to achieve compliance[58].

V. Incentives and Financial Mechanisms

The Government of India and States governments are working toward creating a conducive environment for climate change mitigation and adaptation, reducing GHG emissions. Some measures may have a direct or indirect positive impact on Green Building in India.

Incentives and financing mechanisms for building energy efficiency are few and uncoordinated in India and require further development and testing. An early leader in this effort is the Indian Ministry of New and Renewable Energy's GRIHA-based incentives. This program stands out as a means of increasing building energy-efficiency awareness through simultaneously targeting multiple actors in the building supply chain. The package combines incentives for developers, owners, and local-level administrators, all of whose support is necessary at this stage in dramatically increasing the market for efficient buildings.

In March 2007 the conduct of energy audits was made mandatory in large energy-consuming units in nine industrial sectors. These Designated Consumers are also

[58] **Bureau of Energy, "Eco-Niwas Sanwita, Code Compliance and Part II: Electro-Mechanical and Renewable Energy Systems," Ministry of Power, 2021.**

required to employ certified energy managers and report energy consumption and energy conservation data annually.

Under The Perform achieve and Trade (PAT) scheme, targets are identified as Designated Consumers, industrials from most energy heavy industries (more are designated every year), and a percentage of energy consumption reduction target for a 3 years' period to DCs Is assigned, granting them energy saving certificates that can be traded. Industrials have to either achieve their 3 years' energy consumption reduction or buy certificates to get a pass.

In some states, the regulatory regime of Renewable Purchase Obligation (RPO) is in place, mandating that all electricity distribution licensees should purchase or produce a minimum specified quantity of their requirements from Renewable Energy Sources. This is as per the Indian Electricity Act, 2003. Renewable Energy Certificates (RECs) certifies the bearer owns one megawatt-hour (MWh) of electricity generated from a renewable energy source. The REC received can then be sold on the open market as an energy commodity once the power provider has fed the energy into the grid. Earned RECs can be sold to other polluting entities as a carbon credit, for example, to offset their emissions. Any user connected to the grid can sell RECs, this encourages decentralized production of electricity and the installation of solar PV on rooftops of Buildings as well as on plant sites. Moreover, it's an incentive to improve energy usage and efficiency as RPOs are indexed on non-Renewable energy consumption.

Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE), a risk sharing mechanism to provide financial institutions with a partial coverage of risk involved in extending loans for energy efficiency projects, and Venture Capital Fund for Energy Efficiency (VCFEE), established by the BEE Energy, among the beneficiaries would be Service Companies (ESCOs) and companies that plan to undertake EE projects through energy performance contracting are targeted as key potential beneficiaries of the VCFEE. Also supports EE investments in new technologies, goods and services.

India has increased taxes on fossil fuels (petrol and diesel) turning the subsidy into taxation (26% cut off on petrol in 2016) and, with a direct impact on generators bills, it has a positive impact on the Green Building market.

The Bureau of Energy efficiency has introduced "The Bachat Lamp Yojana", a voluntary program under which citizens may exchange incandescent lamps for CFLs (compact fluorescent lamps) using clean development mechanism (CDM) credits to finance the

difference in cost. Installation of solar water heaters in residential buildings is eligible for a subsidy.

In addition to the above, in a bid to promote green buildings in India, few of the state governments and local bodies are providing incentives to those who get their building green-certified.

IGBC is very closely working with several Central and State Government agencies to promote the green building movement in the country. Few of the Central and State Government agencies have given recognition to IGBCs' Green Rating Systems. The list of incentives provided are detailed below[59]:

- The Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, offers fast track environmental clearance for green building projects which are Pre-certified/ Provisionally Certified by IGBC.
- All IGBC rated green building projects in the Micro-, Small and Medium Enterprises sector shall be eligible for financial assistance at concessional rates from Small Industries Development Bank of India (SIDBI).

Below are the states that provide extra FAR (Floor-to-area ratio) for green buildings.

- Punjab: Department of Local Government (Town Planning Wing) offers an additional 5% Floor Area Ratio (FAR) free of charge for projects which are rated Gold or above by IGBC.

- Department of Housing and Urban Development, Government of Punjab offers an incentive of additional 5% Floor Area Ratio (FAR) free of charge and 100 % exemption of building scrutiny fee for projects which are rated Gold or above by IGBC

- Rajasthan: Urban Development and Housing (UDH) Department, Government of Rajasthan offers additional 5% FAR free of charge for projects which are rated Gold or above by IGBC.

[59] W. India, "https://gosmartbricks.com/green-building-government-incentives-india/," [Online].

- West Bengal: Government of West Bengal (Department of Municipal Affairs – Kolkata Municipal Corporation) offers additional 10% FAR for projects which are Pre-certified/ Provisionally Certified as Gold or above by IGBC.

  Government of West Bengal (New Kolkata Development Authority) additional 10% FAR for projects Pre-certified/ Provisionally Certified as Gold or above by IGBC.

- Uttar Pradesh: Government of Uttar Pradesh (Housing and Urban Planning Department) – Additional 5% FAR free of charge for projects which are rated as Gold or above by IGBC.
  Additional 5% FAR free of charge is offered by the Greater Noida Industrial Development Authority (GNIDA) in Uttar Pradesh for projects which are rated as Gold or above by IGBC.

- Maharashtra: Pune Municipal Corporation (PMC) and Pune Metropolitan Region Development Authority (PMRDA), Government of Maharashtra offers an additional FAR of 3%, 5% and 7% for Green Buildings rated as Silver, Gold and Platinum respectively by IGBC.

- Andhra Pradesh: The Industries & Commerce Department offers 25% subsidy on total fixed capital investment of the project (excluding cost of land, land development, preliminary and preoperative expenses and consultancy fees) for buildings which obtain green rating from IGBC. This incentive is applicable for MSME and large industries.

- Municipal Administration and Urban Development Department offers the following incentives to projects obtaining the rating from IGBC:

  20% Reduction on Permit Fees
  If the property is sold within three years, one-time reduction of 20% on Duty on Transfer of Property (Surcharge on Stamp Duty) on the submission of Occupancy Certificate issued by the Local Authority.

Government of Himachal Pradesh (Town & Country Planning Dept.) offers an additional 10% FAR for projects which are granted Gold / Platinum rating by IGBC.

- Jharkhand: Urban Development and Housing Department, Government of Jharkhand offers an additional FAR of 3%, 5% and 7% for Green Buildings rated by IGBC as Silver, Gold and Platinum respectively.

- Haryana: Government of Haryana (Town & Country Planning Department), offers an additional FAR (Floor Area Ratio) of 9%, 12% and 15% for Green Buildings rated as Silver, Gold and Platinum respectively by IGBC.

VI. Education and Awareness

Crucial knowledge and data gaps include a scarcity of factual information, to allow comparison between conventional and green building costs; emphasized data on the energy, water and other resource savings from green construction; availability of consultants and providers who offer green building services and products; and evidence to facilitate investment in financing packages for green building.

There are also information scarcity relating to skills, expertise and financial services, that could restrict the efficiency of the market for green buildings. There is no readily available information about consultants, contractors and providers of green building services and products. The certification of professional and technical personnel for green buildings and making this knowledge public in the relevant city or state would assist in addressing this disparity. NGOs and think tanks can play a significant role in filling those data gaps, publicizing the information, and undertaking awareness raising and policy engagement activities. Boosting the availability of reliable information and knowledge about the advantages and disadvantages of green building would better inform stakeholders and the general public and help to diminish misperceptions[60].

[60] E. Darko , K. Nagrath, Z. Niaizi, A. Scott, D. Varsha and K. V. Lakshmi, "Green building: case study," odi.org.

VII. Analysis

The difficulty of implementation of Green Building in India mainly resides in the complexity of voting Green Building by-laws at state level, the spread of illegal construction due to the massive housing shortage, the lack of trained professionals and communication on existing financing schemes. Furthermore, there is difficulty to involve low rise buildings in the shift to Green Building and to find new ways to stimulate and boost the market for Green Building materials and equipment because of the market power monopoly of a handful of manufacturers of energy efficient products that has resulted in a non-competitive market for products like insulations, chillers, and so on.

While the national policy intent is clear, its application at the state and city level is not consistent. While some states have opted to incorporate certain features, this is not uniform across the country. Also, the laws still follow a piecemeal approach. An overall sustainability approach that can be seen at the national level has not translated into a comprehensive set of laws and codes. The implementation of existing laws is also a major lacuna. There is a need to build and strengthen the capacities of regulatory bodies, especially at the local level, to ensure the effective implementation of these laws.

There is a lack of standardization of alternative green materials and technologies that could help to reduce the costs of green construction. This prevents mainstreaming these materials as all buildings have to meet national building codes and local bylaws. Also, current policies do not simultaneously promote housing that is both affordable and green. The issues are encapsulated in Figure 14.

The effort to develop ECBC-compliant local by-laws is the most important obstacle facing building energy efficiency efforts in India. Although several states are purported to already have such by-laws, there is little public documentation of these accomplishments.

There is a lack of appropriately trained professional personnel, and technical and skilled labor. Skilled construction workers need to have the right skillset and experience for green construction. Issues concerning sustainability should be an integral part of all relevant professional curricula, and there should be public certification for professional and technical staff in relation to green construction.

There is a need to develop the capacity to supply green building materials and products, including building supply chains and the use of commercial marketing methods.

Developing implementation capacity will be a significant challenge and will require further concerted efforts by all stakeholders, especially governments at all levels, to align incentives and drive initial market demand for inputs such as skilled labor and certified materials. To provide a secure foundation for further policy development and ensure successful implementation, national government resources should be deployed to characterize building energy use in greater detail and to keep codes and tools current according to new building energy use data. Concurrently, capacity development efforts need to be ramped up to use tools to train current university students as well as mid-career building inspectors and other political stakeholders at the local level[61].

Figure 14: Green Building Barriers (source: Green building: case study)

[61] **"Energy Building Code & Green Building certification"**

India does include Green Building in its strategy to reduce its GHG emissions. Under the impulse of the Bureau of Energy Efficiency of the Minister of Power, Energy Building codes and equipment labels were developed and enforced, or in the process to be enforced (ECBC-R). Targeting Energy heavy industries first has paid off, and the PAT and RPO schemes are the adequate incentives to accompany this measure.

The progressive lifting of subsidies on petrol and diesel is also a step in the right direction to promote Renewable Energy and shorten the payback period of equipment. The Government of India and more and more state governments are promoting GRIHA Rating System and Green Building in General as they set an example by going further than the ECBC and Building green public Buildings, and have them certified. ECBC is having a positive effect. Commercial buildings certified for energy efficiency now account for 1.2bn square feet (about 111m square meters) of space. Although experts say the true impact of the ECBC's implementation may be greater because some building owners are willing to simply secure energy savings rather than going through multiple procedures to become certified. India has yet to develop an energy code for low-rise residential buildings. This may be a rational choice considering the growing importance of commercial and high-rise residential buildings covered by the ECBC and the need to work within administrative and technical capacity constraints. However, it appears that middle-income and wealthy residential households, especially in urban areas, are quickly increasing their energy consumption as incomes rise, and this will continue into the medium-term. Regulating energy use in residential buildings will require amendments to India's Energy Conservation Act, which does not currently allow BEE to establish residential building codes. Before this occurs, basic research needs to be conducted to better characterize this sector and strategies for the integration of residential buildings into the ECBC.