5/1/2017

Can “EDGE” be the Solution to Sustainability of Commercial Buildings in Colombian Market?

ENGR6991: PROJECT AND REPORT III

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ABBREVIATIONS

LEED: Leader in Energy and Environmental Design

EDGE: Excellence in Design for Greater Efficiencies

CGBI: Green Business Certification Inc

USGBC: United States Green Building Council

CCCS: Consejo Colombiano de Construcción Sostenible (in spanish)

CO_2 : Carbon Dioxide Gas

ANSI: American National Standards Institute

ASTM: American Society for Testing and Materials

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers

ISO: International Organization for Standardization

IES: Integrated Environmental Solutions

BREEAM: Building Research Establishment Environmental Assessment Method

EPA: Environmental Protection Agency

LEED BD+C: LEED Building Design and Construction

LEED ID+C:

LEED O+M: LEED Operation and Maintenance

LEED ND: LEED New Development

IFC: International Finance Corporation

1. ABSTRACT

Traditional energy efficiency certificates for buildings, such as LEED (Leadership in Energy and Environmental Design) certification, have not gained adequate penetration in developing (and less-developed) countries. Some factors contributing to such a trend include cost, complexity and demand for new resources that are not always available, nor are all projects prepared to assume. The World Bank in an effort to aid the building sector, which is one of the principal carbon emissions productive sectors and the user of a big amount of resources that implies high energy and water consumption, has developed a new tool called EDGE (Excellence in Design for Greater Efficiencies). This paper examines the capabilities of EDGE and tests if it does have qualities and features required to gain more momentum for energy upgrade in building sector, particularly in developing countries. According to its proposal, EDGE is low-cost (compared to better-known certifications); has a user-friendly software to apply, and a "do-it-yourself" nature. Also it is estimated to gain at least 20% penetration in the next seven years, within the new building construction market in the country targets (Kapoor 2016). If successfully realizing its goals, EDGE can identify itself as an important tool to fill the lack of fund in developing countries for adopting traditional certifications. We have focused on Colombian building construction market (as a developing country with an increasing rate of immigration from rural areas to the cities) to investigate the opportunities for realization of such goals. Through a detailed qualitative and quantitative analysis of requirements for applying EDGE to commercial building projects, the opinion of construction and energy rehabilitation experts in Colombian building industry was mined through survey questionnaires. The paper evaluates the success chance of such simplified methods in the Colombian commercial building market, through analysis of the experts' inputs.

Stablishing parameters of comparison between EDGE and LEED is not a basic activity, the market niche is diametrically opposite, costs are different because requirements are part of different structures for the assessment and EDGE is an initiative in early stage of inception in the market, while LEED is a mature rating system in the market for almost twenty years. The proposed methodology will go towards the path to identify lacks and limitations influencing the stationary behavior of the figures in penetration of markets for LEED. Once identified these aspects, the design of the survey will allow making an approach to the perception and opinion of the experts mentioned in the previous paragraph.

As the answers will express qualitative opinions and statements, part of the methodology defined for this document will include the quantification of the answers given by the experts. The use of statistical tools will define the final assessment to the surveys to obtain as result the tendency of the statistics that will help in the comprehension and future of LEED for Colombia. The provisional results for this document will provide a scope until the final design of the survey. Final results will take three more months of interviews and contacts.

2. INTRODUCTION

In the recent decades, a wide range of literature has appeared in reference to the environmental impact of building projects during the different phases of the construction process. Since the early design to the occupation and renovation phases, decisions made, will contribute with a greater or lesser impact to the environment, as they will define variables as water and energy consumption or CO2 emissions or other contaminant substances generated to the atmosphere (Vierra, 2016).

With more than three years background in implementation of national initiatives in climate change mitigation for Colombian government, I always got a particular interest for energy efficiency options for productive sectors. Now, as a student in building engineering master, many information about building certification ratings and standards are always present in daily studies and classes. Nowadays, LEED is well-known as the most recognized brand in reference to building certifications. However, previous discussions with one of the first certified professionals for LEED (Leadership in Energy and Environmental Design) in Colombia, I discover a new rating system called EDGE (Excellence in Design for Greater Efficiencies). Not so many literature has showed up in reference to EDGE due to the novelty of the tool, 2016 was the year for kick-offs presentation around the world. The first thing that caught my interest is that EDGE was designed for emergent economies in developing countries. The second thing, the do-it-yourself idea proposed for EDGE in order to reduce the certification cost and the importance given to the owner, project management or relevant stakeholders in the process to achieve the grant certification.

Within the previous ideas, my document will consist of several main parts, a Literature Review presenting a short brief of the history of certifications, beginning for BREEAM, and going through the LEED world and the current versions in the market. The second part consist in a presentation for EDGE where I will recollect information and evidence of the history and status for this new initiative. An EDGE in-action chapter to show my self-experience for the proposed EDGE software. The methodology approach to present Colombian situation in relation with LEED and EDGE cost and penetration and the design of the questions for the survey to develop. The final list of the questions and the conclusions that will include next steps, the results at this point of the total project, recommendations, limitations and hypothesis. The final results after the survey is distributed will be ready for august.

3. LITERATURE REVIEW

When we mention building standards, we refer to the guidelines with specific elements listed to achieve a particular purpose, is a guidelines to compare the own work with the standardized proposed strategies or activities stated in the standard. Those elements can be rules or characteristics in particular to develop a building project (when refers to a building project) or a specific activity. Usually the building standards are designed as consensus by different stakeholders involved in construction sector in processes lead by organizations related to government. Federal agencies used to adopt the standards created by private sector according to established regulations. The common entities behind standards creation in construction sector are ANSI, ASTM, ASHRAE or ISO (Norman, 2008), standard development organizations, with ISO as a head worldwide standards coordinator. The result of their work, specific standards, usually become in law or basis for industry rules and norms once the sector assimilate the concepts contained in the proposed standard. The ANSI/ASHRAE/USGBC/IES Standard 189.1, *Standard for the Design of High Performance Green Buildings except Low-Rise Residential Buildings* (Vierra, 2016), is the first standard designed for green buildings. With a comprehensive language, this standard has chapters for site water, energy, efficiency, indoor quality and materials. New developments in matter related to building energy efficiency, converge to new specific green codes and standards.

The green codes are the green standards brought to its new level of sustainability and performance. According to the U.S. Department of Energy, the green building codes are those standards, which goes beyond the minimum requirements for energy codes, to improve efficiency in water and energy consumption more efficiently (U.S. DEPARTMENT OF ENERGY, 2012). The scope can be regional, national or global and their availability is increasing in the past few years with a strong tendency sector to use them as the cornerstone for new projects in order to reduce environmental impact and achieve sustainable purposes. The character of codes can be prescriptive, performance-based or outcome-based. The first is an approach to code compliance as a recipe to be followed, with specifications for materials, installation and equipment. In the second type, the focus of the code is to achieve specific results more than prescribed indications, the outcome-based form is for example when a specific performance as defined water consumption in a project, is measurable and the result can be reported to keep the entire project at the proposed water consumption levels in certain period of time or at least report possible consumption anomalies in the system. (Vierra, 2016).

The main difference between green building codes and building rating systems are the condition of mandatory for the first. Green building rating or certification systems are the evolution of the green product certifications to analyze the systems and the projects as a whole or o total product. According to a set of sustainable and green options a project could carry out, the performance of the project earn credits or rewards in order to achieve a certain type of certification level. The design of these systems are conceived to impact the whole phases of the project since design to demolition in order to achieve the objectives required for a specific type of certification (Vierra, 2016). The Green Building Alliance considers the green building certifications as a way to add relevance and credibility for building projects and teams behind development. It creates an image of accountability for energy and water consumptions and contaminant generations and consider benefits as reduction of operational costs, possible local national

and international recognition, higher valuation on property sale and rental among others (Green Building Alliance, 2016).

These ratings or certifications can be single-attribute when are focused in a unique element as water or energy consumption, or multi-attribute when consider not only water and energy but also, carbon emissions, level of toxicity or measurement and report of variables in consumption and waste production.

3.1. FIRST DEVELOPMENT OF RATING SYSTEMS

As mentioned by Cole and Valdebenito (Valdebenito, 2013), one of the milestones in the introduction of building environmental assessment methods, is given by the appearance in United Kingdom of the Building Research Establishment Environmental Assessment Method (BREEAM) in 1990. Initially conceived as a voluntary program in which the project managers or the owners could use as a self-regulation tool of the new building. Its principal key drivers to reach the actual importance are the policy requirements and client demand. Previously to 2000, the use of the tool was very limited. However, for the first decade of the new century, government in UK begun to give relevant importance to the policy making process and is included in the list of strategic tools for building sector and new projects carried out with public resources. For 2000, the government also include BREEAM as a "mandatory mechanism" for government projects in construction. After some fails in appliance at the beginning, for 2005 different government dependencies start to apply a legal framework to start to require BREEAM assessment as a condition for development and funding and at local and regional appliance it become in the key to define sustainable paths and strategies for development (Schweber, 2013). Nowadays, one of the most valuable mechanisms to establish green building standards and codes in countries.

The credits are distributed in several categories: Management, Energy, Transport, Water, Materials, Waste, Land Use, Innovation, Pollution and Wellbeing. Each one of those categories has its own weight and assigns respective credits. The final amount of credits achieved for the project, will assign a rating according to BREEAM system. The different categories of certification are contained within five major areas: Communities, Infrastructure, New Construction, In-Use and Refurbishment and Fit-Out (Establishment, BRE Building Research, 2017).

Nowadays, BREEAM counts more than 500.000 certified developments and more than 2 million buildings registered for assessment in the 27 years of existence of the rating certification tool (Establishment, BRE Building Research, 2017). BREEAM together with LEED are considered the two more mature rating systems known worldwide by number of certified projects and recognition in the building sector. For this reason are well recognized in different countries to the ones of origin, UK and USA respectively (Valdebenito, 2013).

3.2. LEED

In the year 2000, the U.S. Green Building Council (USGBC), released for the first time a criteria for the assessment and improving of environmental performance of buildings denominated LEED (Leader in Energy and Environmental Design) (Valdebenito, 2013). As mention before, jointly with BREEAM, the two

most recognized systems worldwide, LEED is the American version of a sustainability assessment method coming from the previous decade of work in Europe (United Kingdom) in BREEAM.

Started as a pilot program in 1998 (LEED 1.0), two years after, was full released. Until 2006, LEED passed from one standard for new construction to six standards for the different phases of the construction process. Growing to around 200 volunteers divided in multiple committees. The focus of the tool pretended to**:**

- Define "green building" by establishing a common standard of measurement
- Promote integrated, whole-building design practices
- Recognize environmental leadership in the building industry
- Stimulate green competition
- Raise consumer awareness of green building benefits
- Transform the building market (ENVIRONMENT AND ECOLOGY, 2017)

The major categories addressed were Location and Planning, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation and Design Process and Regional Priority (ENVIRONMENT AND ECOLOGY, 2017). LEED is a multi attribute rating system; this means its scope is focus in multiple aspects as we can see according to the different categories mentioned. For each of the categories there are prerequisites stablished in relation to water or energy consumption reduction. Once prerequisites are accomplished, inside each category, there are several specific strategies to earn credits. The number of strategies applied, will determine the certification or no certification and the type that the building could achieve (Vierra, 2016). LEED certification program is, without hesitation, a success development for USGBC. The non-profit organization was capable of positioning worldwide the tool and still increasing the number of users.

Currently, the two used LEED versions are LEED 2009(v3) (5), and in November 2013, LEED v4 was opened for registration of new projects under this system rating. Deadline for projects registration under v3 was October 31, 2016 (CANADA GREEN BUILDING COUNCIL, 2016).

3.2.1. LEED V3

LEED V3, also known as LEED 2009 was designed as a possible 100 base point rating plus possible additional 6 and 4 points for Innovation in Design and Regional Priority respectively. The maximum points in the other performance categories are scored as 26 points-Sustainable sites, 10 points-water efficiency, 35 points-Energy and atmosphere, 14 points-Materials and Resources and 15points-Indoor Environmental Quality. Inside each category, there are mandatory elements required to earn any possible point, as well as individual elements, which assign points by accomplishment (Wooldridge, 2011). The levels according to the achieved points are Certified (40-49 points), Silver (50-59), Gold (60 – 79) and Platinum (80 and above). In comparison with the eight areas presented before for V1, in V3 is excluded Location and Planning, considered in Sustainable Sites category (ENVIRONMENT AND ECOLOGY, 2017).

LEED 2009 defines five main rating systems with respective subdivisions:

Green Building Design & Construction: for New Construction, for Core & Shell, for Schools, for Retail: New Construction and Major Renovations and for Healthcare

Green Interior Design & Construction: for Commercial Interiors, for Retail: Commercial Interiors

Green Building Operations & Maintenance: for Existing Buildings: Operations & Maintenance

Green Neighborhood Development: for Neighborhood Development

Green Home Design and Construction

As a period of transition is occurring and deadline was October 31, no more projects can be registered anymore under LEED V3 methodology. Any project interested in registration must do it under LEED V4.

3.2.2. LEED V4

In November 2013, the new era for LEED started with the launch of LEED V4. As his CEO Rick Fedrizzi expresses in the User-Guide, they are trying to demand better performances, materials and efficiencies in order to be correlated with the improvement made for the tool and for the users. LEED V4 is addressing a variety of 21 market sector adaptations. This new version includes existing schools, existing retail, new and existing data centers, warehouses and distribution centers, hospitality and mid-rise residential categories (USGBC, 2014). A wide variety of categories has been added and improved since LEED beginnings in the last decade of previous millennium. A big institutional challenge for governments and policy-makers is to promote paths to sustainability; this situation is represented for the increasing interest from practitioners and scholars in topics related to this paths. Business sustainability certifications and its relevance nowadays are a clear evidence of this challenge and LEED V4 a punctual example of the evolution in efficiency standard certifications.

Experts working in the design of the new certification system have evaluated the previous user experience in older certification process projects, as well as pilot exercises to determine the impact in a set of new projects under the new methodology. The purpose was to refine the program and design a redefined the tool according to changes in sectors as new codes or trends in building. Many key updates should be expected to make V4 like a very dynamic tool. Another principal focus is the importance of the project impact, locally and globally in communities. Increase of the incentives and points for those projects with a higher impact in the environment as well as in the social and economic area are visible in the new LEED version. The V4 is trying to give a higher importance to regional context, defining regional and local standards valid to obtain the points for certification. The importance of scaling down strategies and customize them according to specific conditions in cities or regions in particular, will play an important role for widespread increase in the use of certifications. Regional governments will participate more actively when they are conscious that the tool is being developed tailored to the real situation and characteristics of the area in which they are governing.

As an example of the evolution and adaptation, energy category (20% of possible points) highlights energy consumption measuring importance. As part of prerequisite to obtain credits in this category, the projects must be capable of measuring the entire energy consumption. Within the proposed activities for credits earnings, once again, one strategy in Advanced Energy Metering refers to specific metering for end-uses consuming more than 10% and connected to building automation system. Another proposed strategy or integrative process in energy is Demand Response, which encourages the use of technology with demand response features (USGBC, 2014). According to the Department of Energy, demand response is the opportunity for the projects and finally the users to participate more actively in their own energy consumption definition and the operation of the electric grid. Based in reduction and shifting the use of electricity according to peak periods, obtains in remuneration financial incentives and reduction of payments costs for electricity billing (U.S. DEPARTMENT OF ENERGY, 2017). Something similar occurs for Water Efficiency category in prerequisites; project must have capability for total measure of water consumption and in addition, requires reduction in 30% over the landscape water consumption, using EPA's WaterSense Water Budget (EPA, 2017) or by no irrigation. Many other different modifications are proposed for several categories in the V4, similar modifications in prerequisites and credits are part of the new version and are a clear example of the readaptation and dynamism for LEED through the years of existence. Governmental policies and regional programs are focusing the scope to the metering and reduction in consumption of renewable and non-renewable energy sources and the tool has to propose its strategies taking account of these trends in policies and agreements. The relation works in the counter direction also, when decision makers use the new proposals inside the rating standard systems to promulgate new laws or draw up the path in a sector, as we see in the BREEAM section and the example of UK and the application of the standards proposed fro the tool in the new governmental projects.

The new rating system descriptions include new categories (USGBC, 2014):

LEED for building design and Construction (LEED BD+C): For new construction and major renovation, for Core and Shell Development, for schools, fro retail, for data centers, for Warehouse and Distribution Centers, for Hospitality, for Healthcare, for Homes and Multifamily Low-rise and for Multifamily Midrise

LEED for Interior Design and Construction (LEED ID+C): for Commercial Interiors, for Retail and for Hospitality

LEED for Buiding Operation and Maintenance (LEED O+M): For Existing Buildings, for Retail, for Schools, for Hospitality, for Data Centers, for Warehouse and for Distribution Centers

LEED for Neighborhood Development (LEED ND): Plan for conceptual and master planning and Project for whole projects

To decide which rating system is the appropriate to use, the methodology proposes to use the 40/60 rule. Assigning a rating system to each square meter in the project and at the end, the selection is made based on the rule as the graphic shows:

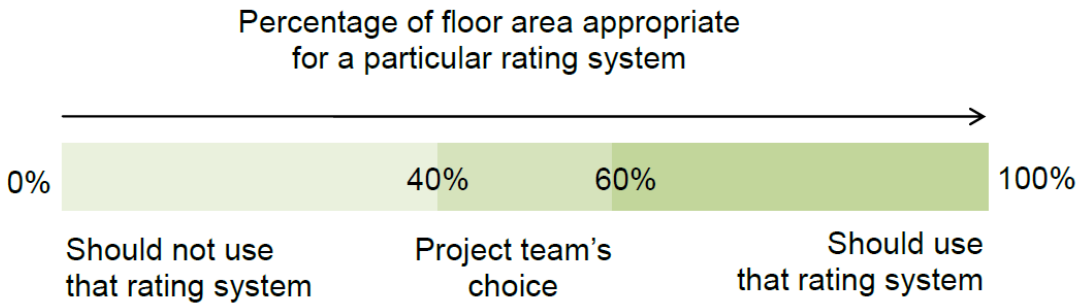

Figure 1 Percentage of floor area appropriate for a particular rating system (USGBC, 2014)

The scores for silver, gold and platinum certification achievements remain the same than in previous version.

3.2.3. PRINCIPAL CHANGES IN LEED V4

The next chart includes the principal differences in LEED V4 in comparison with LEED V3 or 2009 and is extracted from the LEED V4 GUIDE:

PERFORMANCE CATEGORY	NEW CREDITS AND PREREQUISITES	PRINCIPAL CHANGES
GENERAL	• Integrative process (credit)	Since project start, stimulate the energy and water consumption analysis and design phase
LOCATION & TRANSPORTATION	• LEED for Neighborhood development (credit)	LT is a new PC included taking related credits from other PC. Make an easier and simplified path to earn points
SUSTAINABLE CITIES	• Site Assessment (credit)	Create incentives for an early analysis in the development site
WATER EFFICIENCY	• Outdoor water use reduction (Prerequisite) • Building level Water Metering (Prerequisite)	Considers EPA WaterSense Water Budget tool to reduce landscape water use. Encourage work teams to measure water consumption and importance to

	• Cooling Tower Water Use (credit) • Water Metering (credit)	water sources and cycles for projects.
ENERGY AND ATMOSPHERE	• Building-Level Energy Metering (Prerequisite) • Advance Energy Metering (credit) • Demand Response (credit)	As in previous category, makes relevant the energy metering. Encourages to use devices to participate in demand response programs
MATERIAL AND RESOURCES	• Construction and Demolition Waste Management Planning (Prerequisite) • Building Product Disclosure and Optimization-Environmental Product Declarations (credit) • Building Product Disclosure and Optimization—Material Ingredient Reporting (credit)	Targets and reporting in waste management required. Reinforce importance in life-cycle impacts of products and materials and aims in the use of better ones. Stablish rewards for products with Environmental Product declarations and those which fit local products criteria
INDOOR AND ENVIRONMENTAL QUALITY	• Interior Lighting (credit) • Acoustic Performance (credit)	Incorporates controls for lighting systems. Requirements for noise levels, sound isolation and others related. Acoustic Performance does not apply for School and Healthcare

Table 1 Principal changes in LEED V4

First sight changes in the LEED V4 are clearly pointed to increase the market options for possible certified projects. With its new 21 possible options divided in the 4 rating systems and several divisions is doubling the amount of options for LEED 2009. The category rating system Green Home Design and Construction is now included in LEED BD+C, additionally, the other new sub categories included in this category are Data centers, Multifamily Midrise, Homes and Multifamily Low-rise, Hospitality and Warehouse and Distribution Centers. In LEED ID+C V4 Hospitality is included. For LEED O+M new options included are Hospitality, Warehouse and Distribution Centers and Hospitality.

When the methodology makes presentation of modifications in LEED V4 tends to use words related to simplifying and streamlining. The proposal of the new version is to make the experience user-tool easier. LEED was conceived as a dynamic rating system (USGBC, 2014) and the evolution towards a simple way to accredited points by users is explained in detailed, much better than in previous versions. Steering

Committee proposed another tools as webinars in education for LEED V4 to strength capacities of users and the calculators and forms are easier to use. The USGBC updates three features, same forms to work prerequisites and credits, the spreadsheets and calculators are now located together with the credit library and the requirement of less documentation as in previous versions (USGBC, 2016). New developments are the result of the experience of all previous years working worldwide. The proposed changes are coming from the experience of project managers and certified personal working in several projects. A ”beta” period that counts with the participation of 112 projects in different areas help in the tune up of the final version (USGBC, 2014).

Location and Transportation is a new-scored category and group together features related to biking facilities, access conditions and location to improve use of public transportation in order to reduce car use. Some other prerequisites were included in almost all the credited categories. Those are listed in the table above.

Checking the table, in the categories of water efficiency and energy & atmosphere, there is a strong trend to measure and quantification of water and energy consumption. This characteristic is shown detailed in the paragraphs before the table.

3.3. EDGE

The Guide for Policy-makers and experts developed by Copenhagen Centre on energy efficiency in 2016 (Tools for Energy Efficiency, 2016), had as purpose, the mapping of existence tools contributing to improvements in energy efficiency. Policy-makers and technical experts can consult these guidelines where the tools were selected based in criteria that counts focus in energy efficiency in building, free and public availability and relation with development of efficient actions in cities. For EDGE (Excellence in Design for Greater Efficiencies), next image shows the profile tool assigned in the next data sheet.

Excellence in Design for Greater Efficiencies (EDGE)

Organisation	International Cooperation Finance
Description	EDGE calculates the utility savings and reduced carbon footprint of a green building against a base case. For non-residential buildings, user can see how much extra it costs to build green – and how short a time it takes to earn back the money through operational savings.
Aim	To help calculate energy savings of a green building.
Target audience	Policy-makers, experts
Approach	Interactive
Scope	Project
Stage of PD cycle	Implementation; Tracking
City focus	Supporting
Source	https://www.edgebuildings.com/software/

Figure 2 Tool's profile (Tools for Energy Efficiency, 2016)

According to the categorisation of the tools for the same Guide, for approach, scope, stage of the policy development cycle and city focus this is the result for EDGE:

NAME OF THE TOOL	APPROACH		SCOPE		STAGE OF THE POLICY DEVELOPMENT CYCLE					CITY FOCUS	
	Passive	Inter-active	Project	Policy	Scoping	Identifi-cation	Design	Imple-menta-tion	Track-ing	Target-ing	Sup-porting
Excellence in Design for Greater Efficiencies (EDGE)		x	x					x	x		x

Figure 3 Description for EDGE in catalogue of tools (Tools for Energy Efficiency, 2016)

Is considered a tool with an interactive approach with environment, its scope is not towards policy development but the project execution, considered to be used during implementation and tracking of the project and being a supportive tool when a city focus is made. Many countries in Asia (IFC, 2015)and Africa have been developing launch events to present during 2016 this initiative as a revolutionary tool in the market of green building certifications.

World Bank encountered a great potential in building sector, according to the impacts of different variables as climate change, increasing in population and changes in patrons of percentage inhabitants in cities and rural areas. The variations in energy consumptions and the impacts in the environment, linked with the modification in social and economic policies, attract the curiosity and dedication in studies and research in order to improve energy efficiency (Kapoor, 2016). The IFC (International Finance Corporation) is one of the biggest dependencies in the World Bank and the head in the EDGE creation and development. Formed in 1956 is owned for the 184 countries members of the collective group and who decides and determines its policies. Considered the greatest global organization with focus in private sector and presence in more than 100 countries, its network is conformed for financial institutions and more than two thousands firms around the world (IFC, 2016). Prashant Kapoor, Principal Industry specialist-Green Buildings for IFC, explains the entity has more of 3500 employees located 100 developing countries around the world, 100 field offices in 95 countries (Kapoor, 2016). Its mandate is giving by three principal premises:

- "Investing alongside others in private enterprises that contribute to development without governments guaranties. Provide funding for companies and initiatives working in emerging markets,
- Mobilizing capital from others by bringing investment opportunities to investors
- Advising to help stimulate private capital flows and improve the investment climate" (IFC, 2016).

For the IFC is of vital importance to go inside the building sector and especially to the energy efficiency area. For this purpose, EDGE has become in the core of this undertaking to delineate green paths. Dr. Kapoor defines the role of the program as "to provide an easy to understand standard for green buildings that focuses on cost savings, and GHG reductions through less use of energy in the building and in its materials" (Kapoor, 2016). According to the Introduction brochure, green buildings can provide several benefits as savings operative costs in parallel with improving energy and water efficiency use, reducing the carbon footprint, reducing GHG emissions and generate jobs through homegrown innovations. The

introduction maintains that EDGE use is an inexpensive, simple and reliable way to keep savings in utility without differentiate in the income of the client or magnitude of the project (IFC, 2016). The previous description reinforce one of the premises for EDGE in order to be accessible for the most of the people, particularly in developing countries with emergent economies.

The standard proposed by EDGE tries to keep the mayor simplicity, focusing in a 20-20-20 strategy. It means 20% reduction in energy consumption, 20% in water consumption and 20% reduction in energy imbedded in building materials. As we can observe, EDGE is only focusing in 3 areas with only a 20% target in reduction for each of them. For experts and others immersed in the building certification topics this could be not a very completed analysis, the support to these objectives is the low participation with traditional buildings. Kapoor shows the example of India, where of the total amount of new projects; only 3% are registered for green certifications. Similar situations occurs in Asia an Latin America, even in developed countries with typical use of traditional certifications, the use of LEED or BREEAM is reducing in the past years as we see forward in this document. The objective for EDGE as a voluntary certification program is to penetrate the 20% of the market building in the next 7 years.

EDGE is basically a building design tool, a certification system and a green building standard with principal focus for emerging economies. The design of its platform tries to be as simple and basic as transversal for any individual with certain knowledge and capacities related to building field, it does not matter his profession (engineer, architect, owner, developer, project manager) is capable to use it. Mr. Kapoor explains:

EDGE tools: Taking account of the case base information available and the selection of green strategies, EDGE strengths the identification of solutions to reduce operational costs and GHG emissions.

As part of the package, a contextual data of utility costs and climate for different worldwide cities is provided, an investment planning tool for owners and developers, building physic calculations used for design specific results and use of a monthly quasi-steady state calculation based on the European CEN and ISO13790 standards.

EDGE Standard: Is obtained according to the 20%-20%-20% reduction rule presented before, in comparison with the project developed under typical local practices

Edge Certification: The projects meeting the standards will be candidates to receive the certification, which validates the performance. The certification could be used for corporate branding, marketing and finance accessing purposes and will be provided for certification partners previously determined by IFC (Kapoor, 2016).

3.3.1. HOW IT WORKS?

According to the Methodology report, EDGE is considered as a certification system, building design tool and green building standard for emerging countries.

From the information provided by the user related to the project, EDGE is focused in find technical options at early design stage in order to decrease the environmental impact as well as project costs. EDGE is developed for homes, hospitals, offices, hotels and retail. If the project is able to reduce in a 20%, as mention above the water use, energy consumption and embodied energy in materials, then is candidate to grant the certification. (IFC, 2016)

Once the methodology is presented, a basic tutorial with self-experience in the use of the software will be included for this document.

3.3.2. METHODOLOGY

The EDGE methodology takes account in the following five aspects to obtain calculations for water and energy consumption and embodied energy consumption for the project. The updated, refined and accurate of the information provided the better responsive and dynamic model could be obtained. (IFC, 2016)

1. **Climatic conditions of the location**
   For 350 large cities around the world in emerging countries, there is a big database of information provided in reference to climate. Monthly or annual average temperature, humidity, wind velocity and rainfall, Solar radiation intensity, carbon dioxide intensity and average energy cost for the city. If city is not yet in the list, is recommended to use info of the closest city. The system is continuously adding new information for more cities. For cities without own information, calculations can be made based in closest city with database available.

2. **Building type and occupant use**
   As previously mention, there are five categories and per each one specific assumptions are made. For homes, apartments and houses are considered and the information provided is based on income categories. In hotels category, both, hotels and resorts are considered and information on occupancy, area and services are deducted from star rating. The assumptions for offices are coming from occupancy density and hours of use. The type of hospital (public, private, specialty, clinic or exams center for example) for this category and for retail buildings the assumptions will be obtained from the type of retail. The equipment will be determined for the type of building too.
   It is clear that not all the information can be provided or accurate at the design phase. For this reason, EDGE provides default data for each category, to facilitate the form of the base case for the user.

3. **Design and specifications**
   EDGE provides the information in design and specifications according to typical national practices and codes. Primary information obtained from this section, defines the energy performance of the building or project.

4. **Building orientation**

Passive heating and cooling is optimized by building orientation. EDGE defines 8 average orientations to facilitate the process to the user. The geometry and orientation do not have to be calculated for each apartment, flat or house, incurring in high costs and extra time used. For hotels there are 8 averaged directions too, considering the design for this kind of projects to orientate in function of the best views, the street,, the pool or the beach. For the orientation in the other categories, EDGE has a calculation model, which permits the user to adjust orientation to reduce solar heat gain.

5. Base case vs. improved case

The comparison between these two cases will give us the differential in energy consumption. The base case is the initial state of the project based on assumptions and empirical information from similar buildings and current practices worldwide and there is only individual one per each project.

The improved case is the result of the techniques applied over the project design in order to obtain the energy consumptions. The difference between the two scenarios will determine if the project obtains the EDGE standards. In the case of non-residential projects, the payback period and the incremental cost of technical measures applied are provided.

Although EDGE was conceived as a global use, the purpose is to make it fit at local level with the help of governments and institutions related with regulation and development of buildings inside the countries. If the support is obtained through databases and market studies, the relevance of EDGE as a powerful tool inside the building development will increase.

EDGE obtains the energy demand from thermal calculations and takes account of the different variables impacting this variable. Demands for Overall energy and virtual energy for comfort, HVAC, regular and hot water requirements and lighting energy as well as estimating rainwater harvesting or recycled water and the embodied energy of materials, are calculated according to current codes and standards valid for the project being studied and certified.

Validation of the methodology has been undertaken, using different dynamic simulation software (eQuest, IES, DOE and Design Builder) in different parts of the world, to compare the results with the ones obtained from EDGE tool in the same locations. Variations in the results has been in the range of 5% and 8% and according to the simplicity of the EDGE model, a variance under 10% is accepted to validate the results (IFC, 2016).

Once the Literature Review was presented during this chapter, the next chapter will condense the experience as a new user using the software proposed by EDGE. The primary input will be the methodology and user guide offered by IFC and my previous experience in the building sector as professional and as a master student. I will denominate this new chapter as EDGE in action.

4. EDGE IN-ACTION

This chapter is share my self-experience with the interface proposed in the software delivered by IFC to execute the assessment for the granting certification.

Many times has been mention in this document as one of the principal features for EDGE is the easy-user experience. Within the chapter, I will share my personal experience with the software. Once the project is open, the next is the first screen:

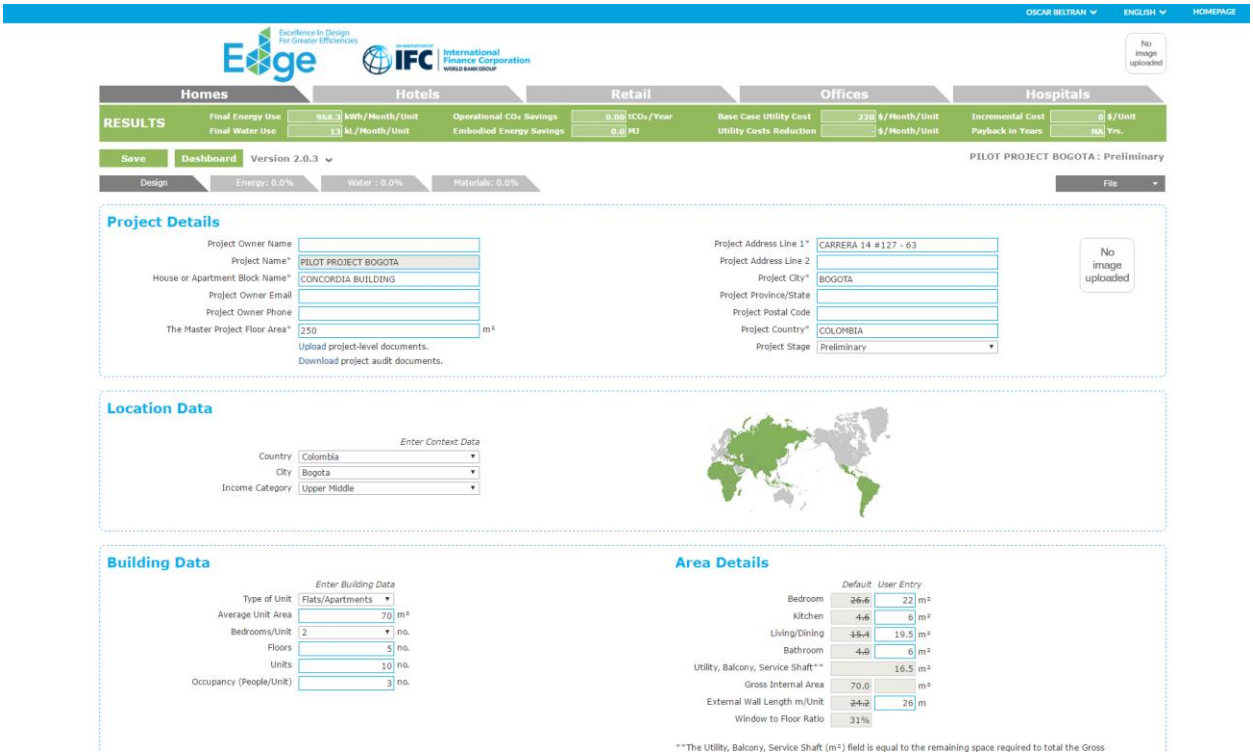

Figure 4 Initial screen EDGE software

In grey the 5 links to the different categories available, Homes, Hotels, Retail, Offices and Hospitals.

4.1. DESIGN TAB

By default is in the Design tab where the general information to the project is added. The boxes available are:

Project Details: All the general information as name, address contact information

Location Data: City and country

Building Data: All the information related to total number of bedrooms floors and units

Area Details: Areas and divisions in the building, window to floor ratio and external wall length

Building Systems: AC and Heater existence for the building

Key Assumptions for the base case: All information related to combustibles costs and uses in the building, cost of water, CO_2 Emissions for Electricity generation, window to wall ration, walls and roof paint reflectivity percentage, U values for Roof Wall and Glass SHGC, Cooling System and heating System standards and efficiencies average temperature, latitude and average rainfall for the city. There are Default options given by the software or the option to add manually the accurate information if available.

The required information is adjusted by category:

In Hotels: **Basic Parameters** asked for Star Rating, Type of Hotel, Average Occupancy, Irrigated Area and the existence of pool, spa, banquet service and restaurants. In **Building Data** specific information about areas of hotel, guest rooms, front house, Conference, back of house

In Retail: **Building Orientation** is added, **Basic Parameters** and **Building Data** related to Retail features

In Offices: **Building Orientation** is added, **Building Data** related to Offices features as Occupancy Density, Operational hours, Working Days and Holidays and distribution of different specific areas as lobbies or corridors

In Hospitals: **Building Orientation** is added, **Building Data** related to Hospitals features

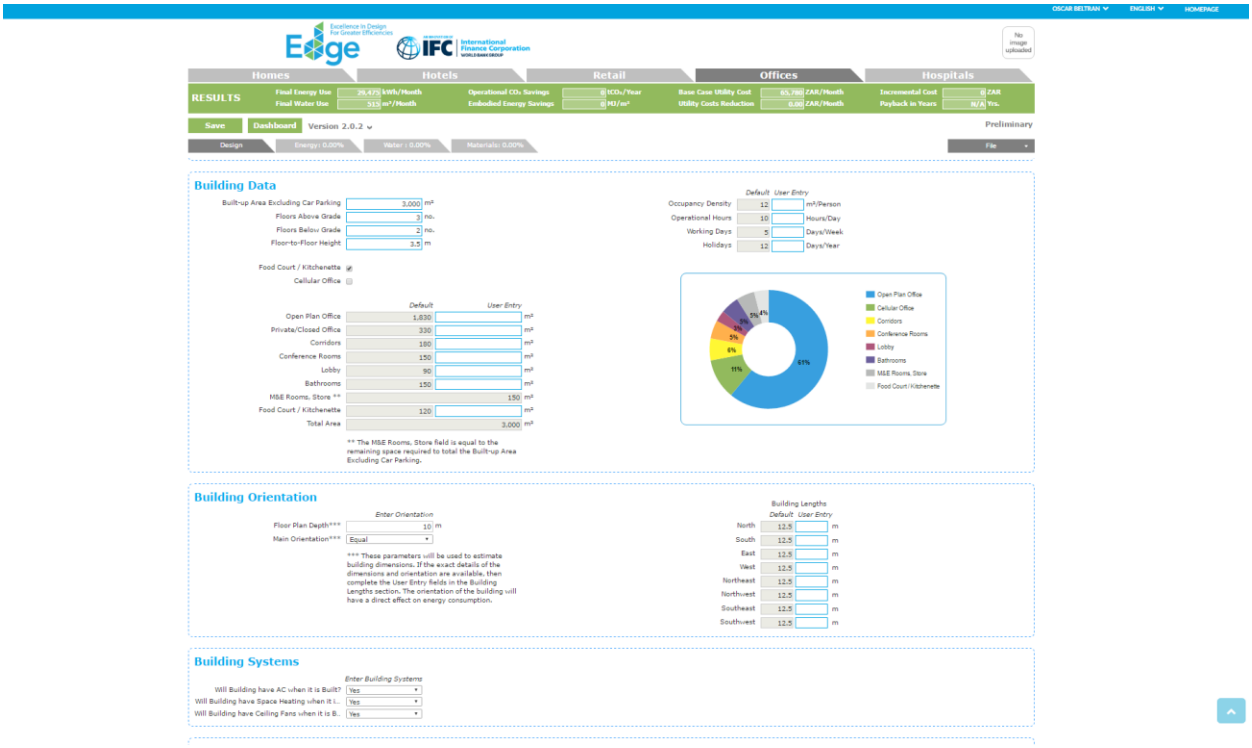

Figure 5 Example Design tab for offices

An example of Design Tab for offices, where the Building Orientation Box is presented and the example of data information required.

4.2. ENERGY TAB

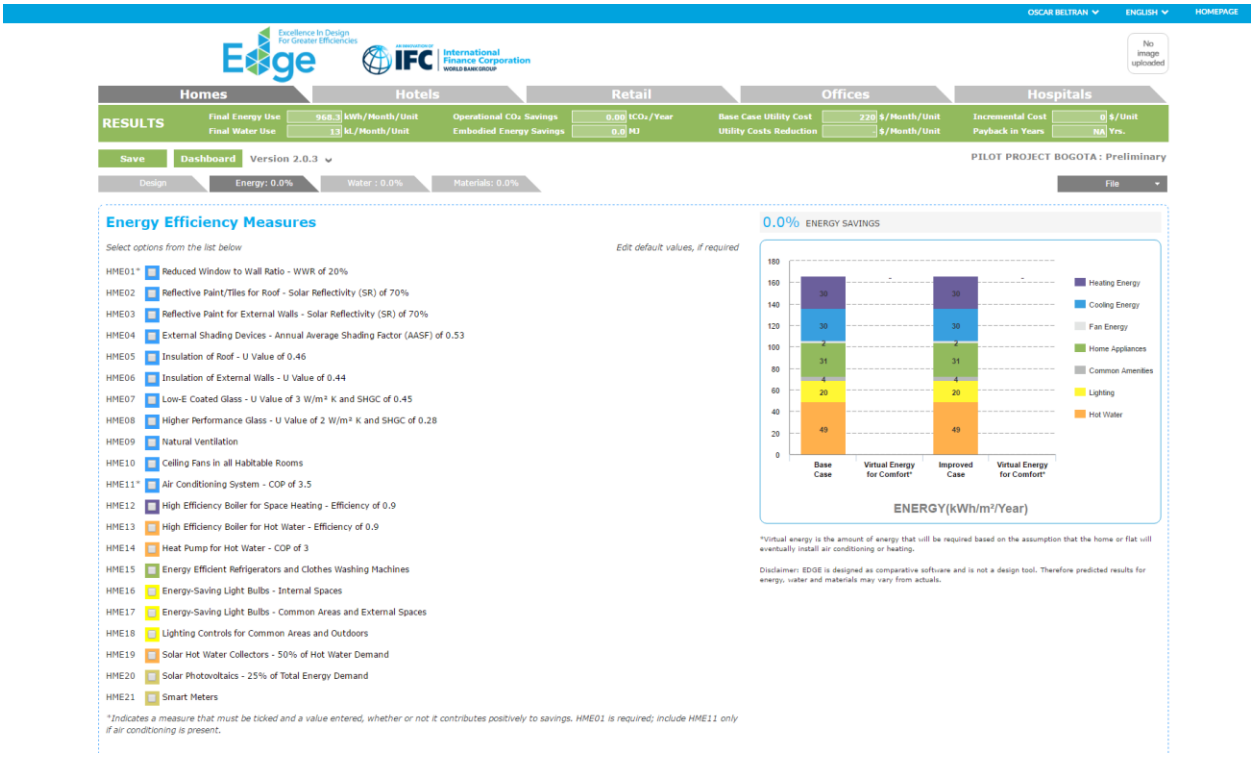

Figure 6 Example Energy tab for Homes

As shown in the previous graphic, the energy Tab shows a list of Energy Efficiency Measures divided by groups, Heating, Cooling and Fan energy, Home Appliances, Common Amenities, Lighting and Hot Water. For each group there are proposed measures, the graphic in the right compares the Base Case, the project without any Measure versus the Improved Case scenario and the total amount of energy savings according to selected measures. Once any measure is selected, the graphic updates, calculating the respective energy saving to the total consumption of the building.

According to the Category, some groups are added.

Hotels: Pump Energy, Other, Laundry and Catering

Retail: Pump Energy, Others, Refrigeration, Food Court

Offices: Pump Energy, Other, Computers, Food Court Kitchenette

Hospitals: Pump Energy, Laundry, Catering, Equipment, Lift, STP, Water Pumps

The software gives the option to modify the default values established for each of measures in the list if the user requires it.

The next is a screen where some Measures are applied and the graphic adjusts showing the percentage of saving energy.

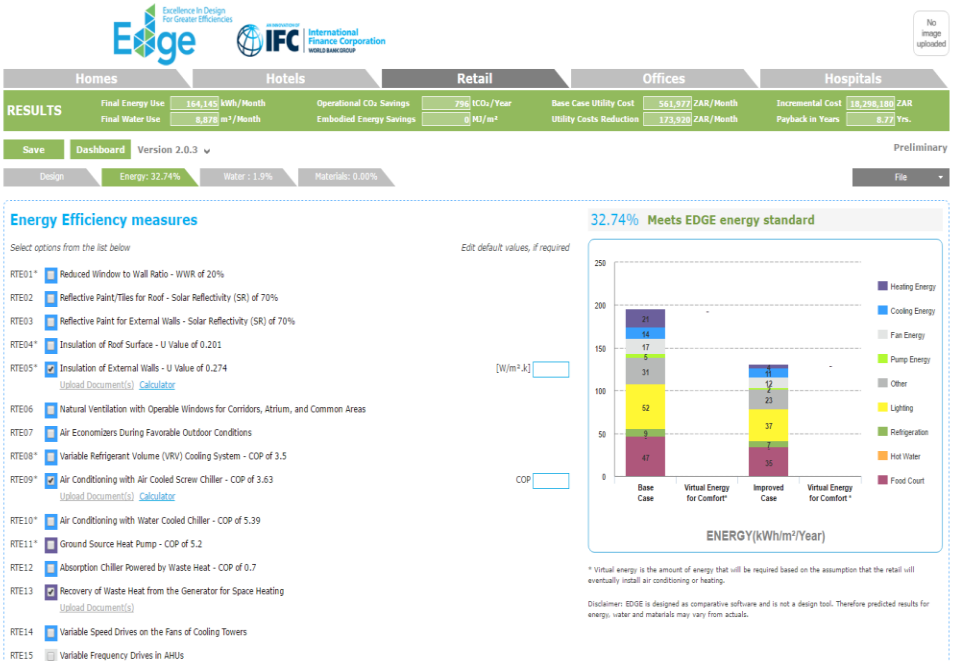

Figure 7 Example Energy tab for Retail

4.3. WATER TAB

Pretty much, Water Tab has the same dynamics than Energy Tab, a list of Water Efficiency Measures and when those are selected, adjustments in consumption savings are done in the right graphic.

Sources of water consumption for **Homes** are Shower, Kitchen, Water Faucets, Water Closets and Washer & Cleaning. Units of measurement are (kL/unit/year). Check next screen

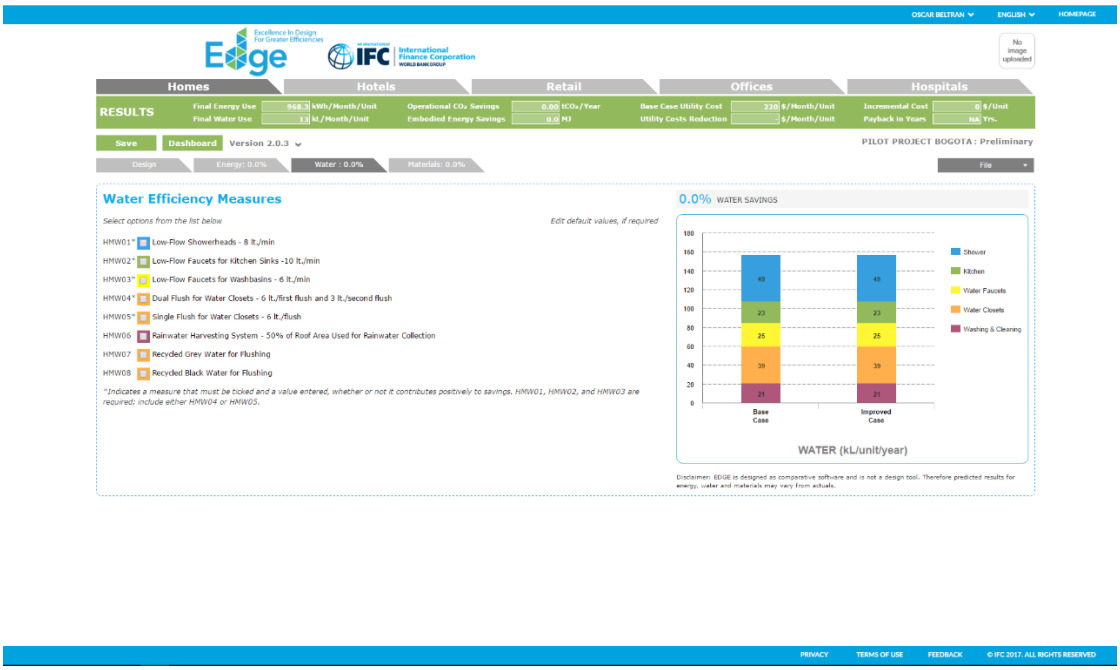

Figure 8 Example Water tab for Homes

Some adds are done for the other categories in sources of consumption.

For **Hotels**, Guest Showers, Faucets and W/C, Laundry, Public Area, HVAC, Kitchen, Landscaping and Swimming Pool. Units of measurement are (m3/Room/year)

For **Retail**, Water Faucets, Water Closets and Urinals, HVAC, Kitchen, Landscaping and Other. Units of measurement are (Lts/person/day)

For **Offices**, Water Faucets, Water Closets and Urinals, HVAC, Food Court/Kitchen, and Other. Units of measurement (Lts/day/person)

For **Hospitals**, Showers, Kitchens, Water Faucets, Water Closets & Urinals, Laundry, Landscaping, Equipment Process, HVAC, Other. Units of measurement (Lts/Patient/day)

The software gives the option to modify the default values established for each of measures in the list if the user requires it.

The next if an screen of Water Tab for Offices and respective comparison between Base Case and Improved Case and Percentage of of Water savings.

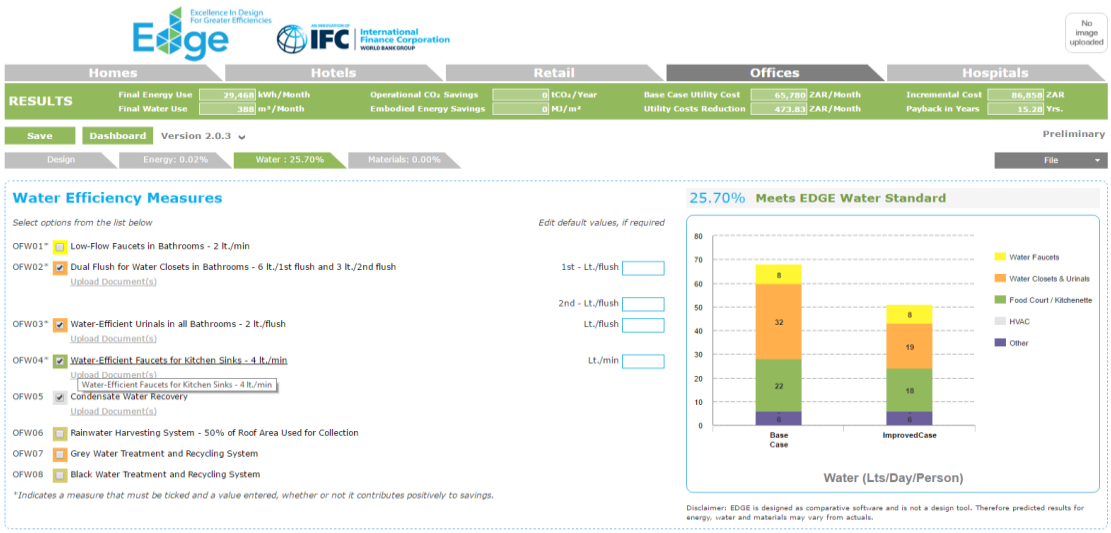

Figure 9 Example Water tab for Offices

4.4. EMBODIED ENERGY IN MATERIALS TAB

Inside this tab, Material Efficiency Measures and groups for the five categories are the same. Floor Slabs, Roof Construction, External Walls, Internal Walls, Flooring and Window frames. For each sub category, the material can be selected from five different options in Window frames to 41 options for External Walls. The units for saved energy are (MJ/m2).

For each selection of material when possible inputs can be added according to special features of materials. A material has to be selected for each sub category and for floors, roofs and walls thickness will be provided too. If there are a proportion of different materials for any of sub categories, this differentiation can be done in the software. Same dynamics is presented as in previous tabs for water and energy for the graphic. An example of a graphic for Materials is shown:

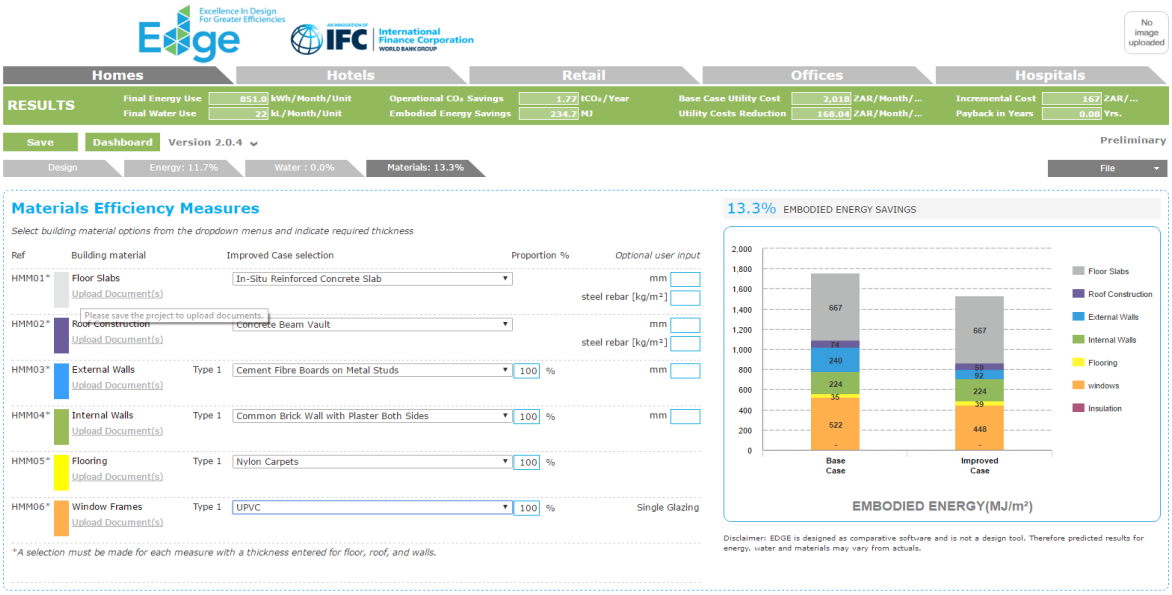

Figure 10 Example Material tab for Homes

As a first time user for EDGE software, I could provide that the tabs and interface are pretty simple to use and all the information is contained in only four tabs. In general, the information provided is clear and my only doubts are related to the technical matter of some of the proposed activities, which I believe could be understandable easily for a project manager or the project owner.

After the EDGE in-action chapter, I will start to define the methodology used to establish a possible comparison not directly related to the operational and technical content, because as we have observed are part of two different natures and objectives. Is relevant to define how to quantify the perception and opinion of the respondents that will be interviewed for the purpose of this document.

5. METHODOLOGY

Due to the limited time of presence for EDGE in the market, there is no robust information about the penetration or number of projects registered already, but is possible to formulate a set of questions or statements targeted to professionals in the field of the rating systems and construction sector to know preferences.

The questions will derive from the different chapters of this document, adapted for the Colombian case and arranged in different sets according to the selected subject matter for each set. A survey questionnaire will contain the whole set of classified questions and the target participants will be related professionals, LEED and EDGE auditors and specialized professionals, certification clients and users and civil servants in entities in charge of regulation or support of this type of programs in the national government. All of them having participation in the local Colombian market.

The whole group of interviewees must have the domain or knowledge about LEED due to direct experience as related workers, clients or external observers. A first group of questions based on LEED will conform the initial part and according to the knowledge about EDGE a second group of questions will be set up for those who know the new initiative and a different one for those with no knowledge about EDGE.

The assessment proposed implies the evaluation of qualitative answers from the survey respondents in relation with the sets or categories established. The defined statements will allow obtaining the preferences or degree of agreement from respondents. This implies the requirement of quantification for the answers to the several statements. For this reason, a liker-type scale is the proposed approach in order to scale the responses obtained.

Once the answers will be recollected, according to the number of participants, statistical analysis will be provided to state the general perception of EDGE in the universe of the survey. The importance in the Colombian construction market in order to become in a tool that can provide a clear path in sustainable development.

To define the final set of questions, a first analysis of information related to costs and penetration for LEED and EDGE will conform the initial part of the methodology. The definition of the categories for the set of questions will stem from this analysis and the previous content of the document.

5.1. COLOMBIAN SITUATION

In this part of the chapter, I refer to the current legal framework in sustainable building for Colombia, as well as the information related to LEED Colombia.

5.1.1. LEGAL FRAMEWORK

The entity in charge of regulation for the building sector in Colombia is the Minister of Housing, City and Territory. Considering the next functions for the Minister; from 3571 Decree 2011, article 2 “Formulate

the policies of urban renewal, integral improvement of neighborhoods, housing quality, urbanism and construction of sustainable housing, public space and equipment" and from 1077 Decree 2015 title 7 part 2 book 2 "National Government through the Minster of Housing, City and Territory, will adopt by resolution, the parameters and technical guidelines for the sustainable construction", The 0549 Resolution 2015, aims to establish minimum percentages and saving measurements in water and energy consumption for buildings and adopt the guidelines for sustainable building for water and energy savings in buildings. (Republic of Colombia, 2015)

The 0549 promulgates that minimum parameters for measurements in energy and water savings should contain mandatory percentages of reduction, gradual application systems according to population, procedures for measurement certification, procedure and monitoring and control tools to measure implementation and incentive promotion.

This new resolution is the result of the work of the building sector, where the visible head has been the Sustainable Building Colombian Council (CCCS for its abbreviation in Spanish). They have lead different initiatives and represents more than 200 hundred of the principal representatives in the sector form different areas (electricity, plumbing, HVAC, contractors and suppliers, etc.). CCCS is a key actor in the development of certifications inside the country and LEED initiative is coordinated through them for projects in Colombia.

5.1.2. LEED COLOMBIA

In Colombia the LEED program is the result of a technical alliance between the U.S. Green Building Council (USGBC), the Green Business Certification (GBCI) and the Sustainable Building Colombian Council (CCCS for its translation in Spanish) since 2010. To March 2017 Colombia counts with 193 accredited professionals divided in the different categories LEED AP: 52 BD+C, 15 O+M, 5 ID+C, 3 Homes, 1 ND and 103 LEED Green Associate. The historical trend of certifications in Colombia demonstrate that the primary use of LEED certification is for Non-residential projects. (CCCS Consejo Colombiano de Construcción Sostenible, 2017)

For 2014 LEED Colombia had certified 40 projects, the first Platinum certification was granted during this year, the accurate distribution of certifications showed:

- 136 registered projects in official LEED Colombia list in more than 20 cities for a total of 3,3 Million of square meters registered
- Platinum: 1 project, 10.928 square meters
- Gold: 17 projects, 329.346 square meters
- Silver: 15 projects 505.935 square meters
- Certified: 7 projects 58.062 square meters
- In process: 95 projects 2,53 millions of square meters (Sostenibilidad Semana, 2014)

According to registration to april 24th, 2017, the next information is provided in relation to the official registration and certification from LEED Colombia:

- 338 registered projects in official LEED Colombia list, 44 cities and 6,3 millions of square meters registered
- Platinum: 8 projects, 108.605 square meters
- Gold: 53 projects, 912.294 square meters
- Silver: 25 projects 343.313 square meters
- Certified: 14 projects 108.624 square meters
- In process: 243 projects 4,82 millions of square meters (CCCS Consejo Colombiano de Construcción Sostenible, 2017)

The next graphics, show the distribution by type of projects for the 338 projects mentioned above. 100 certified and 238 registrated (source: CCCS with data from USGBC):

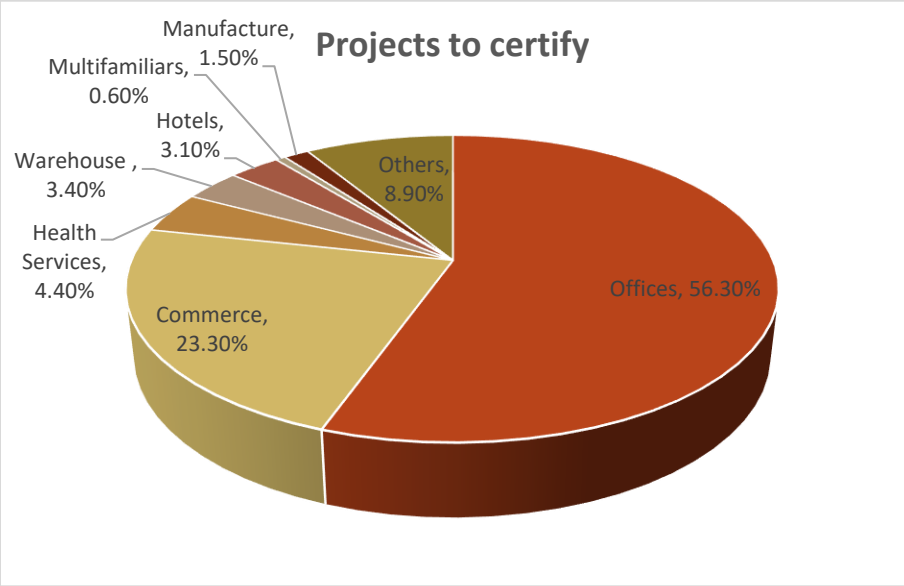

Figure 11 Projects to Certify LEED Colombia

As stated in the graphic, there are no projects in the residential sector than the multifamily projects. Offices and commerce projects concentrate almost the 80% of the total of the projects to certify. In the other categories the relevant categories are Hotels, Warehouse and Distribution Centers, Manufacture and Industries and Health Services.

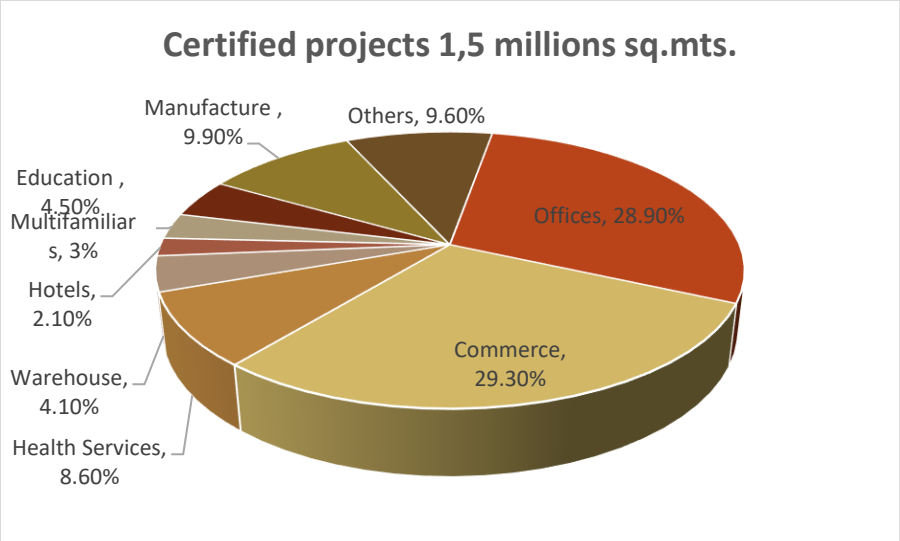

Figure 12 Certified LEED Projects Colombia

In the group of the 238 projects already registered, once again we can check the absence of residential projects. The most of the projects are concentrated in Offices, Commerce and Manufacture and Industries and Industries. The other relevant categories are multifamily projects, Education, Warehouse.

The building census from National Administrative Department of Statistics in Colombia define the new buildings for 2015 in 19,996 millions of square meters and for 2016 19,193 millions of square meters and some other studies in construction states that the tendency will maintain for 2017 with a minor reduction in square meters for new buildings. Historical series since 2010, the year of launch for LEED Colombia bring the next results for new buildings in all the Colombian territory (DANE, 2017):

YEAR	SQUARE METERS (THOUSANDS)	VARIATION
2010	8,964	
2011	14,269	59.18%
2012	13,733	-3.75%
2013	18,514	34.81%
2014	17,847	-3.6%
2015	19,996	12.04%
2016	19,193	-4.02%
TOTAL	**112,516**	**114.11%**

Table 2 Square meters for new buildings registered in Colombia 2010-2017

With the available information for LEED projects to October 2014, 904.000 sq. mts. The total amount of new building census 2010-2014 (with the discount of the last trimester of 2014) is 68,946 sq. mts. The total certified area is 1.31% of total new licensed buildings for the same period and total registered area in official LEED list is 3.67 %.

Nowadays, with information to march 2017 for registered and certified LEED projects and construction census updated to the last trimester of 2016 (the average of the first trimesters for 2016 and 2015 will be added to the total to be in concordance with the LEED information to march 2017), total certified is equivalent to 1.18 % and total registered area equals to 4.11%.

PERCENTAGE OF CERTIFIED AND REGISTERED LEED PROJECTS IN RELATION WITH TOTAL AREAOF NEW BUILDINGS FOR COLOMBIA SINCE 2010		
YEAR	**CERTIFIED**	**REGISTERED**
2014 (TO OCTOBER)	1.31%	3.67%
2017 (TO APRIL)	1.18%	4.11%

Table 3 Percentage of LEED penetration in Colombia

It is important to understand how was the penetration of LEED and the general features of the work carried out for the CCCS. As I mentioned before, the CCCS in one of the key actors in the development of initiatives with relation to building sector. Representing the most of the relevant entities and companies in the sector plays a principal role in the application of LEED for Colombia. Is the entity in charge of the coordination and through the LEED Colombia round tables, technical instance where issues related to the typical practices in architecture and engineering are discussed to be proposed in order to adapt in LEED process to current Colombian situation.

CCCS has shown a superlative participation in the history of LEED, as one of the result of this effort the director Crsitina Gamboa, is vice-president for the technical group of LEED International round table. This is the instance where technical representatives of different countries discuss the global issues inherent to LEED and approve the modifications proposed for countries in order to fit the national situation in building sector.

One of the remarkable results of the work made in the round table LEED Colombia is the development of the national version for a rating system in homes category. Is called CASA. As we see in the data from Colombia, there are no home projects for the Colombian market. This represents the very low interest generated for this system in comparison for the other sectors (Commerce, Offices, etc.). This rating system is the result of the efforts and work of many years and is a clear example of the evolution in a national

market to adapt and tailor a certification system to the current state of building sector. All developments were clearly oriented taking account of the legal framework and the participation of the different relevant actors at all level in the work chain for the sector.

The information of the last three paragraphs has been obtained from interviews with technical supporters, auditors and experts involved in the development of LEED and currently starting to work with EDGE as a new initiative. One more of the important extracts that I could make from the interviews is the referent to the cost. Is a constant that is relative denominate LEED as expensive or EDGE as a cheap rating system. Many literature in the last decade, has discussed different percentages in the add value for sustainable construction and in general there is always an over cost. However, the represented value of that cost could be compensated for the increase in the commercial value of the project or even in the quality conditions in the inhabitants of the project as residents or workers. A complete study could be developed to understand the Colombian situation and could form an independent study for future research projects.

5.1.3. COSTS FOR LEED COLOMBIA

The applicable fees for Colombia are the same registered for GBCI and are presented in the next table extracted from usgbc.org:

BUILDING DESIGN AND CONSTRUCTION FEES PER BUILDING	**ORGANIZATIONAL OR NON-MEMBERS**	
REGISTRATION	$1,500	
PRECERTIFICATION		
Flat fee (per building)	$5,000	
COMBINED CERTIFICATION REVIEW: DESIGN AND CONSTRUCTION	**RATE**	**MINIMUM**
Project gross floor area (excluding parking): less than 250,000 sq ft	$0.068 /sf	$3,420
Project gross floor area (excluding parking): 250,000 - 499,999 sq ft	$0.066 /sf	$17,100
Project gross floor area (excluding parking): 500,000 - 749,999 sq ft	$0.060 /sf	$33,000
SPLIT REVIEW: DESIGN		
Project gross floor area (excluding parking): less than 250,000 sq ft	$0.055 /sf	$2,740
Project gross floor area (excluding parking): 250,000 - 499,999 sq ft	$0.053 /sf	$13,760
Project gross floor area (excluding parking): 500,000 - 749,999 sq ft	$0.049 /sf	$26,625

SPLIT REVIEW: CONSTRUCTION		
Project gross floor area (excluding parking): less than 250,000 sq ft	$0.018 /sf	$910
Project gross floor area (excluding parking): 250,000 - 499,999 sq ft	$0.018 /sf	$4,585
Project gross floor area (excluding parking): 500,000 - 749,999 sq ft	$0.016 /sf	$8,875

Table 4 Fees for LEED Commercial (USGBC, 2017)

For projects with bigger floor gross area than 750.000 sq. ft., GBCI should be contacted to establish the fare. The usual waiting time for the Reviews are 20-25 business days, if waiting time needs to be reduced to 10-12 days period, a $10.000 dollars extra charge will be added according to availability. This fee table applies for projects registered later than December 1st, 2016.

This is the cost for the certification. During the interviews with the experts, they noted that these costs do not represent other type of expenses according to the requirements of LEED. The initiative counts with the participation of a construction commissioner, a typical position in construction projects for U.S. Tough for Colombia this is not a must in the projects. This cost could be consider for the Colombian case as an over cost in the framework of LEED but at the same time, is a plus for the execution of the project, given the relevance and management of the information generated for the project on the side of this commissioner.

5.1.4. COSTS FOR EDGE

Colombia is part of the "EDGE in other countries" selection, which means a country without a local certifier in place (as Costa Rica, Indonesia, South Africa, Philippines, India or Vietnam). Green Business Certification Inc. GBCI and THINKSTEP-SGS are the certification providers for 125 projects included Colombia and the stated costs are defined in two ways (IFC, 2017).

CERTIFICATION PRICING BY GBCI

REGISTRATION=	U$300 per project site	
CERTIFICATION	**PRICE(PER SQUARE METER, EXCLUDING PARKING)**	**MINIMUM**
0 -25,000 FLOOR AREA (SQM)	U$0.27	U$2,250
25,000-50,000 FLOOR AREA (SQM)	U$0.22	U$6,750
50,000 -75,000 FLOOR AREA (SQM)	U$0.17	U$11,000

Table 5 Certification pricing EDGE GBCI

The cost includes both certification phases, design and construction. A local auditor must be hired and the charge is in addition to the cost of the certification.

CERTIFICATION PRICING BY THINKSTEP-SGS

REGISTRATION=	U$300 per project site			
PROJECT TYPE	**CERTIFICATION**	**DESIGN AUDIT**	**FINAL AUDIT**	**TOTAL**
Residential (one unit type)	U$1,500	U$3,650	U$4,320	U$9,470
Residential (per additional unit type)	U$490	U$890	U$460	
Commercial (single end use)	U$1,550	U$4,005	U$4,710	U$10,625
Mixed-Use Buildings (per additional end use)	U$990	U$2,670	U$1,560	

Table 6 Certification pricing EDGE THINKSTEP-SGS

5.2. SURVEY DESIGN

5.2.1. CATEGORIES FOR SURVEY

Once going through the Literature Review, EDGE introduction and EDGE in-action and the cost and fee information, the analysis has to be limited to the more relevant areas transversal to both rating systems. The boundary will be set up taking account of three principal features: cost, operability and penetrability.

According to Jerry Yudelson in his book “Reinventing Green Building”, LEED is not growing anymore in the U.S., during the first 15 years, LEED certified less than 1% of residential and commercial new projects in the country. For the end of 2015, only the 0,7% of new commercial buildings were certified in U.S. and this is consider a really low number. (YUDELSON, 2016).

1. **COST**

LEED

Let's assume a project 20.000 square meters (metric system is used in Colombia) for commercial use (single end use), registered for combined certification in design and construction. There is no extra fee for moving ahead in the deadline for review results.

20.000 sq. mts. = 215.278 sq. ft.

Registration: U$1.500
Precertification: U$ 5.000
Combined Certification Review: 215.278 sq. ft.* U$0,068/sf= U$14.639
TOTAL: U$21.139

If is only Design Review

Split Review Design: 215.278 sq. ft. * U$0,055/sf. = U$11.840
TOTAL U$ 18.340

If is only Construction Review

Split Review Construction: 215.278 sq. ft. * U$0,018/sf. = U$3.875
TOTAL U$10.375

One of the first evaluations that can be validated is that for very small projects in area, the cost could be proportionally higher than for bigger projects. If in our example the area of the project would be 4,000 sq. mt., the cost of the combined review is stated in U$2,928, but with the minimum fare, the project will not pay under U$3,420 according to the table plus the other fixed costs. For smaller projects, the price will be more significant. In developing countries as Colombia, for small projects, more than U$10,000 only for certification process could be significant. According to different specialists contacted for this document, the cost of the different strategies and technical knowledge applied to achieve the proposed credits in LEED could vary between 15%-20%.

EDGE

For the same proposed Project 20,000 sq. mts. floor area, we obtain the next costs:

For GBCI

Registration: U$300

Certification: U$0.27*20.000 sq. mts. = 5,400

Total = U$5,700

For THINKSTEP-SGS

Registration: U$300

Certification + Design Audit + Final Audit = U$1,550 + U$4,005 + U$4,710 = U$10,265

Total = U$10,565

2. OPERABILITY

My first perception after my different research sources and the interviews with specialists is that LEED is not an elemental and basic tool to use, it requires preparation, domain of a certain knowledge and long time dedication, to obtain the results expected to grant certifications. With the launch of V4 the situation has not changed at all and many project teams were still immersed in the big universe of LEED 2009 (The previous version to V4) when now they are confronted with new rules for the most recent version.

Yudelson states in his book that the design of future rating certification systems for design, construction and operation, must found in three principal features, Smart, Simple and Sustainable. It means be easy accessible with a technology comprehensible such as any special training is not required to use the software required to operate the tool or system. Besides the fact that has to be addressed in climate change solution improvements and promote the use of cloud-based platforms to manage the design and operation for buildings. In the same line, proposes five key performance indicators, the rating system should point to: energy use, total carbon emissions, water use, waste minimization and ecological purchasing. (YUDELSON, 2016)

According to my own exploration of the EDGE is clear that is not very difficult to work in the different interphases tabs of the software, the do-it-yourself proposal should stimulate the knowledge spreading and the direct involving for the responsible team in projects in the achievement of the certifications.

Definitely, the simplicity of the software could be an attractive feature to massif the use of the tool, but would be this enough to achieve the 20% of the market in the next 7 years?

3. PENETRABILITY

The capacity of penetration in new markets and strength the participation in markets where a rating certification system is already established, is highly influenced for the two previous features. Cost and operability will contribute to define the percentage of penetration, in particular for developing countries.

As mention in the previous titles, ability in design to provide tools and software with a high friendly-user component and based in new technology-savvy proposals, as well as a structured networking with policy-makers and decision-takers are features that can provide a high acceptation to users. Governmental support will be a key factor; as the BREEAM case in UK, with the involvement of the entities in charge of regulation for the building sector and the definition of construction of standards and codes defining a clear path to the promotion of rating systems.

Process to grant building certifications must tailor the specific characteristics of the country, region and/or city and at the same time, in parallel, dynamism to modify or adapt to new possible conditions in the real time. Nowadays, with climate change already modifying the typical average temperatures and rain

amount and intensities, the new tools must prepare for this type of modifications. In the same line, variation in social and/or economic variables, as average income in sector construction and variation of prices in raw materials and political stability of a country could influence the assessment for a project in particular.

5.2.2. LIKERT STATEMENTS AND POSSIBLE ANSWERS

The next chapter will provide the final version of the survey proposed for the experts in the Colombian building market. In the first paragraphs of the Methodology Approach, is explained the use given to the Likert Scale, which will be applied over statements where the experts will answers having five options to select one. The five possible option answers will include:

1. Strongly agree
2. Agree
3. Neither/Nor Agree
4. Disagree
5. Strongly Disagree

No open questions will be provided, but an option for comments and additional information will come at the end of the survey

5.3. HYPOTHESIS

EDGE has potential to become in a revolutionary tool in the standard certification field. The do-it-yourself proposal is a revolutionary method to stimulate the massive use of the new tool. The main key of the success will be related to the capacity to promote the tool and the premise of low cost in comparison with actual situation in market. LEED has come in a stationary phase where the increase in participation of new building projects is stopped in the recent years. However, it looks that for Colombia this trend does not apply. The team for LEED Colombia is solid and sound and specially for the commerce and offices categories, there is a big participation of new projects.

LEED participation in the market will maintain, at least in the short time, but conditioned to an evolution well integrated with the reality of the markets independently. Specific differentiation between developed and developing countries with specific conditions, strategies and activities designed to achieve the certification must be formulated and available in the software designed per each particular case or project.

Efforts in multilateral agencies as CFI from World Bank with the EDGE initiative are a good example of good practices to promote a new development. One of the largest entities developing new initiatives with private sector (CFI is probably the biggest organization worldwide) and the support of the World Bank as a multilateral organization with presence in the most of the countries in the world is an ideal breeding ground for the beginning of a widespread growth strategy. Market penetration of 20% in seven years is a very ambitious objective and the success is strongly linked to the aspects presented as categories for survey.

Subsequent, the local involvement from government and the regulation entities in building sector can condensed the achievements obtained from the previous paragraph. To scale down to the real situation of each country is an assignment to fall on the tasks of the national and regional decision-makers to define the strategies the widespread growth.

In regards to the particular characterization of the future tools, cost and operability are part of the keystone in the success of new proposals in building certification field. It seems that LEED is becoming in the type of certifications used for big companies with huge building projects, with very high economical resources, where the cost of the certification process does not considerably affect the assigned budget. A considerable difference in cost is perceived for the basic example proposed in the cost section for the two options (LEED and EDGE) and this can be a distinguishing factor to select one or other option in the market. Operability is perceived in a similar manner, a situation in which the project team components does not have the option to manage the software for themselves and is required to fall on the hiring of new staff, shall not be a preference for the team.

5.4. SURVEY QUESTIONNAIRE

A survey questionnaire will be developed to be used for analysing the ideas proposed in the hypothesis, the bigger number of experts possible will be reached to make the universe for the statistical approach as robust as possible. See the survey in the appendix.

The proposed methodology procures to manage each of the different categories as an independent unit, though the definition process to state them, results in many of the questions are transversal to two or to the three of the categories. This particularity will keep noted in the moment of assessment with statistical tools.

6. CONCLUSION

Principal conclusion obtained from the document to this point, is that there is a path of distance between LEED and EDGE. The first is a matured tool with a scope that has been refined through the years of presence in the market, while EDGE is still in a phase of adaptation and looking for international recognition especially in in-developing countries. The last line, defines a difference in target niches and probably the reason why the two programs are not comparable, as LEED is becoming in the brand used for big companies to certificate their new massive building projects, (hotels, public buildings, universities, new offices developments, etc.). EDGE looks to be designed for those projects with limited budget or an option for those projects able for certification but omitting the granting because of the cost of traditional certifications.

There is a big difference in reference to the operability, as the two tools look understandable under the sight of my previous knowledge, it is clear that EDGE offers lots of simplicity in the development to grant the certification. Of course, this situation responds initially to the lower level of requirements and categories to develop the assessment. LEED requires pre-requisites (there are prerequisites in all categories) and a set of more complex and advanced activities to obtain the credits in all categories (seven categories) to determine the level of certification obtained. In the EDGE assessment, all the information is presented in four basic tabs and there are only three categories to achieve activities and obtain the 20% reduction in each of the categories to grant the certification. EDGE does not provide differentiation in the type of certification awarded, while in LEED there are four possible results (Certified, Silver, Gold and Platinum) for EDGE the project accomplish or not.

In the other hand, EDGE is paying a cost with the simplified certification process proposal. As I could analyze after the different interviews, I wonder if EDGE can be considerate such a 100% sustainable program. Checking the 549 resolution states: “Sustainable construction is understood as a set of passive and active measures in the design and construction of buildings that allow the achievement of the minimum water and energy specifications indicated in this resolution, aimed at improving the quality of life of its inhabitants and the exercise of actions With social responsibility” (Republic of Colombia, 2015). Keeping this line, EDGE is not considering aspects related to ventilation that are relevant in relation to quality life inside buildings.

However, this simplicity in the EDGE software, point to something very relevant in the importance of energy efficiency rating systems for buildings. Countries are trying to introduce greener codes and standards in the building sector and this type of programs are good means to optimize this proposal. The problem is that if the traditional certifications are not increasing the percentage of participation in the market of new buildings, are sending a signal of reject by typical users of this kind of programs. EDGE is in an early stage to define if its penetration will be successful, but contains a set of features that could improve penetration in comparison with actual programs, lower cost, better operability in its interface and potential for penetration. Based on the two previous paragraphs and the support of the IFC as the entity in charge of the design and strategies for penetrability, the possibilities to take a primary stand in the market of certifications is high.

6.1. NEXT STEPS

As the presentation of this document has its result in the design of the survey, during the next three months, socialization with experts will take effect. The proposal is to contact at least 80 – 100 professionals in the building construction with emphasis at least in LEED. It cannot be expected the whole group of interviewers have certain knowledge for EDGE, but the questions for those who do not have it, will be edited for comprehension.

Once the results are obtained, statistical analysis will be provided to define the tendency in the answers from experts. The statistical assessment will deliver results that will confirm if EDGE has potential to penetrate the Colombian market or in the opposite hand, the probability according to preferences and points of view from respondents will deny the options of penetration and durability in the Colombian market.

After the finalization of this document, many developments can be proposed to strength EDGE literature. Experts with Associated Professional or Greener Specialist certification within LEED Colombia can register for auditors in EDGE and propose a model of comparison taking account accurately all the differences between the two proposed systems.

Robust information with reference to client preferences in relation with certification processes for new buildings, could deliver a better path for design of new tools perfectly fitted for Colombian market or at least propose better improvements to already existent rating programs. EDGE has proposed its initiative under the premise of adaptation according to particular requirements for projects or places in particular. The client preferences will determine if there are some other programs that could have an important valuation in the Colombian building sector and being worthy or a deeper analysis.

6.2. LIMITATIONS

Having a better experience with the LEED interface would aid to establish a more concrete comparison especially in the operability category. A better analysis could be made for a LEED AP (Associated Professional) who understand much better all the universe of the options of work with the LEED software.

As it is part of the proposal for a simpler and practical tool, EDGE supports its assessment in three categories (energy and water consumption and energy embedded in materials) while LEED is based on seven: General, Location and Transportation, Sustainable cities, Water efficiency, Energy and atmosphere, Materials and Resources and Indoor and Environmental Quality. There is not a relation between the complexity and categories of the tool and the amount of resources being evaluated and the final savings obtained for the two tools. The first draft scope for this document was settle under the comparison for the two tools, but these differences in the evaluation process, does not allow to do it easily.

This document is limited to the analysis of LEED as the most recognized rating system in Colombia, tough, the market is increasing fast and newer options are appearing, especially in the local markets, where the governments and entities with initiatives tailored to the local situation are trying to fill the lack the

traditional systems are not covering. Is probable that results from the application of the survey will show other initiatives being developed for Colombia.

Is important to analyze the role for CASA, the building certification created and fitted for Colombia in the framework of home certifications. As I was focus in the commercial sector, CASA seems to be not that relevant, but according to the information provided for experts, the same kind of approach could work to improve tools already in the market, as EDGE.

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8. APPENDICES

1. SURVEY QUESTIONNAIRE

Demographic questions

Profession:
Sector or field of work:
Expertise with LEED:
Expertise with EDGE:

LEED

Do you know LEED?

CERTIFICATION COST

1. the cost of LEED certification is too high
2. LEED certification cost is a reason for users to avoid certificate their projects
3. Prices designed for building projects are fair and proportional for any kind of size and cost of project
4. There are at least one or more energy efficiency certification or program cheaper than LEED in the market
5. The high cost in the certification process is a reason for project teams in building projects to achieve the requirements for certification, but avoid the payment to grant the certification

OPERABILITY

1. LEED is a good tool to spread the construction project information at all levels of the project team
2. If you are a first time user for LEED, it is a friendly-user tool
3. There are at least one or more options easier to use that LEED in the market of energy efficiency certifications and programs
4. The proposed LEED V4 really offers a new way to certificate buildings and is revolutionizing the market
5. The 21 different categories offered for LEED V4 are good enough to cover the most of the options of buildings in the market
6. LEED is a dynamic tool that adapts to different projects it does not matter the specific requirements of a project in particular. Can be scale down to those specific requirements and determined features of regions or cities
7. The number of categories for evaluation in EDGE are enough, not short to excessive
8. Many of the advertising and publicity states that newer versions of LEED are simplifying and streamlining the process for certification. This statement is clearly proved in LEED V4

PENETRABILITY

1. LEED is an option limited for small building projects (projects under US 100.000), usually big projects from big companies are the typical LEED users
2. The proportion of penetration in the construction market for LEED is not increasing in the US and decreasing in some categories. For Colombia, the situation is similar. That tendency would change in the short term

(For questions 3 to 5) Do you think the reason for situation presented in numeral 2 is?

3. Low brand recognition and advertising of LEED
4. High cost of the certification
5. Too complex process that involves more personal to be hired and extra activities to carry out
6. The participation of local and national government and entities in charge of regulation play a basic role in the penetration of building energy efficiency certifications in the Colombian market
7. LEED counts with a set of information related to different geographic sites in the world that can be used by default to personalize projects
8. Colombia is prepared to institutionalize a certification program as LEED
9. There are at least one or more options in energy efficiency certification or program that has penetrated markets stronger than LEED

EDGE for experts

CERTIFICATION COST

1. EDGE certification cost is accessible for any kind of project it does not matter the cost and size (projects under US 100.000 inclusive)
2. EDGE cost is a fair and proportional cost for projects looking for a energy efficiency certification
3. There are cheaper energy efficiency certifications available in the market

OPERABILITY

1. EDGE is a very easy tool to use
2. Any person in charge of the project could use EDGE with a short and basic preparation
3. There are at least one or more energy efficiency certification easier to use than EDGE
4. Four principal tabs (design, Energy, Water, Materials) are enough to provide a good assessment building certification
5. EDGE lay the foundations of its certification process in five pillars: Climatic conditions of the location, building type and occupant use, design and specifications, building orientation and base case vs improved case. These are enough to better calculate consumption and saving of energy, water and energy embedded on materials

PENETRABILITY

1. In general terms EDGE is a revolutionary tool to massify the use of energy efficiency certifications in construction sector

For the questions 2 to 4. In order to strengthen the penetration of EDGE in the markets of countries in development, the tool should focus in:

2. Low cost
3. Advertising and brand spreading and recognition
4. Easy access and friendly-user management
5. There is at least one or more energy efficiency certification with more options of penetrability in the market
6. The participation of IFC, one of the largest entities in the world working with the private sector, underpin the path to success for EDGE
7. EDGE promulgates the focusing in a list of more than 130 in-developing countries, there is no doubt this will help to the overcrowding of EDGE as a certification system
8. The 20%-20%-20% objective to achieve the EDGE certification is an attractive goal to stimulate the use of EDGE
9. Providing default information about more than 350 cities around the world as well as key assumptions for the base case are feature that highlighted the potential of EDGE
10. Colombia is prepared to institutionalize a certification program as EDGE

EDGE for non-experts

CERTIFICATION COST

1. Market should offer certification tools with cost accessible for any kind of project, it does not matter the cost and size (projects under US 100.000 inclusive)
2. In general certification costs are fair and proportional for projects looking for a energy efficiency certification in general
3. There are cheaper energy efficiency certifications available in the market

OPERABILITY

1. Colombian market requires certification programs easier to use than LEED
2. For any project, any person in the project team should be able to use the software or tool for certification with a short and basic preparation.
3. Colombian market offers energy efficiency certification programs easier to use than LEED
4. For a better operative management, certification programs should compress the quantity of tabs to the minimum possible amount to simplify and optimize the execution of the assessment
5. If a new certification program lay the foundations of its certification process in five pillars: Climatic conditions of the location, building type and occupant use, design and specifications, building

orientation and base case vs improved case. These are enough to better calculate consumption and saving of energy, water and energy embedded on materials

PENETRABILITY

1. Already exist in the market revolutionary certification programs to massify the use of energy efficiency certifications in construction sector

For the questions 2 to 4. In order to strengthen the penetration of a new certification program in the markets of countries in development, the program should focus in:

2. Low cost
3. Advertising and brand spreading and recognition
4. Easy access and friendly-user management
5. There is at least one or more energy efficiency certification with more options of penetrability in the market
6. Part of the success for a new program certification is the participation of private sector or representative entities of the private sector in the design and pilot of the certification program
7. It is very important for a new certification program to focus in in-developing countries, there is no doubt this will help to the overcrowding of the certification system
8. A proposed certification program, which request for granting the certification the reduction consumption of water, energy and energy embedded in materials in a 20% each, could has a big potential to become in a popular and frequently used program
9. Colombia is prepared to institutionalize a certification program

COMMENTS (To provide any information you consider valuable in reference to the topic of the interview, do not hesitate to comment anything you consider relevant)

2. SLIDES CCCS PRESENTATION LEED PENETRATION