

# Economic Analysis on Green Building in Colombia and its Advantages

Orjuela Sanabria Cristian Ricardo<sup>1</sup>, Uribe Celis Sandra Liliana<sup>2</sup>, Ospina Lozano Sandra Elodia<sup>3</sup>

<sup>1</sup>School of Engineering – La Salle University of Colombia, Bogotá D.C.

<sup>2</sup>MSE, full-time professor, Civil Engineering Programme –La Salle University, Colombia.

<sup>3</sup>MSE, full-time professor, Civil Engineering Programme –La Salle University, Colombia

**Abstract:** *The concept of sustainable development has been established as a feasibility and durability guidance for environmental integration processes. The introduction of this concept in the engineering and building sectors poses new challenges to the conciliation between the needs of people and the capacity of the planet. Since 2007, when the Colombian Green Building Council (CCCS, by its Spanish initials) started operating in Colombia, the sector has shown its interest in every change thereto related. However, in a developing country such as Colombia, there are economic and political obstacles that prevent businessmen from adopting an “eco-evolutionary” standpoint that allows it to stay in the market and have caused that green building could be only achieved with the aid of the State and the familiarisation of professionals on this regard.*

**Keywords:** Green building, Colombia, sustainability, residues, sustainable development, Civil Engineering, Reutilisation

## 1. Introduction

The concept of sustainable development has become an initiative that allows orienting different production models in order to achieve feasibility and sustainability on the relationship between welfare and environmental integration processes, thus becoming a feasible alternative to a predominant model of development. The United Nations Educational, Scientific, and Cultural Organisation (UNESCO) [1] has stated that this concept is related to the existing growing concern in the international community over the last decades of the 20<sup>th</sup> Century about the relation between economic and social development and its relatively immediate effects on the environment. According to the Brundtland Report, Our Common Future, of the World Commission on Environment and Development [2], sustainable development at a global scale is the one that meets the needs of the present without compromising the capacity of future generations to meet their own needs. However, environmental damages caused by the construction industry clearly shows the problems future generations will have to face to meet their own needs.

Civil Engineering has greatly contributed to the progress of nations both in economic conditions and activities and to the welfare of the population of an area of interest. However, similarly to how social and political models face changes, processes and methodological development conducted in Civil Engineering are to be modified. According to the United Nations Environment Programme [3], the introduction of sustainable development in engineering is a new challenge that seeks to conciliate the needs of people with the capacity of the planet. In fact, should current patterns not change, the expansion of constructions shall destroy, or at least disturb, natural and wildlife habitats on more than 70% of the surface of the Earth by 2032, mainly due to population growth, economic activities, and urbanisation [3].

Oteiza & Tenorio [4] state that constructions take up to half of resources consumed from nature by mankind. It is considered that 25% of waste is caused by the building and demolition sector [5], and over 70% of world energy is consumed by this sector [4], thus becoming one of the sectors with the largest impact on climate change. In this sense, Civil Engineering is in a privileged and compromising position with regard to the implementation of any reversal mechanism against these effects, and green building plays an essential role as manager and principal actor in such change. As engineers, the latter implies acting based on not only environmental aspects, but also on socioeconomic and cultural aspects in the following fields: design, building, material extraction, and technical specifications, and even building management.

## 2. Rationale

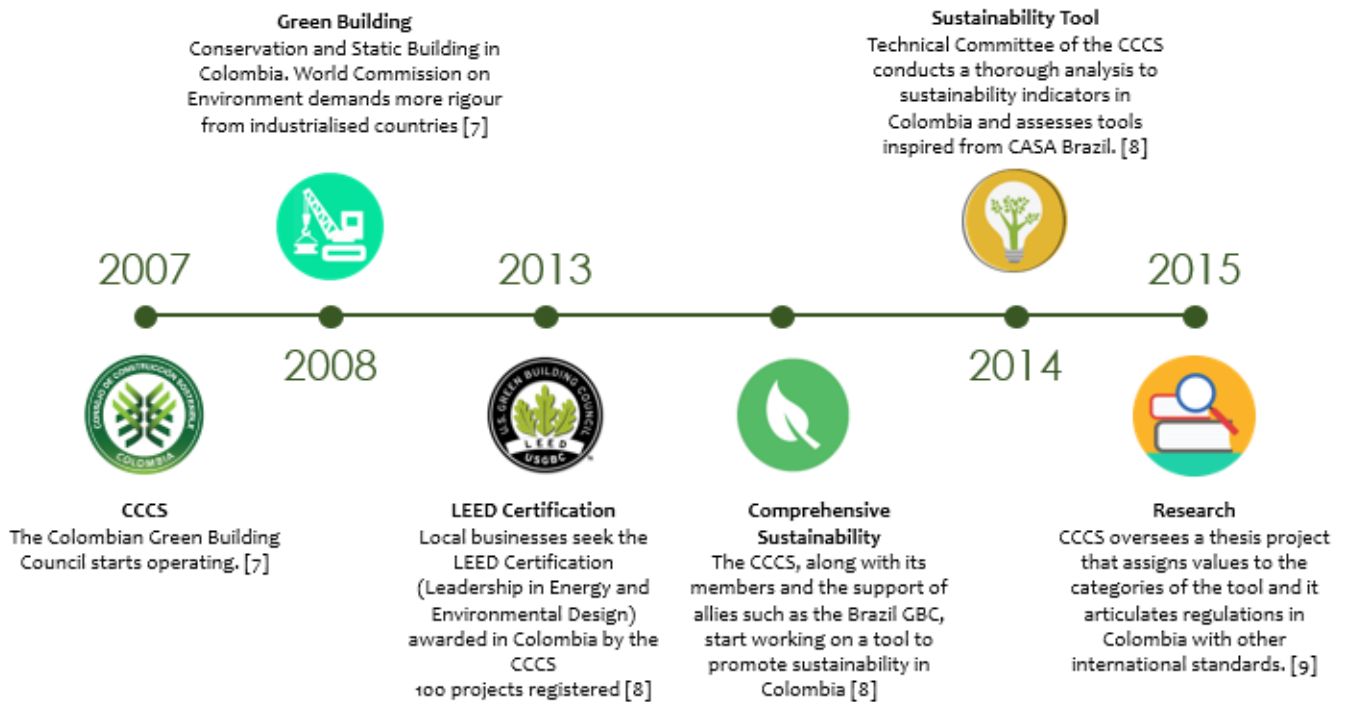
It is worth stressing that green building was born as a solution to environmental problems; it is a substitute to traditional building that, in addition to technical and economic solutions, provides environmental benefits. However, this trend has lately increased in several countries, to the point of becoming a necessary culture and policy for development. Although concepts such as sustainability or energy efficiency are common in economic and social debates when project managers make decisions, the trend of building companies embarking on innovation and development has increased over the years.

In the beginning, it was no easy task and there was the “myth” that overrun was intrinsic to green building<sup>1</sup>. However, high performance and sustainability are key elements of green building, which are related to a design conceived from engineering activities, becoming a key aspect. According to Portafolio [6], with good design and

<sup>1</sup>The practice of increasing energy, water, and material efficiency in buildings, in addition to reducing health and environment damages, but whose origin trace back to late 19<sup>th</sup> Century.

good engineering backing it, there may be a 40% to 50% decrease in building costs in comparison to traditional building.

## Green Building in Colombia



**Figure 1:** Green Building in Colombia Timeline

On Figure 1 appears a timeline of green building in Colombia, starting with the launch of the Colombian Green Building Council, LEED certifications in Colombia, and sustainability tools.

Taking the latter into account, this article seeks to analyse, in general terms, each characteristic of green building from the economic aspect of a business starting its second decade in Colombia, and that has already been studied in some European and Latin American countries.

### 3. Supply, Demand, and Elasticity

In Colombia, according to the National Department of Planning (DNP, by its Spanish initials), investment estimates by 2020 would add up to 112 trillion pesos, of which 16.6 trillion pesos, 15% of the total, shall be for the housing, city, and territory development sector [10].

The real estate building market has shown their growing concern about environmental protection. The demand for green offices and malls has increased in Colombia over the past few years [11]. This demand is generated by companies from other sectors with important financial power and environmental responsibility that also seek to reduce utility costs, such as power and water, and to increase their legitimacy.

As for supply, there are building companies specialised in developing these designs and strategies with clear goals, such as certificating their projects<sup>2</sup>. On Table 1 appear some building companies currently operating in Colombia under

green building criteria [12], [13], [14].

The development of infrastructure in Colombia is going through changes thanks to green building and its benefits, which are making that an increasing number of building companies follow this path. Seeking to foster sustainable development in the building sector, the Colombian Chamber of Construction (CAMACOL, by its Spanish acronym) is currently at the forefront with the EDGE (Excellence in Design for Greater Efficiencies) Certification created by the International Finance Corporation, a member of the World Bank, which monitors energy and water saving, a modelling system, to verify the fulfilment of the standard, in addition to a process of auditing and certificating the design and building of new buildings for housing, offices, hospitals, businesses, and hotels [15].

As for elasticity, the demand for green buildings is deemed elastic, and as a result, an increase in building prices decreases sale chances. Since green buildings intend to replace traditional buildings, individuals interested in purchasing homes desist from purchasing them even though they may be cost efficient regarding energy and water in the long run.

<sup>2</sup> LEED Construction Certification

**Table 1:** Green Building Criteria amongst Colombian Building Companies

GREEN BUILDING CRITERIA	COLPATRIA	AMARILO	ARPRO	INCOL	PRODESA	PROKSOL	OIKOS	TRIADA	VIC	BOLIVAR	PIJAO	CONCRETO
CCCS Member	X	X	X		X		X	X		X		X
Signing of a green building agreement for Bogotá and Cundinamarca	X	X	X	X	X	X	X	X	X			X
Integration of sustainability criteria for buildings	X	X	X	X	X	X	X	X	X	X	X	X
Restoration of vegetation and environmental compensation	X									X		
Energy consumption reduction	X	X	X		X	X	X	X	X	X		X
Water saving	X	X	X		X	X	X	X	X	X		X
Utilisation of waste through reutilisation and recycling	X	X	X				X			X		
Use of rainwater	X			X					X			
Wastewater management		X										
Quality of life area of work		X	X		X			X	X			
Human resources area of work		X							X			
Environmental goods and services area of work			X	X	X	X	X	X	X			
Climate change mitigation and adaptation area of work				X				X				
LEED-certified construction	X	X	X		X		X				X	X
Bioclimatic intervention			X									
Social interest housing				X	X			X				

However, according to a World GBC report<sup>3</sup> [16], cost overruns related to green building, which has been a persistent obstacle, can be suppressed as long as environmental strategies and management programmes are integrated from the very start of the project. In other words, green buildings should not be more expensive. Green building real estate projects in Colombia will grow at annual rate of at least 10% [17]. The LEED Certification in Colombia represents 6.1 million square metres of green projects in the country, consisting of 143 certified real estate projects with an area of over 2 million square metres, and 220 more awaiting certification, representing 3.9 million square metres.

As for building project management, material reduction, product replacement, product recycling, and function elimination are valuable and relevant tools for the construction industry, where resources and water management make up a large part of project costs. It is evident that one of the most common mistakes in the building sector is that companies seek isomorphism<sup>4</sup>, which hinders innovation and deteriorates the relationship between organisations and the environment, increasing the risk of threats and unbalance.

Because of this, the green building market must keep evolving so that the market abides by the law of supply and demand.

#### 4. Economic Efficiency

Project buildings aimed at sustainable development bring

<sup>3</sup> World Green Building Council

<sup>4</sup> This term refers to organisations completely dependent on external scenarios, creating a common model or pattern in a system

economic benefits to the owner. At companies, malls, or retail companies, public utilities such as water, sewer, and power are consumed, in addition to security, management, and others. Users pay for public utilities billed by companies in Bogotá at a unit value (cost per consumption unit). When structures are built promoting efficient processes and resources, this consumption is reduced, thus reducing expected costs to real costs (approximate monthly cost). On Table 2 appears some information on economic benefits.

Furthermore, public and private organisations are acknowledging the need to generate economic incentives, even with State actions such as Conpes 3919 of 2018 (National Green Building Policy) [18]. Based on the Millennium Development Goals (MDGs) relevant for green building, such as ensuring environmental sustainability and promoting a world society for development, Colombia has made significant progress to ensure minimum levels of prosperity, welfare, and environmental preservation.

In this sense, it is worth highlighting the fact that economic activities, particularly those of the building sector, use natural resources such as soil, stony materials, and inputs such as wood and concrete, etc., in the development of their activities. The inadequate use of resources causes environmental damage. Building companies must protect the environment, taking the benefits of the organisation into account [19].

As a sector, building is one of the activities with the largest impact in the environment, increasing as the demand for buildings rise. For this reason, CONPES 3919 was established to promote the inclusion of sustainability criteria in the lifecycle of buildings through instruments for transition, monitoring, and control, as well as financial incentives to implement green building initiatives with an

action course until 2025 [18].

The initiative of the building sector in the integration of the sustainability concept in the development of building works has received much attention from financial entities. However, while actions promoting nationwide aid are consolidated, building companies keep voluntarily including new initiatives to achieve green certifications and to meet the UN MDGs by 2030 [20].

Resolution 613 of 2015 of the District Secretariat of Planning (SDP, by its Spanish initials)<sup>5</sup> includes incentives such as an increase in constructability for buildings adopting measures related to eco-urbanism and green building, and water and energy saving in new social interest houses (VIS, by its Spanish acronym) and priority interest houses (VIF, by its Spanish acronym). On the other hand, according to Decree 2205 of 2017 and Resolution 589 of 2018<sup>6</sup>, having verified the sustainability approaches of building projects, VAT discounts are granted to promote passive measures for buildings certified, or that are in the process of being certified, from their design stage<sup>7</sup> [20].

To contextualise economic efficiency, hereunder is shown, as an example, the ALPINA Research and Development Centre<sup>8</sup> that has a LEED International Certification. The surplus of the ALPINA consumer is higher than other companies because it receives the same service at a lower price [21].

However, these companies do not operate under perfect competition, in other words, control over the price of products by interaction of supply and demand. Until the demand is higher, consumers shall continue receiving the benefits in cost reduction. Thus far, the only companies seeking economic benefit are ALPINA, 3M<sup>9</sup>, and ANH<sup>10</sup>.

**Table 2: Economic Benefits**

	Energy (Kw/h)	Water (m <sup>3</sup> )
Consumption Reduction	From 20% to 50%	40%-50%
Cost & Payment Disposition	COP 279,690	COP 5250
Approx. Consumption	22,000 Whs	2360 m <sup>3</sup>
Approx. Monthly Cost	COP 6,153,180	COP 1,890,000
Approximate Monthly Saving	COP 2,000,000	COP 760,000
Annual Saving	COP 24,000,000	COP 9,072,000

## 5. Internality of Externality

Since traditional building creates lifestyles that greatly consume non-renewable resources, this global consumption has been affected by the Kyoto Protocol<sup>11</sup>; however, though countries undergo higher production costs and consumers must pay more to obtain said resource, the environmental

impact has not been fully mitigated. New projects that further reduce this externality and bring more benefit to the society must be promoted.

Building is one of the most contaminating sectors due to its large demand of CO<sub>2</sub>-producing materials. In addition, the exorbitant consumption of 17% fresh water, 25% cultivated wood, and 30% to 40% energy contributes to one third of CO<sub>2</sub> emissions and two fifths of solid waste [16].

The cost of green building projects is still above 10% in comparison to regular building. "Industry professionals operate under the assumption that green building increases design and construction costs between 10% and 20%, with some estimates even reaching 29%..." [22]. In Colombia, this investment is impossible to be borne by the constructor only, unlike in the United States where there is no substantial difference.

Although the Government is promoting this participation in accordance with Act 788 of 2002 [23], whereby projects leading to environmental improvement are having tax incentives, the benefit or internality of the State is not enough.

In 2015, the Ministry of Housing, City, and Territory performed regulations, through Resolution 0549 [24], with the purpose of setting minimum percentages and water and energy saving measures for new buildings and adopt sustainable building guidelines for saving water and energy in buildings [25].

Currently, some projects of the Congress seek to create adequate manuals and use guidelines with environmental criteria since it further increases the demand for this type of construction. The Government may internalise this benefit of the constructor to the society, acting as a regulation body of the financial sector for fewer interests on these projects, and to discourage non-friendly projects in order to end the irresponsible consumerism from the city and the environment.

For instance, building unions following sustainability guidelines in their projects receive great benefits such as credits (24-month credits for 15 billion pesos), tax exemptions, VAT exemptions, preferential credit rates (Effective Annual Rate –TEA– of 5% for traditional constructors, whereas green constructors receive 4% at Bancolombia), paperwork time reduction, and an increase in constructability [26][27].

Green bonds are the same as regular bonds or certificates of debt used in regular economy. The only difference is that they are deemed "green". This means that their funds are used for one of several of these categories: i) Renewable energies, ii) Energy efficiency, iii) sustainable management of natural resources and land use, iv) prevention and control of contamination, v) clean transportation, vi) preservation of land and water biodiversity, vii) adaptation to climate change, viii) sustainable management of water and wastewater, ix) green buildings, and x) products adapted to circular energy [28]. For instance, in 2017, Banco Davivienda launched green bonds for COP 430,000,000 with

<sup>5</sup> Mayor of Bogotá

<sup>6</sup> Republic of Colombia

<sup>7</sup> VAT

<sup>8</sup> A Colombian food-producing company, mainly dairy

<sup>9</sup> U.S. company dedicated to research, development, manufacture, and trading of industrial equipment

<sup>10</sup> National Hydrocarbon Agency

<sup>11</sup> It is a protocol of the United Nations Framework Convention on Climate Change (UNFCCC) and an international agreement whose goal is reducing the emissions of six greenhouse gases that cause global warming.



a 10-year term and a reference interest rate (IBR, by its Spanish initials) of 2.13%.

## 6. Short-term and Long-term Production Costs

To analyse production costs, the approach of this article is building companies whose green building costs exceed regular building costs by 10%.

Most of these costs are destined to adapting energy services to the inclusion of renewable energy and rationalising the lighting and water system as result of the use and reutilisation of such system (with reutilisation projects, catchment of rainwater, adoption of consumption-reducing components, innovative technologies for the reduction the volume of wastewater and water purification stations). For this reason, both the infrastructure required for energy and water and basic materials used and labour are fixed costs, and depending on the size of the construction, costs are established.

Nevertheless, in actuality, most additional costs in the design and building stage are not as high as shown by statistics and depend more on managerial factors than on building factors. This means that the moment when decisions are made and the sustainability is included in the planning weighs more, and it depends on the knowledge of the work team during the feasibility stage rather than design. It also depends on a proper management of environmental and political strategies, and especially on the planning and scheduling of the work. In real LEED-certified projects, according to a study conducted by the Colombian Green Building Council, results showed a cost overrun of only 4.1% [29] and not the 10% published statistically.

With the industrialisation of green building, even more with a differentiating component for which many people are willing to pay more, benefits may be multiplied if applied to social interest housing since their low cost allows them to be more affordable for vulnerable populations. It is observed that it may boost the efficiency of scarce resources (in this sense, subsidised homes) and the spectrum of benefited population.

Additionally, and with regard to long-term costs, there are studies that show that this type of solutions generates major savings in public utilities (energy and water) throughout the service life of a project, becoming more profitable the built space, that is, more maximisation of the land production factor. This type of buildings tend to become more valuable faster than other non-sustainable properties, and businesspeople enjoy better sales of commercial spaces and an increase in productivity of people. Unfortunately, this goes beyond the scope of the analysis of marginal costs, means, and totals because there is no information available on their relevance for businesspeople or owners of sustainable houses.

## 7. Policy

In 2016, the reference CASA Colombia was consolidated<sup>12</sup>

<sup>12</sup> Green building certification adapted to the Colombian context.

as a tool to certify sustainable homes that incorporate integral design strategies, better work practices, and social responsibility. This system includes every applicable regulation in Colombia.

It facilitates the cost-efficient structuring of new housing projects, and it includes social and priority interest houses. It promotes the measuring and verification of concrete sustainability indicators. And it provides solutions to the market as a management model with higher levels of sustainability in accordance with the regulations on sustainable building in the country. (Decree 1285/15 and Res. 549/15) of the Ministry of Housing, City, and Territory). [9], [24], [30].

In 2016 the first version of the Guideline Protocol for Sustainable Urbanism (PLUS) of the CCCS, which is a reference document to provide guidance on essential values that make a city or a neighbourhood sustainable, was issued. It contributes to the selection process of the site and urban design for everyone seeking to make a positive impact in their area. PLUS corresponds to a document of reference for formulators, planners, and designers that includes specifications and values that sustainable urban spaces in any space in Colombia must meet.

## 8. Conclusion

The construction industry, which in this case should be called “market niche” and that is also directly related to social dimension in any country, is the perfect stage to contribute to sustainable development from any stage. However, in a developing country such as Colombia, there are economic and political obstacles that prevent businessmen from adopting an “eco-evolutionary” standpoint that allows it to stay in the market and have caused that green building could be only achieved with the aid of the State and the familiarisation of professionals on this regard.

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