Alliance HQE GBC FRANCE

THE HIDDEN TREASURES OF RENOVATION

RESULTS OF THE HQE PERFORMANCE LCA RENOVATION TEST

EDITORIAL

A Renovation Wave, which will accelerate the decarbonisation of buildings, is an initiative highlighted in the European Green Deal as an essential to achieving a carbon neutral Europe by 2050. Buildings account for 40% of the European Union's energy consumption and 36% of its greenhouse gas emissions. It is time to act and reduce this footprint.

Key to addressing the environmental impact of the sector is reducing the whole-life carbon of buildings – which encompasses both embodied and operational emissions. However, there is currently a lack of methodology, and guidelines for measuring, reporting and optimising whole-life carbon in existing buildings. In this field, buildings professionals need guidance on how they can help to work towards the objectives of the Paris Agreement.

Alliance HQE-GBC, the alliance of professionals for a sustainable living environment, has identified two important barriers which the sector must overcome before it can decarbonise its existing buildings effectively: the technical barrier and the economic barrier. The purpose of this report, which is part of a wider programme, is to build the competence of industry stakeholders on this subject through case studies and show what can be done to remove these barriers.

After presenting the key principles of the methodology to perform LCA for renovated buildings, this document describes the first results and observations from the first HQE Performance test for renovated buildings. A case study is present in this document, to illustrate the first results for collective housing. This document highlights the need to continue the acquisition of knowledge, particularly in terms of best practice for the circular economy.

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METHODOLOGY

AN LCA METHOD BASED ON THE FRENCH E+C- STANDARD

Life cycle assessment is an environmental assessment method that quantifies **the impacts** of a product, service, or process over its entire life cycle: from the extraction of raw materials to its end-of-life treatment.

Standardised and recognised, it is the most widely used method in terms of environmental assessment (see ISO 14044, EN 15978). It works on a voluntary basis today in France, but its use should be mandatory in 2020 for new buildings with the new French environmental regulations.

Life cycle assessment (LCA) takes into account all environmental impacts from the production phase to the end of a building's life. Also, being a multi-criteria method, it prevents unintended consequence of shifting negative impacts from one area to another.

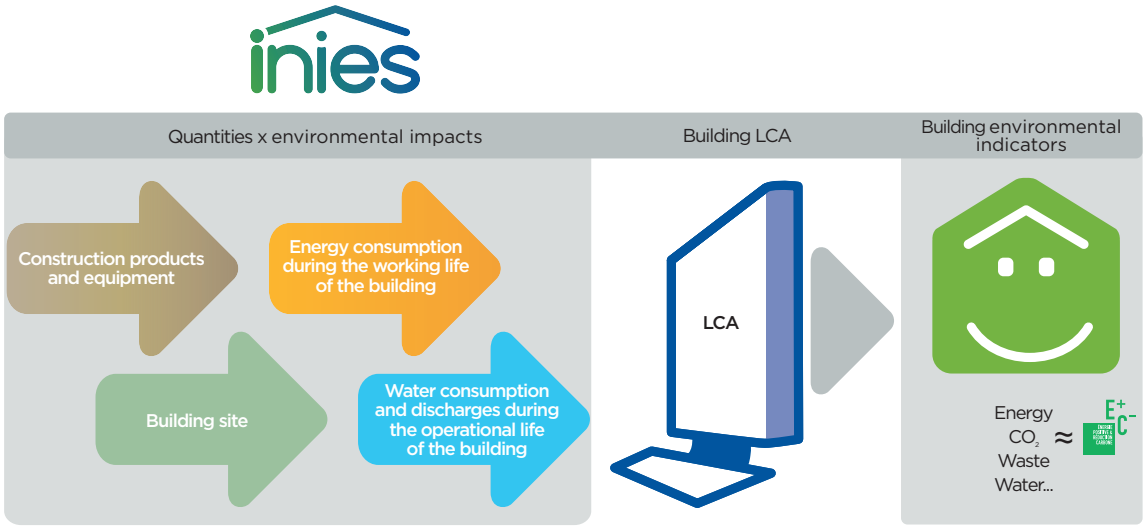
The method of this test allows the calculation of environmental performance indicators for a renovation or refurbishment initiative under the responsibility of a project owner. It is based on the EN 15 978 standard and the Energy-Carbon benchmark for E+C- experimentation*.

These indicators are the sum of four contributors:

- the **Construction Products and Equipment contributor**, which considers all the components of a building and its plot. They are divided into 13 batches (see Glossary);
- the **Energy consumption or energy contributor**, which covers all the energy used by a building;
- the **Water consumption and water discharges contributor** which covers all water used by a building and its plot;
- the **Construction work contributor** which covers the building site's energy consumption, its water consumption and discharges, and the removal and treatment of excavated material.

The reference study period is 50 years.

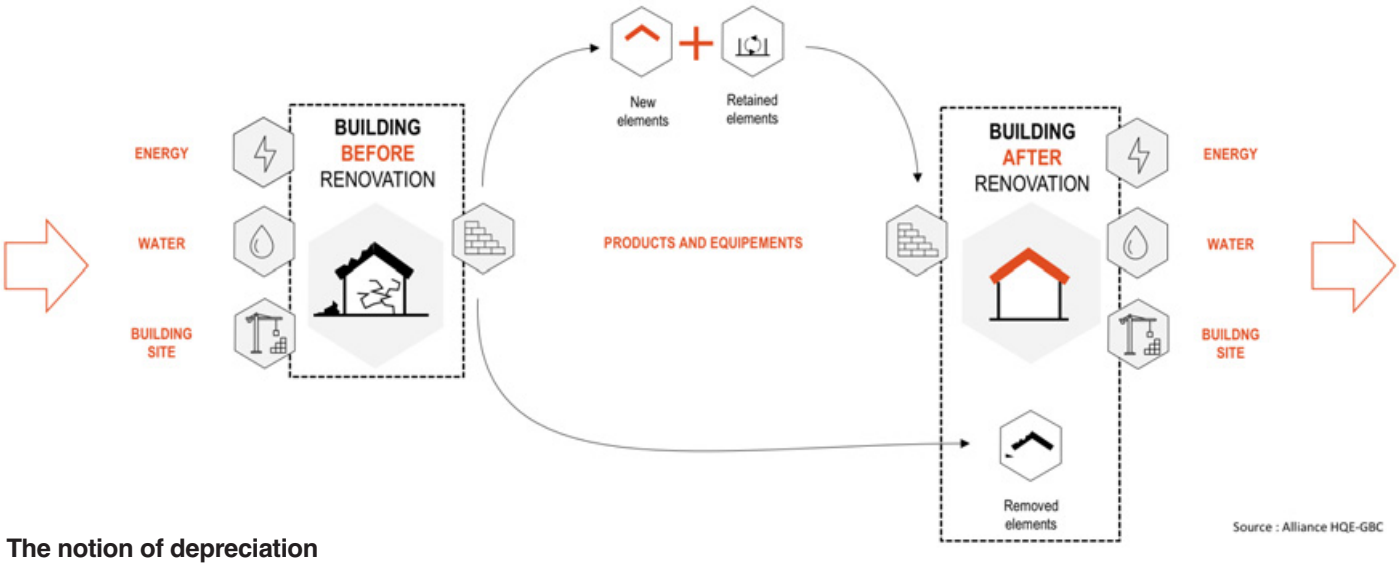
The data used during this test were all taken from the INIES database or from a set of fixed batch data sets made available for this study.



The method takes into account all the energy consumed in the building whether or not it is covered by French thermal regulation (RT). RT energy (covered by thermal regulation) considers 5 uses in the Primary energy consumption indicator: heating, cooling, domestic hot water (DHW), lighting and auxiliaries (ventilation, etc.). Non-RT energy corresponds to the consumption of the other uses of the building: use of appliances, common areas, car parks and lifts.

Three different categories of elements are considered in Construction Products and Equipment contributor:

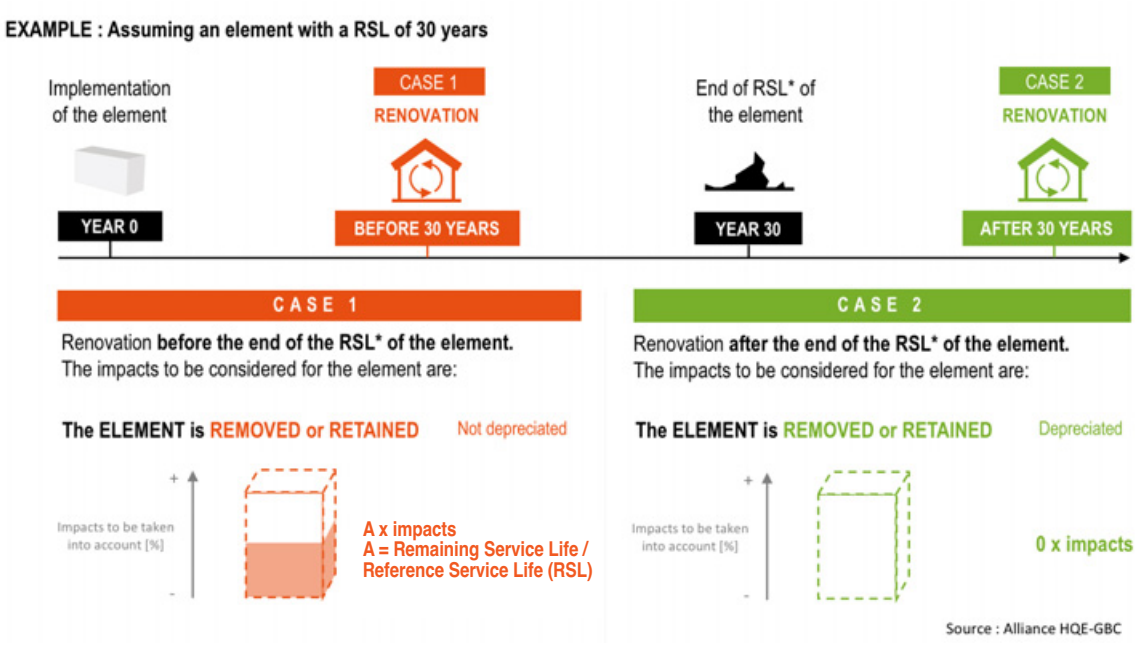
- Elements **removed**: those removed from the building.
- Elements **retained**: those remaining in the building, including those re-used.
- **New** elements: those added to the building that may be reused or reused off-site.



The notion of depreciation

In this method, the environmental impacts of construction products and equipment over their life cycle are not instantaneous or phased. **They are presented consistantly over their entire lifetime**, thus producing a cushioning effect. With a linear hypothesis, if a product has a reference service life (RSL) of X years, 1/X times of its environmental impact over the "total lifecycle" will be depreciated each year. However, if the products and equipment in the original building have already been depreciated over the study period considered in the life cycle analysis, then their impact is zero.

Depreciation is an accounting term that defines the loss in value of a company's fixed assets due to wear and tear over time or obsolescence. It can be calculated on a straight-line depreciation (equivalent depreciation each year) or on a degressive depreciation (greater depreciation at the beginning of the asset's use).



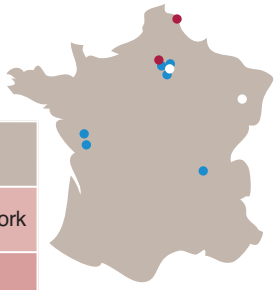
A re-used element can come from different sources: either it is an element retained during renovation work, or it is an element presented consistantly the deconstruction of another building. It should also be noted that the buyer of re-used elements also inherits their depreciated environmental impacts if they have not reached their reference service life (RSL).

TESTERS AND RESULTS

THE HQE PERFORMANCE TEST FOR RENOVATED BUILDINGS

In 2017-2018, LCA calculations have been carried out with this specific methodology for ten renovated buildings. This HQE Performance test was conducted at a national level for a wide range of projects. It was an opportunity to point out specific issues, to improve the methodology and to observe any initial trends.

10 PROJECTS FOR FIRST OBSERVATIONS



	Name	Year of construction	Floor Area SDP (m^2)	Storey	Structure	Location in France	Heating System
Collective Housing (LC)	LC1	1969	7 543	18	Concrete	92	Heating network
	LC2	1983	5 571	2	Concrete	59	Electricity
Office of Administrative Building (B)	B1	1920	2 745	2	Concrete I wood	44	Electricity
	B2	1952	865	2	Wood I concrete	44	Heating network
	B3	1940	5 815	8	Concrete	75	Heating network
	B4	1996	18 345	8	Concrete	92	Gas
	B5	1964	10 661	8	Concrete	69	Electricity
	B6	1927 + extension in 1983	11 498	4	Stone I concrete	75	Heating network
Other activities (A)	A1	1971	13 007	7	Concrete	75	Heating network
	A2	1806	709	2	Stone	88	Wood

THE 7 FIRST OBSERVATIONS

Like all HQE Performance tests, this edition on the LCA of renovated buildings has improved sector knowledge which can be summarised in 7 main observations :

1 «For the renovated buildings in this test, if the renovation is ambitious from an energy point of view, then they can target the same energy performance levels as a new building.»

2 «For the renovated offices in this test, embodied energy* represents between 17% and 42% of total primary energy consumption.»

3 «For the renovated buildings in this test, greenhouse gas emissions are almost equally divided between Construction Product and Equipment (CPE) and all-use energy.»

4 «For the renovated buildings in this test, the products and equipment that have the greatest impact on carbon emissions are different from those in new buildings.»

5 «For the renovated buildings in the test, the quantity of non-hazardous waste is less than half that of a new building.»

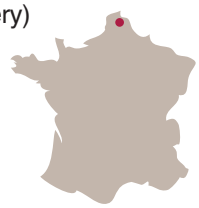
6 «For the renovated buildings in the test, the batches with the greatest impact on the hazardous waste indicator are the HVAC and Heating network technical batches.»

7 «The circular economy also means reducing resource depletion, which is a further LCA indicator to be explored in the future.»

This study also made it possible to consolidate application rules for the LCA of existing buildings, designed as an addendum to the E+C- standard, thus offering all stakeholders the possibility of comparing renovated buildings with the Energy-Carbon performance of new buildings. Finally, this test highlighted the need to continue the acquisition of knowledge, particularly in terms of guide value for the circular economy

CASE STUDY: WAVRIN COLLECTIVE HOUSING

- Collective housing (3 storeys)
- 75 apartments
- SDP (floor area): 5 571 m²
- Date of construction: 1983 (hypothesis)
- Year of renovation: 2017
- Asbestos: Yes (recovery)
- Cost of rehabilitation: 5,099,000€



Retained elements

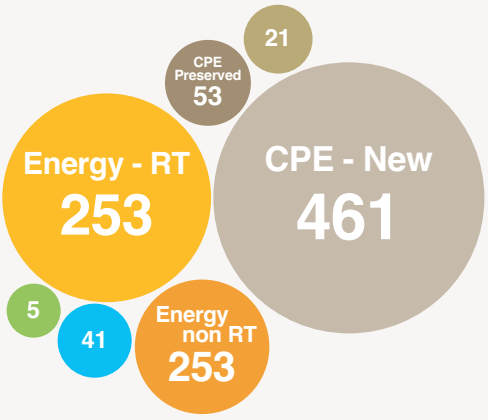
- Concrete structure
- Interior partitions and doors
- Plumbing networks and equipment
- Electrical distribution incorporated in concrete slabs and walls

Key points of the renovation

- Replacement of facades
- Insulation of roofs
- DHW replacement
- Removal of common premises and housing expansion
- Standardisation and making the housing more comfortable

Climate change

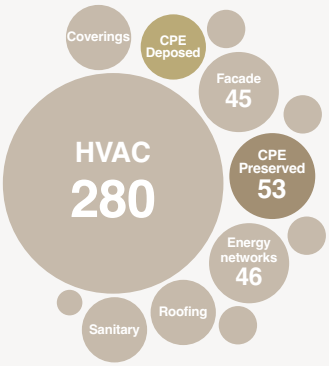
All contributors (kg eq. CO_2/m²SDP)



= E_{GES} total : 956 kg eq. CO_2/m² SDP

Focus CPE

Construction Products & Equipments
(kg eq. CO_2/m²SDP)



= E_{GES} PCE : 535 kg eq. CO_2/m² SDP

Operative energy
- RT (thermal regulation)
- non RT (other uses)

Construction Products & Equipments
- New
- Disposed
- Preserved

Other contributors
- Building site
- Water

Comparative data : French E+C- Standard levels for new buildings

Carbon 1 < 2291 kg eq. CO_2/m² SDP
Carbon 2 < 1309 kg eq. CO_2/m² SDP

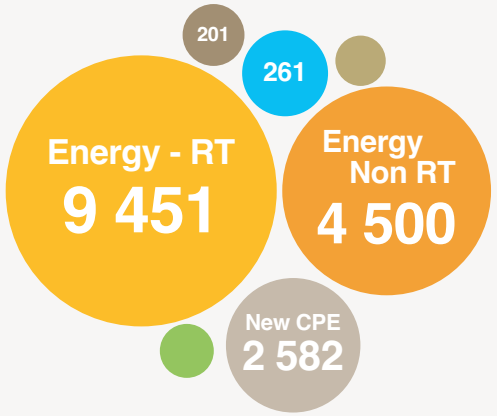
E+C-

Carbon 1 < 900 kg eq. CO_2/m² SDP
Carbon 2 < 850 kg eq. CO_2/m² SDP

56% of greenhouse gas emissions over the entire life cycle of the building are due to the Construction Products and Equipment (CPE), and 40% are due to energy consumption (RT and non RT). For the Construction Products & Equipment contributor, the retained elements (mainly from batches 1 to 5) that have not yet been depreciated (17 years remaining for reference lifetime ≥ 50 years) account for 10% of the impacts. For new items, batches 8 (HVAC), 10 (energy network) and 6 (facades) have the greatest impact (53%, 9% and 8% of emissions respectively). Removed elements account for 4% of the emissions. In comparison with the thresholds of the E+C- experiment for new buildings, the Wavrin project easily reaches level CARBON 2.

Total energy consumption

All contributors (kWhep/m²SDP)

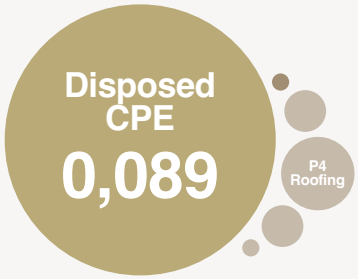


= E_{NRJ} total : 17 257 kWhep/m² SDP

The total primary energy consumption is mainly due to the consumption of RT (thermal regulation) and non-RT energy (81%) and the Construction Products and Equipments contributor (17%). This building is less efficient in terms of energy over its life cycle than a new RT 2012 building according to the median values of the HQE Performance 2012 test (+44%).

Resource Depletion

Construction Products & Equipments (kg eq. Sb/m²SDP)



= E_{ADP} PCE : 0,094 kg eq. Sb

Only 46% of the data used for this modelling included the resource depletion indicator. So, the results should be dealt with carefully. Here, the depletion of non-fossil abiotic resources is mainly due to deposed elements. The sanitary facilities account 95% of the impact.

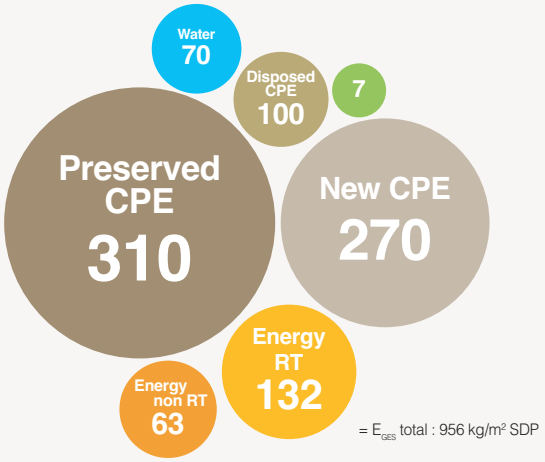
New building marker

- HQE Performance 2012 median value for new homes: 11 968 kWep/m² SDP.

The indicator «non-fossil abiotic resources» encompasses natural non-renewable non-energy resources. The more the resource is considered scarce and exploited, the higher the value of the indicator.

Waste

Non-hazardous waste (kg/m²SDP)



= E_{GES} total : 956 kg/m² SDP

Comparative data/new buildings
Mean value for collective housing, HQE performance 2012
3777 kg/m² SDP

Hazardous waste (kg/m²SDP)

= E_{GES} PCE : 535 kg/m² SDP

Operative energy
- RT (thermal regulation)
- non RT (other uses)

Construction Products & Equipments
- New
- Disposed
- Preserved

Other contributors
- Building site
- Water

In terms of non-hazardous waste, Construction Product and Equipment represent 71%, half of which is due to the impact of retained or preserved Construction Products and Equipment (17 years to be amortized for reference lifetime ≥ 50 years) not amortized. The energy contributor (RT and non-RT) also has a significant impact, accounting for 21% of the impacts. The water contributor represents 7% and the construction work contributor is considered as nil. This building generates almost 4 times less non-hazardous waste than a new construction in total life cycle according to the results of the 2012 HQE Performance test. In terms of hazardous waste, the Construction Products and New Equipment contributor produces 96% of hazardous waste. Technical packages 8 (HVAC) and 10 (energy network) generate the most hazardous waste.

GLOSSARY

Carbon energy experimentation / E+C- experimentation:
The «Carbon Energy» experimentation (or E+C- experimentation) is a French environmental label and methodology which aims to assess energy performance and whole-life cycle carbon footprint of buildings. It was first developed for new buildings in order to prepare the new Environmental Regulation (RE2020) which will be released in 2021. More information can be found in the dedicated French website (batiment-energiecarbone.fr).

SDP (surface de plancher):
Floor area

Embodied energy:
Amount of energy consumed during the life cycle of a material or product: design, extraction of raw materials, processing, manufacturing, transport, implementation, maintenance and finally recycling. Only the energy consumed during the use phase is not counted.

RT:
French Thermal Regulation

INIES database:
French reference Database (for environmental and health product and equipment data) can be used in the context of the renovation LCA.

CPE or element:
Construction Products and Building Equipment.

FDES or EPD:
EPD = Environmental Product Declaration.
FDES is the French equivalent of EPDs.
FDES stands for Environmental and Health Product Declarations (FDES = Fiche de Déclaration Environnementale et Sanitaire). FDES include health indicators as well as environmental ones.

The 13 batches of construction products and equipment for a building:

1 VRD (roads and various networks)
2 Foundations and infrastructure
3 Superstructure - Masonry
4 Roofing - Waterproofing - Structural work - Zinc plating
5 Bulkhead - Lining - Suspended ceilings - Interior joinery
6 Facades and exterior joinery
7 Floor, wall and ceiling coverings - Screed - Paints - Decoration products
8 HVAC (Heating - Ventilation - Cooling - Domestic Hot Water)
9 Sanitary facilities
10 Energy networks (heavy current)
11 Communication networks (low current)
12 Lifts and other internal transport equipment
13 Local power generation equipment

Another batch is also considered: Refrigerant Fluids

READ MORE

E+C- EXPERIMENT

Visit the French E+C- standard website (FR)
http://www.batiment-energiecarbone.fr

LCA GUIDE

Read the practical guide to assess environmental performance of renovated buildings (EN/FR)

FIRST OBSERVATIONS

Read the first observations report for renovated buildings taking into account circular economy & E+C- (FR)

METHODOLOGY

Read the E+C- standard addendum to perform LCA for renovated buildings (FR)

DATABASE

Visit the French INIES database (FR)
https://www.inies.fr

CASE STUDIES

Read the detailed case studies reports for renovated buildings taking into account circular economy & E+C- (FR) (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

Alliance HQE-GBC France is the alliance of professionals for a sustainable quality of life. It brings together unions, professional federations, companies, local authorities, and professionals. Buildings, urban planning and infrastructure through all stages of their life cycle – construction, operation, renovation – are at the core of its DNA, in an all-encompassing vision combining quality of life, respect of the environment, economic performance and responsible management. Thanks to its voluntary initiatives in France and abroad, the alliance acts for the general interest to innovate, increase knowledge, disseminate best practice and represent the buildings sustainability sector. Alliance HQE-GBC is the French member of the World Green Building Council (World GBC), a global network of sustainable building professionals in more than 74 countries.

AIA Environnement is a project management company bringing together teams of multidisciplinary staff (Architects / Engineers / Urbanists) which rely on the expertise of the AIA Life Designers organisation. AIA Environnement is also a member of the Alliance and has been following the Alliance's work on renovation since the beginning. Because sustainable development and life cycle are closely linked together, AIA Environnement supports the stakeholders of a project from the planning phase through to its implementation and operation.

Redevco is a retail and residential real estate investment management company. It acquires, develops, and manages real estate investments. Retail has always been Redevco's main investment focus, with currently more than 300 assets under management in Europe's most attractive urban retail destinations. Recently, the company has started investing in residential projects and aims to create vibrant places for people to live, work, shop, and play.

The World Green Building Council (WorldGBC) is a global action network of approximately 70 Green Building Councils (independent, non-profit organizations made up of companies and organizations working in the building and construction sector) from around the world. The WorldGBC is transforming the building and construction sector in three strategic areas - climate action, health and well-being, and resources and circularity to drive the ambitions of the Paris Agreement and UN Global Goals for Sustainable Development.

Contact
Alliance HQE-GBC
4, avenue du Recteur Poincaré - 75016 Paris
Phone: +331 40 47 02 82 - Mail: secretariat@hqegbc.org
www.hqegbc.org