NZC RENOVATION COLLABORATIVE INNOVATION PROGRAMME

Optimisation and NZC scenarios of selected generic cases

April 2022– Index B

Alliance HQE GBC France · REDEVCO FOUNDATION · AIA ENVIRONNEMENT · WORLD GREEN BUILDING COUNCIL

NZC RENOVATION PROJECT

The NZC Renovation programme aims to identify a consistent method for raising the performance of existing buildings on their entire life cycle. It is led by Alliance HQE France GBC and financed by REDEVCO Foundation . The project focuses on seven representative case studies. It aims to highlight effective levers for reducing carbon emissions on the French renovation market..

The project is made of three steps:
1. Readjusting the renovation LCA method carried out during the HQE Performance test 2017
2. Carrying out representative case studies, subject of this document, and their optimisations.
3. Drawing up a guide of good practices and carrying out an optimisation of the projects to get closer to carbon neutrality.

The objective is also to share this work throughout Europe by making available in English the methodology and the case studies carried out. This project is organised in collaboration with the World GBC which will allow communication throughout whole Europe thanks to its network and in partnership with AIA ENVIRONNEMENT, member of the Alliance which has provided its expertise in various fields and has carried out all the life cycle assessments.

Each stage aims the measurements, the effectively reduction and the growing commitment of professionals concerning emissions throughout the whole life cycle of existing constructions.

PURPOSE OF THE DOCUMENT

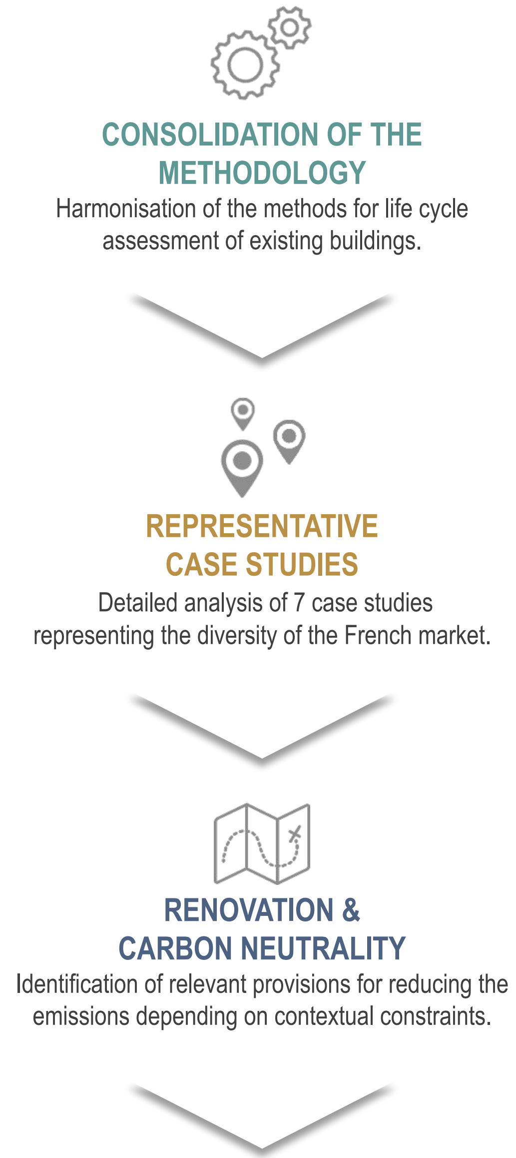
This document is part of phase 3 of the NZC Renovation programme.
Its purpose is to **present the optimisations of the life cycle assessments (LCA) carried out on the 7 projects representative** of the renovation market in **France.**

It is composed of the following three parts:

First part:
- Definition of the concept of carbon neutrality applying to renovation.
- Presentation of the methodology chosen to calibrate and optimise the seven selected generic cases.

Second part:
- An analysis of the main optimisations developed for each case study, by presenting the assumptions made and the achieved results.

Conclusion:
- A global comparative analysis with an identification of differentiated issues.
- A description of the avenues for further study.
- A glossary for non-technical and international readers.



The three steps of the NZC Renovation project

THE 7 SELECTED GENERIC CASES

Existing buildings represent a wide variety of typologies, morphologies, locations and contextual constraints. The 7 selected case studies each correspond to a representative project family that can be duplicated on the scale of the French market. Their choice was strongly motivated by this issue of representativeness. The sufficient progress of the project and the availability of specific and argued data were also sine qua non conditions to allow the LCA to be carried out.

A – INDIVIDUAL HOUSING IN SPRAWLING URBAN ENVIRONMENT

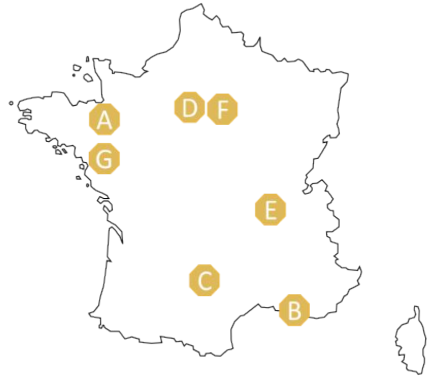
"Zero energy" renovation of 4 individual occupied housing, Chateaugiron (35)

B – LARGE HOUSING ESTATES IN SUBURBAN AREAS

Renovation of 446 collective housing units Résidence la gavotte, Septèmes-les-Vallons (13)

C – ANCIENT HERITAGE BUILDINGS IN MEDIUM SIZED TOWN CENTERS

Refurbishment of 9 housing units and a shared area, Rodez (12)



D – LARGE UNITARY URBAN AREA TO BE REFURBISHED IN THE HEART OF THE CITY

Goujon new head office, Paris (75)

E – INDUSTRIAL HERITAGE IN REGENERATED WASTELAND

H7, French Tech "Totem space", Lyon (69)

F – MAJOR RENOVATION FOR RECENT CORPORATE REAL ESTATE

IBOX tower, Paris (75)

G – URBAN GROUND FLOOR TO BE ACTIVATED

Wigwam office, retail space in a historical building ground floor, Nantes (44)

LCA METHODOLOGY USED

The methodology used for the study is that described in the LCA Renovation methodological guide of the Alliance HQE (initially published in 2018 and released in June 2020 in English version). This method based on static LCA has the following singularities:

- Taking retained elements into account, with depreciation corresponding to the age of the component in relation to the standard service life.
- Taking removed items into account.
- Methodology taking reused materials into account, where appropriate.

This methodology was adapted according to the feedbacks from the project. In particular, we noted, in the LCA renovation guide, that the depreciation of CPEs with a service life of more than 50 years is subject to several interpretations.

The guide mentions following points:

- The depreciation calculation suggests taking into account the reference service life of CPEs, as denominator.
- As soon as the renovation is carried out after 50 years, all the materials are depreciated, even if the RSL of the product is greater than 50 years.

However, in the calculation, this creates a threshold effect for the impact of materials with a RSL of 100 years. Indeed, their depreciation in the 49th year is 49/100 and in the 50th year they are considered to be depreciated.

We have therefore proposed to rectify the depreciation calculation in order to limit the threshold effect by proposing the following addition:

A = CPE Remaining Service Life / min (CPE Reference Service Life; Building Service Life)

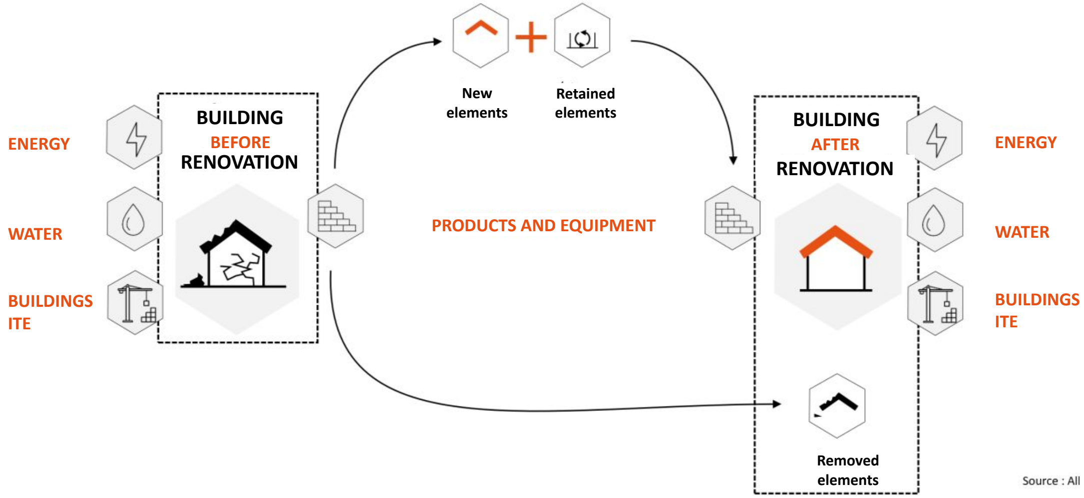


Figure representing the LCA Renovation methodology –LCA Renovation Guide Alliance HQE GBC

Depreciation calculation of a CPE [in %]:

$$A = \frac{\text{Remaining Service Life}}{\text{Reference Service Life (RSL)}}$$

Example for the case of option1:

Lets consider an element having a RSL* of 30 years. The renovation taking place after 20 years, the product has not paid all of its environmental debts. Its remaining service life is therefore 10 years. It will have to depreciate 1/3 of the impacts of the CPE (10/30) over the next life cycle.

***RSL:** Reference Service Life mentioned in the FDES and PEP

LCA Renovation Guide – Depreciation – LCA Renovation Guide Alliance HQE GBC

DEFINITION OF THE CARBON NEUTRALITY APPROACH

Three types of emissions come into play when we want to talk about carbon neutrality:

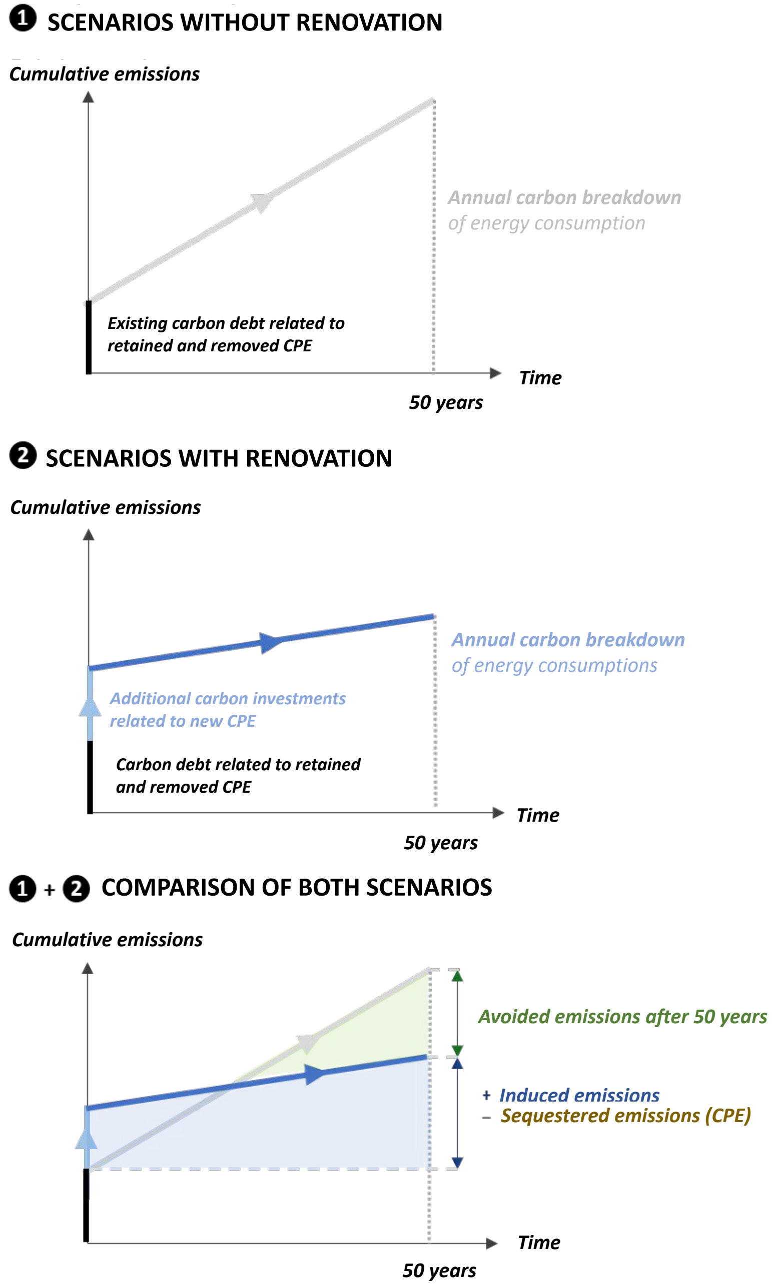
- **Induced emissions** related to energy consumption of the renovated building (all uses) and those related to life cycle phases of the construction products and equipment used in the renovation.
- **Avoided emissions**: actions allowing to reduce GHG emissions. In the context of renovation, it designates the effective reduction of emissions before / after action (without renovation / with renovation).
- **Sequestered emissions** (or negative) corresponding to the carbon drawn from the atmosphere and then stored in natural sinks (forests, soils, etc.) or technological sinks (BECCS for example). In LCA, they can mainly be recovered by using bio-sourced materials in new CPEs or by creating green spaces. They therefore reduce induced emissions.

The carbon neutrality approach is therefore built on three pillars:

1. **The reduction of induced emissions in the perimeter.** It is the heart of the optimisation work presented in this report (***E, ghg,tot)***
2. **The contribution to an effective reduction of emissions:** we foremost consider the reduction linked to the renovation (before/after).
3. **The contribution to an increase of carbon sinks:** this component is relatively low in the strict perimeter of each project, due to the gap between the sequestration potential of the available open ground spaces + renovation materials, and the carbon footprint of the renovation over 50 years. It is therefore considered insignificant at this built scale.

Carbon neutrality approach

Minimise induced emissions
Maximise avoided emissions
Maximise sequestered emissions

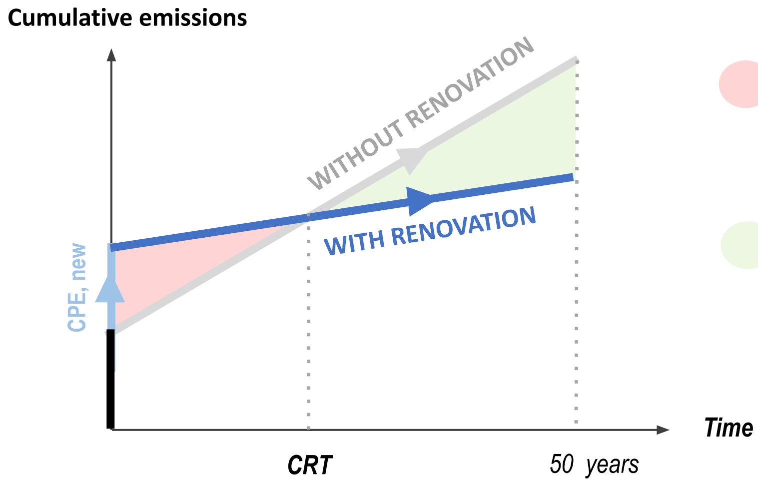


NOTION OF CARBON RETURN TIME

In the context of renovation, the concept of neutrality can be illustrated by the "carbon return time" indicator which represents the effort/gain ratio (induced emissions including those of sequestered/avoided emissions).

It corresponds to the time needed for the savings of resources generated by the renovation in operation to compensate the initial investment in construction products and equipment.

The carbon neutrality approach applied to the NZC project therefore consists primarily in **reducing as much as possible the carbon return time.**



***If t < CRT**, carbon investment in the renovation is not yet compensated by the savings in operation.*

***If t > CRT**, carbon investment in the renovation is compensated and the renovation begins to generate global savings.*

Gross carbon return time *

$$\frac{50 \cdot Eghg_{CPE,NEW}}{Eghg_{ENERGY,BEFORE} - Eghg_{ENERGY\ TOT.}} \approx \frac{\text{RENOVATION EFFORT *}}{\text{GAIN IN OPERATION}}$$

OPTIMISATION AND CALIBRATION METHOD OF THE PROJECTS

3 PERFORMANCE LEVELS →

↓ 3 OPTIMISATION FIELDS

Building products & equipment

The modification of the choice of materials only concerns new materials. If the product is entered with a DED in the project, we keep the same type of data in the "base" and "optimisation" scenarios in order to limit the influence of this parameter (the default data is greatly increased).*

** Default environmental data*

Performance of the envelope

This field includes optimisations on the entire envelope of the project to reduce heating and cooling consumption. It incorporates the insulation level and bioclimatic design elements.

Systems and energy sources

This field queries the energy efficiency strategies of the systems and the use of low-carbon energy sources.

	BASE	PROJECT	OPTIMISATION
	The reference level to meet regulatory requirements without any particular effort on carbon.	*The level of the project as it was designed: represents the current state of the art in terms of low-carbon design.*	*The highest level achievable by integrating the reduction levers deemed to be realistic on the project.*
Building products & equipment	• 100% of the retained undepreciated items are removed (excluding structure and programmatic modifications) and replaced by a new product • Choice of degraded new materials • Modification of technical equipment depending on the defined energy source	• Materials and equipment corresponding to the architectural and technical writing of the project	• 100% of the Removed items are kept and cancellation of new replacement CPEs (excluding lining, joinery and programmatic modifications) • Choice of optimised new materials • Modification of technical equipment depending to the defined energy source
Performance of the envelope	**1st SOLUTION** The project has a RT calculation • Reference UBAT • Reference PEC **2nd SOLUTION** The project has no RT calculation • Calculation of regulatory UBAT (case-by-case) • Estimation of heating consumptions	• RT calculation • DEP • Dynamic thermal simulation • Energy follow-up	**1st SOLUTION** The project has a RT calculation • Reference PEC - 40% • BBC EFFINERGIE RÉNO level **2nd SOLUTION** The project has no RT calculation • Heating consumptions (base) - 40%
Systems and energy sources	• Degradation of heating and/or cooling systems (increase of emission factors and yield reduction).	• Energy sources in line with the project	• Optimisation of heating/cooling systems

5 LOW-CARBON LEVERS

TACTICITY

This concept consists of targeting the work to be done to improve performance while preserving as much as possible the heritage, both architectural and environmental, of the existing building: maximizing the use value over the long term while minimising the use of unnecessary materials. It combines the strategies of sobriety and frugality by integrating the contextual constraints linked to the renovation.

CIRCULARITY

This lever consists firstly in maximising the reused part of existing materials by favouring in situ or nearby reuse. Then, it focuses on strategies for recycling and recovering materials by minimizing the degree of transformation.

MATÉRIALITY

Materiality relates to the choices concerning the new materials and construction products that will be integrated in the renovation operation. It questions the issues of constructive diversity, reinterpretation of traditional know-how and maintaining hygrothermal operation.

TECHNICITY

This lever focuses more specifically on reducing emissions related to technical systems. It consists of finding the right balance between a "low-tech" approach, the reduction of emissions in operation linked to performance and a satisfactory level of comfort.

EXTERNALITY

This lever questions the opportunity, for any renovation operation, to generate indirect positive impacts on its host area: synergy or pooling with neighbours, contributions of low-carbon urban services, compensation dynamics for the benefit of nearby natural or built environments.

TACTICITY
Preserve the existing building
No unnecessary material
Review use value

CIRCULARITY
In-situ, ex-situ reuse
Selective deconstruction
Recovery of resources

MATERIALITY
Constructive diversity
Eco-materials adapted to the renovation

TECHNICITY
Low-tech design
Digital discernment
The right technology in the right place

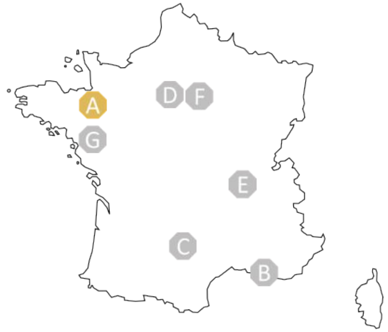
EXTERNALITY
Sharing and pooling with neighbours
Compensation with positive externalities in the urban area

Find a detailed and illustrated representation of the 5 low-level carbon levers in the __dedicated booklet__

02

OPTIMISATION BY PROJECT

A - INDIVIDUAL HOUSING IN SPRAWLING URBAN ENVIRONMENT - PROJECT SHEET



ZERO ENERGY RENOVATION OF 4 INDIVIDUAL OCCUPIED HOUSES

CHATEAUGIRON (35)

Actors	VINCI-CONSTRUCTION
Construction date	1993
Programmation	4 individual houses
Area par function	T2 : 51m² T3 : 66m²
Number of storeys and car park	Ground floor house
Nature of work	Thermal renovation
Cost estimation	Around 400 000 € before tax excluding options
Planning	Notification 31 July 2018 5 months of conception all BT Start of work: 04 February 2019 Inauguration: 13 March 2019 Contractual delivery: 27 May 2019
Specific constraints	Asbestos and in use renovation
Other specificities	**Energie Sprong method** Zero energy target = 0 averaged over the year Performance commitment

OPTIMISATION BY PROJECT

A - INDIVIDUAL HOUSING IN SPRAWLING URBAN ENVIRONMENT - ASSUMPTION SHEET -

Carbon exemplarity +

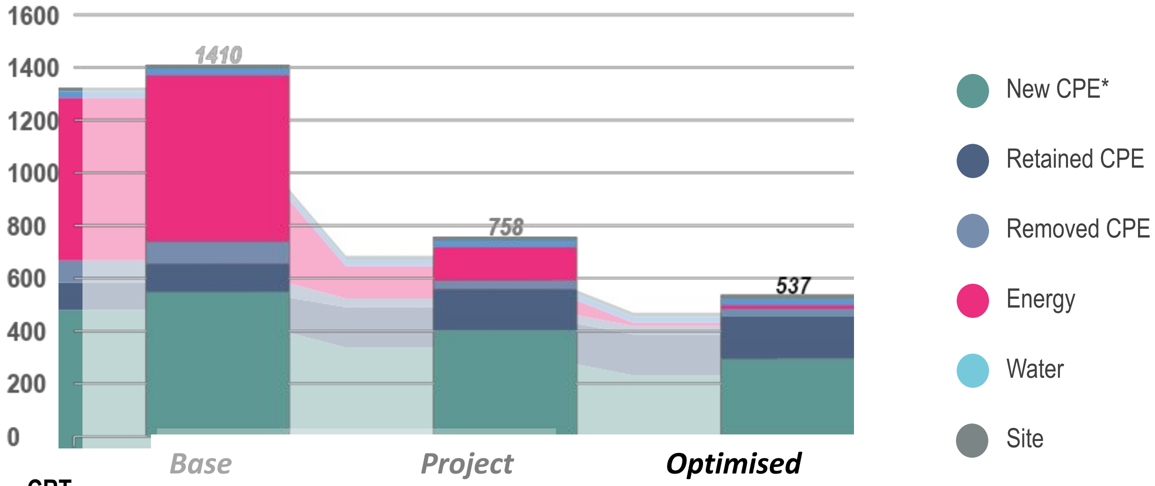
		BASE	PROJECT	OPTIMISATION
CPE	*Roads and networks, structure, joinery*	• Network renovation • Structural addition with degraded concrete (energy module extension) • Roof rafter renovation • Steel roof covering • New rain water pipes	• Retained network • Structural addition with standard concrete (energy module extension) • Retained roof rafter • Steel roof covering • Retained rainwater pipes	• Retained network • Structural addition with optimised concrete (energy module extension) • Retained roof rafter • Slate roof covering • Retained rainwater pipes
CPE	*joinery, finishing*	• New partitions • New interior doors • New interior lining • Glass wool ETI + steel cladding • New plaster ceiling • PVC joinery + new shutters • New tiling	• Retained partitions • Retained doors • Retained interior lining • Glass wool ETI + steel cladding • Retained plaster ceiling • Retained PVC joinery + shutters • Retained tiling	• Retained partitions • Retained doors • Retained interior lining • Bio-sourced wool ETI + wood cladding • Retained plaster ceiling • Retained PVC joinery + shutters • Retained tiling
CPE	*Technical batches*	• Gas boiler	• Heat pump • PV 4650 Wc	• Wood stove • PV 4650 Wc
ENERGY	*Performance of the envelope*	• Regulatory UBAT • Heating = 33 kWh FE / m² / year	• UBAT = 0,364 • Heating = 18 kWh FE / m² / year	• Heating = 18 kWh FE / m² / year
ENERGY	*Efficiency and energy production*	• Gas heating EF = 243 g C02 / KWh	• Electric heat pump EF = 210 g C02 / KWh • PV 4650 Wc	• Wood stove EF = 46 g C02 / KW • PV 4650 Wc

02 OPTIMISATION BY PROJECT

A - INDIVIDUAL HOUSING IN SPRAWLING URBAN ENVIRONMENT - RESULT SHEET

POTENTIAL OF GLOBAL EMISSION REDUCTION

kg eq CO2 / m² for 50 years

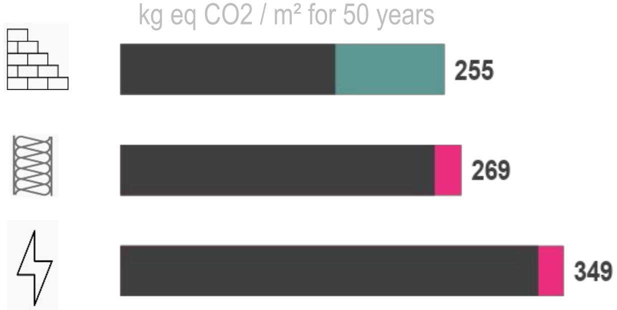


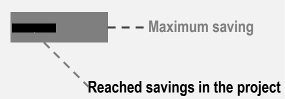
CRT

18 years -------- 10 years -------- 07 years ---->

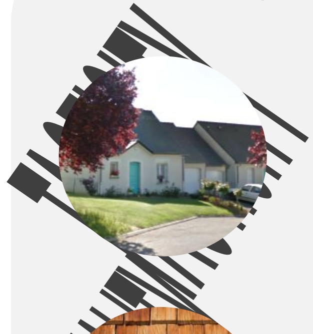
SAVING BREAKDOWN

kg eq CO2 / m² for 50 years





ZOOM ON SOME LEVERS



kg eq CO2 / m² for 50 years

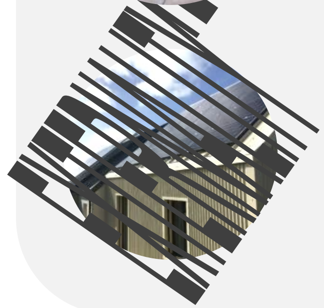
The retained elements (excluding the structure) allow significant saving compared to their replacement within the framework of the renovation.

kg eq CO2 / m² for 50 years

Preferred use of wood for exterior cladding and choice of bio-sourced insulation (wood wool).

kg eq CO2 / m² for 50 years

Choice of a less emitting refrigerant for the heat pump (R513 A instead of R134 A).

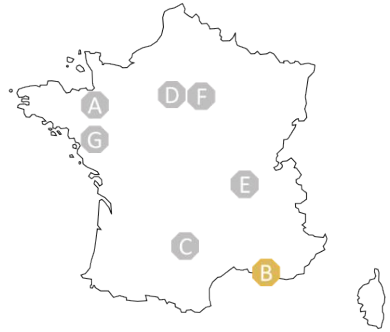


kg eq CO2 / m² for 50 years

Installation of photovoltaic panels on the roof of the housings.

02 OPTIMISATION BY PROJECT

B - LARGE HOUSING ESTATES IN SUBURBAN AREAS - PROJECT SHEET



RENOVATION OF 446 COLLECTIVE HOUSING UNITS RÉSIDENCE LA GAVOTTE

PEYRET, SEPTÈMES-LES-VALLONS (13)

Actors	VILOGIA / BOUYGUES-CONSTRUCTION
Construction date	1971
Programmation	Collective housing
Area per function	38230,2 m² floor area
Number of storeys and car park	14 Buildings: - 2 towers N +15 - 1 tower N+17 - 2 buildings N+8 - 9 buildings N+4 Surface parking space
Nature of work	Energy refurbishment while the site is in use (insulation, window replacement, ventilation…)
Cost estimation	14,63 M €
Planning	Start of work: March 2019 Delivery: 2021
Specific constraints	Occupied site
Other specificities	BBC Renovation NF Habitat BDM label Bronze level

02 OPTIMISATION BY PROJECT

B - LARGE HOUSING ESTATES IN SUBURBAN AREAS

ASSUMPTION SHEET (building L)

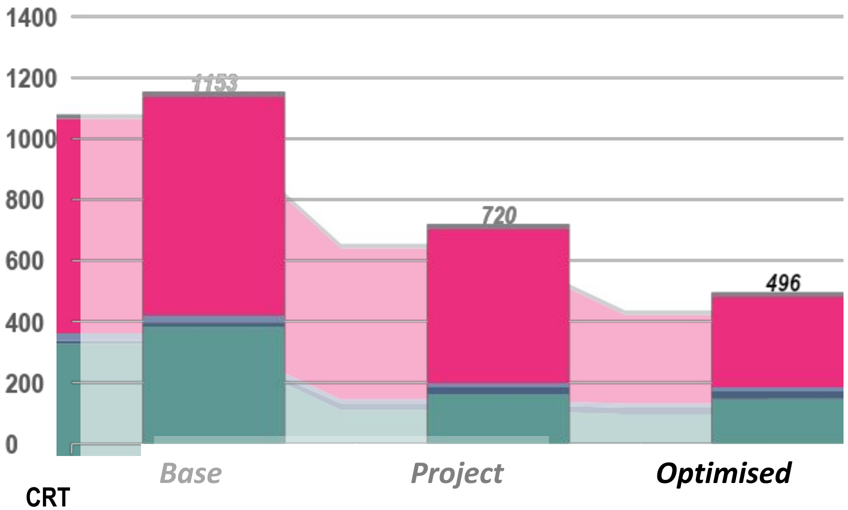
Carbon exemplarity - → +

		BASE	PROJECT	OPTIMISATION
CPE	*Roads and networks, structure, masonry*	• New networks (Fresh water, RW/WW) • New asphalt roads • No structural recovery • New roof waterproofing • New roof gravels • New steel coping	• Retained networks (Fresh water, RW/WW) • Retained asphalt roads • No structural recovery • New roof waterproofing • Retained roof gravels • Retained aluminium coping	• Retained networks (Fresh water, RW/WW) • Retained asphalt roads • No structural recovery • Retained roof waterproofing • Retained roof gravels • Retained aluminium coping
CPE	*Lining, joinery, facades, finishing*	• New partitions • New interior lining • New interior ceiling • New railing • Without ETI • Aluminium cladding over ETI • New tiling	• Retained partitions • Retained interior lining • Retained interior ceiling • Retained railing • PU / stone wool ETI • Polycarbonate cladding over ETI • Retained tiling	• Retained partitions • Retained interior lining • Retained interior ceiling • Retained railing • Wood fibre ETI • Wood cladding over ETI • Retained tiling
CPE	*Technical batches*	• Gas boiler (power 321 kW)	• Gas boiler (power 321 kW)	• Heat exchanger for urban heating network (power 436 kW) • PV (coverage rate 65% of the roof= 49 kWc)
ENERGY	*Performance of the envelope*	• Regulatory UBAT degradation with case-by-case values • +53% higher heating consumption = 15,7 kWh FE / m² / year	• Positive energy building renovation 2009 habitat • UBAT = 0,733 (building L) • Heating = 10,2 kWh FE / m² / year	• Heating= 9,2 kWh FE / m² / year
ENERGY	*Energy efficiency and production*	• Gas heating EF = 243 g C02 / KWh	• Gas heating EF = 243 g C02 / KWh	• Urban heating network EF = 100 g C02 / KWh • Roof photovoltaic integration 49 kWc

B - LARGE HOUSING ESTATES IN SUBURBAN AREAS (building L) - RESULT SHEET

POTENTIAL OF GLOBAL EMISSION REDUCTION

kg eq CO2 / m² for 50 years



- New CPE*
- Retained CPE
- Removed CPE
- Energy
- Water
- Site

CRT

22 years ---------- 08 years ---------- 06 years ---->

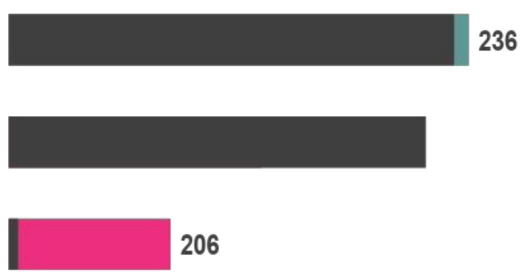
SAVING BREAKDOWN

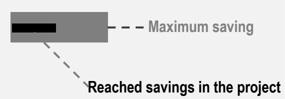
kg eq CO2 / m² for 50 years

Material and equipment

Performance of the envelope

Energy source





ZOOM ON SOME LEVERS

kg eq CO2 / m² for 50 years

Preservation of the steel copings of acroteria and railings.

kg eq CO2 / m² for 50 years

Preferred use of wood for joinery and facade cladding

kg eq CO2 / m² for 50 years

Choice of non-motorized rolling shutters.

kg eq CO2 / m² for 50 years

Use reused or second hand mixers for sink and showers.

C - ANCIENT HERITAGE BUIDLINGS IN MEDIUM SIZED TOWN CENTERS - PROJECT SHEET

REFURBISHMENT OF 9 HOUSING UNITS AND A SHARED AREA
RODEZ (12)

Project owner	UES HABITER 12
Project manager	SOLIHA (Aveyron)
Construction date	"Renaissance" (XIV et XVII centuries)
Programmation	- 9 social housings for people with disabilities or reduced mobility. 2 with severe disabilities - Collective area (help services to disabled persons)
Area per function	Total area= 430.7 m² Collective area= 115.60 m²
Number of storeys and car park	N+3 +1 level (heating system and cellar)
Nature of work	Heavy renovation : - Asbestos removal - Space restructuration - Wood floor structural consolidation
Cost estimation	800 000.00 € before tax
Planning	Construction permit: March 2018 TD: May 2018 Work start: September 2018 Delivery date: December 2020
Old assignment	Building 10 housings with avec 2 commercial areas Property of CCAS de Rodez
	- Heritage building: ABF - Presence of asbestos - Disabled accessibility standard
Other specificities	BBC Effinergie RénovationLabel

02 OPTIMISATION BY PROJECT

C - ANCIENT HERITAGE BUIDLINGS IN MEDIUM SIZED TOWN CENTERS

ASSUMPTION SHEET

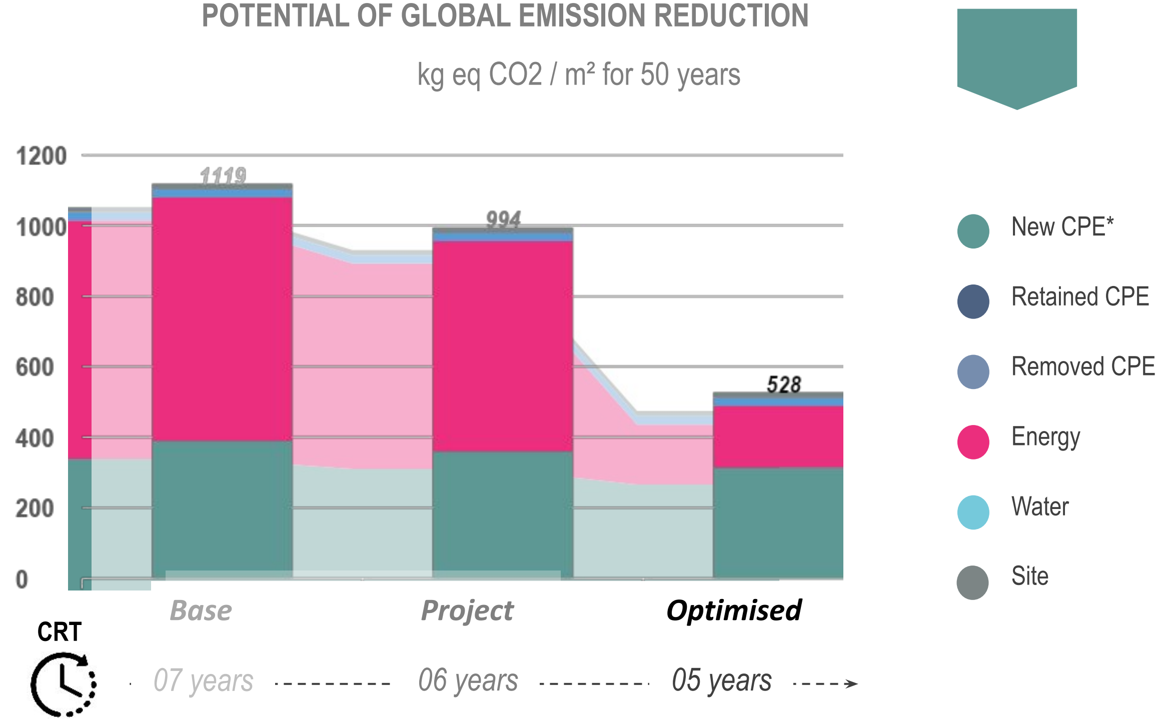
Carbon exemplarity - +

		BASE	PROJECT	OPTIMISATION
CPE	*Roads and networks, structure, masonry*	• Interior courtyard – asphalt • Structural recovery with degraded concrete • Wooden framework refurbishment • Roof covering refurbishment	• Interior courtyard – paved • Structural recovery with standard concrete • Retained wooden framework • Retained roof covering	• Interior courtyard – wood deck • Structural recovery with optimised concrete • Retained wooden framework • Retained roof covering
CPE	*Lining, joinery, facades, finishing*	• New partitions • PU ITI • New interior ceiling • Polyurethane ETI • Aluminium veranda • Tiling	• New partitions • Glass wool ITI • New interior ceiling • Polyurethane ETI • Aluminium veranda • Tiling + PVC	• Partially retained partitions • Bio-sourced wool ITI • Retained interior ceiling • Wood fibre ETI • Wood veranda • Tiling + wood parquet
CPE	*Technical batches*	• Gas boiler (power 60 kW)	• Gas boiler (power 60 kW)	• Collective heat pump (power 20 kW) with external module installed in the courtyard of the building or roof space.
ENERGY	*Performance of the envelope*	• Regulatory UBAT • Heating = 42,1 kWh FE / m² / year	• UBAT = 0,33 • Heating = 36,3 kWh FE / m² / year	• Heating = 25 kWh FE / m² / year
ENERGY	*Energy efficiency and production*	• Has heating EF = 243 g C02 / KWh	• Has heating EF = 243 g C02 / KWh	• Electric EF = 210 g C02 / KWh

C - ANCIENT HERITAGE BUIDLINGS IN MEDIUM SIZED TOWN CENTERS - RESULT SHEET

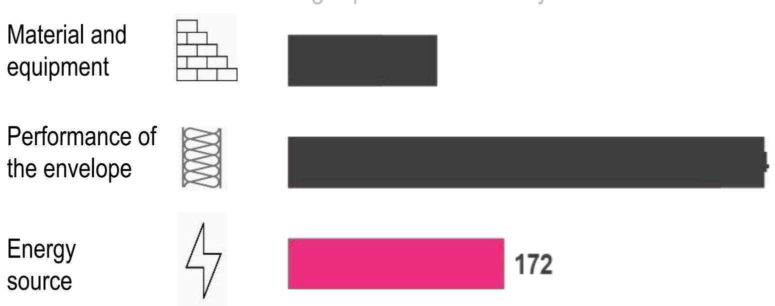
POTENTIAL OF GLOBAL EMISSION REDUCTION

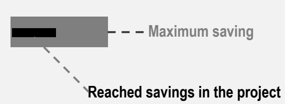
kg eq CO2 / m² for 50 years



SAVING BREAKDOWN

kg eq CO2 / m² for 50 years





ZOOM ON SOME LEVERS

kg eq CO2 / m² for 50 years

Provide a degree of insulation of the opaque walls going beyond the threshold value of the thermal regulation (case by case) by limiting the thermal bridges linked to fixings.

-29 kg eq CO2 / m² for 50 years

Use of wooden parquet (excluding damp rooms) as alternative to a 100% tiling solution..

kg eq CO2 / m² for 50 years

Choice of recycled interior paint.

kg eq CO2 / m² for 50 years

Hypothesis of reducing the carbon weight of plumbing equipment: DHW tank and mixers by comparative analysis and specific approach carried out with manufacturers (-30%*).

* Ratio linked to AIA feedbacks

02 OPTIMISATION BY PROJECT

D – LARGE UNITARY URBAN AREA TO BE REFURBISHED - PROJECT SHEET

BUILDING JEAN GOUJON
PARIS (75)





Actor	COVIVIO
Construction date	1931 (Haussman type)
Programmation	Office
Area per function	9165 m²
Number of storeys and car park	N+8 including: - Ground floor : welcome area, business center et meeting spaces, - 7 office floors partially in coworking - 8th floor canteen with green roof terrace (accessible to persons with reduced mobility) 23 Basement car park
Nature of work	Office restructuration
Cost estimation	27 M €
Planning	Construction permit: November 2018 Demolition work: March to June 2019 Project TD: March 2019 Renovation work: January 2020
Specific constraints	Project in a heritage area, subject to ABF approval Paris stormwater management Flood area: PPRI Specific vegetation constraints: UG zone (Vegetal enhancement zone)
Other specificities	Certifications HQE BD 2016 Excellent BREEAM RFO 2015 Excellent, OsmoZ BiodiverCity, R2S 1 star

02 OPTIMISATION BY PROJECT

D – LARGE UNITARY URBAN AREA TO BE REFURBISHED – ASSUMPTION SHEET

Carbon exemplarity: - → +

		BASE	PROJECT	OPTIMISATION
CPE	*Roads and networks, structure, masonry*	• Interior courtyard asphalt refurbishment • Metal garden boxes • Structural refurbishment with degraded concrete • Standard vegetal roofing	• Retained interior courtyard roads • Metal garden boxes • Structural refurbishment with standard concrete • Standard vegetal roofing	• Retained interior courtyard roads • Wooden garden boxes • Structural refurbishment with optimised concrete • Recycled vegetal roofing
CPE	*Joinery, finishing*	• New partitions • PU ITI • New plaster ceiling • Metal false ceiling • New technical floor non sustainable wood • Aluminium pergolas and curtain walls • Carpet	• New partitions • Glass wool ITI • New plaster ceiling • Metal false ceiling • New technical floor sustainable wood • Aluminium pergolas and curtain walls • Carpet	• Partially retained partitions • Wood fibre ITI • Retained plaster ceiling • Wood false ceiling • Reused technical floor • Wood pergolas and curtain walls • Recycled carpet
CPE	*Technical batches*	• Urban heating network (needs 510 kW) • Cooling unit (power 171 kW)	• Urban heating network (needs 510 kW) • Connection to cooling network	• Urban heating network (needs 510 kW) • Connection to cooling network
ENERGY	*Performance of the envelope*	• Regulatory UBAT • Heating = 82 kWh FE / m² / year	• UBAT = 0,54 • Heating= 73 kWh FE / m² / year	• Heating = 49 kWh FE / m² / year
ENERGY	*Energy efficiency and production*	• Urban heating network EF = 240 g C02 / KWh • Cooling units EF = 65 g C02 / KWh	• CPCU EF = 166 g C02 / KWh • Climespace EF = 7 g C02 / KWh	• Urban heating network EF = 100 g C02 / KWh • Climespace EF = 7 g C02 / KWh

D – LARGE UNITARY URBAN AREA TO BE REFURBISHED - RESULT SHEET

POTENTIAL OF GLOBAL EMISSION REDUCTION

kg eq CO2 / m² for 50 years

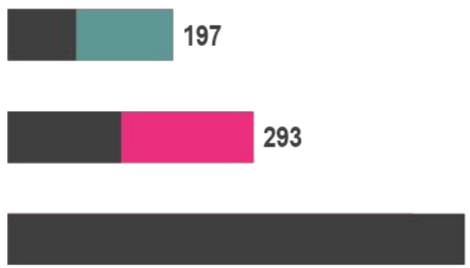
- New CPE*
- Retained CPE
- Removed CPE
- Energy
- Water
- Site

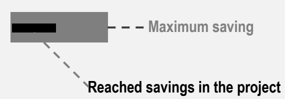
CRT

> 100 years - - - - - 53 years - - - - - 27 years - - - ->

SAVING BREAKDOWN

kg eq CO2 / m² for 50 years





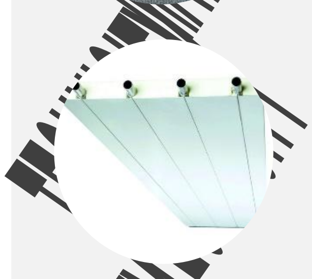
ZOOM ON SOME LEVERS

kg eq CO2 / m² for 50 years

Use reused false floors.

kg eq CO2 / m² for 50 years

Choice of recycled textile floor covering.



kg eq CO2 / m² for 50 years

Hypothesis of halving the carbon footprint of radiant panels (reuse or industrial reduction approach)

kg eq CO2 / m² for 50 years

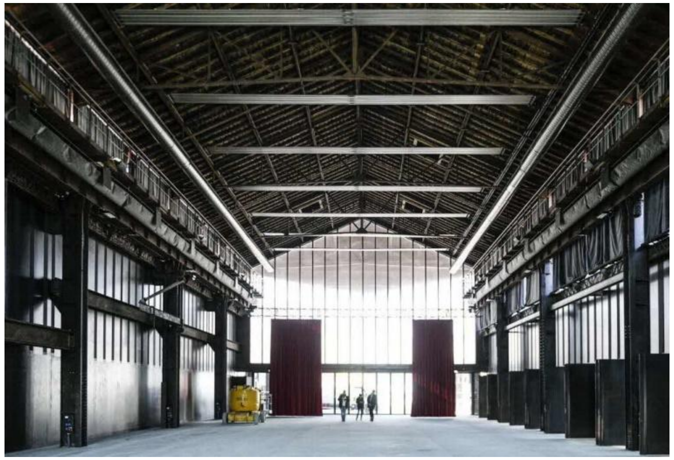
Hypothesis of halving the carbon footprint of pendant lights for indoor lighting (reuse or industrial reduction approach).

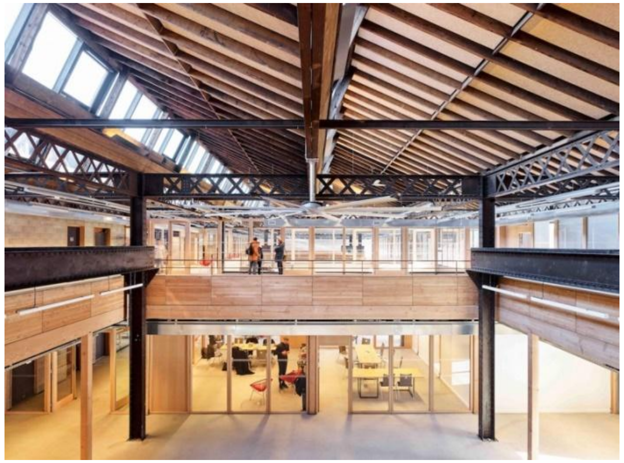
02 OPTIMISATION BY PROJECT

E - INDUSTRIAL HERITAGE IN REGENERATED WASTELAND - PROJECT SHEET

H7, FRENCH TECH "TOTEM SPACE"

LYON (69)





Actors	SPL Lyon Confluence
Construction date	1857
Programmation	Office - Digital start up hosting (French Tech) Event area in order to promote and organise start up activities for the "totem space"
Area per function	2 700 m² office 1 400 m² event
Number of storeys and car park	Workshop: R+1, 1 wooden mezzanine level
Nature of work	Heavy renovation
Cost estimation	5,8 M€ before tax
Planning	Competition: May 2015 Delivery: March 2019
Old assignment	Previous boiler making factory
Specific constraints	Geotechnical constraints Structural consolidation and replacement of the roof elements in order to ensure waterproofing
Other specificities	WWF One living Planet approach Bio-sourced materials Roof-top photovoltaic system (exportation) No active cooling: air fans and natural ventilation.

E - INDUSTRIAL HERITAGE IN REGENERATED WASTELAND – ASSUMPTION SHEET

Carbon exemplarity +

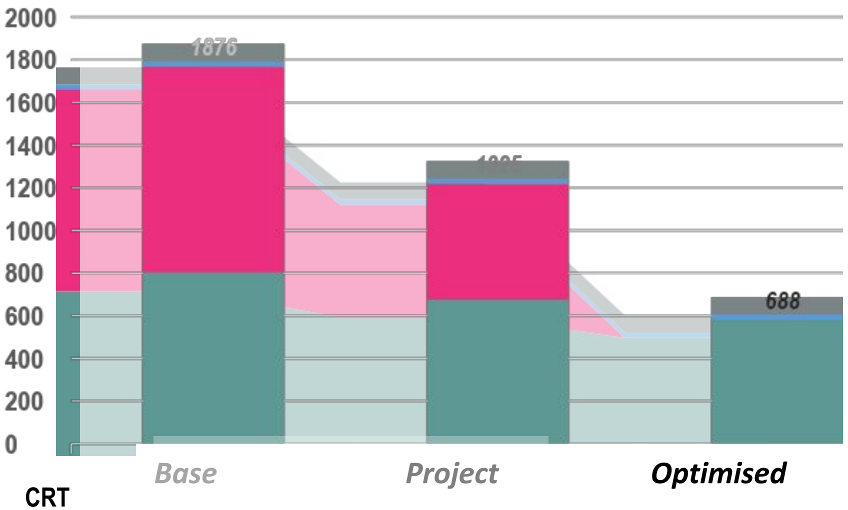
		BASE	PROJET	OPTIMISATION
CPE	*Roads and networks, structure, masonry*	• Structural refurbishment with degraded concrete • Concrete floor • Concrete beams and posts • Metal framework • Aluminium roof covering • Polyurethane insulation	• Structural refurbishment with standard concrete • Concrete floor • Concrete beams and posts • Wood framework • Clay tile roof covering • Stone wool insulation	• Structural refurbishment with optimised concrete • CLT floor • Laminated timber beams and posts • Wood framework • Clay tile roof covering • Flax, hemp and cotton wool insulation •
	Joinery, finishing	• Plaster bloc partitions • Polystyrene ITI • Glass wool ITI • Metal ceiling • Metal false ceiling • Interior metal cladding • Carpet • Solvent paint	• Plaster bloc partitions • Polystyrene ITI • Glass wool ITI • Plaster board ceiling • New technical floor sustainable wood • Interior metal cladding • Carpet • Water paint	• Raw earth partitions • Flax, hemp cotton and wool ITI • Flax, hemp cotton and wool ITI • Wood ceiling • Wood false ceiling • Interior wooden cladding • Recycled carpet • Bio-sourced paint
	Technical batches	• Heat exchanger for urban heating network (needs 410 kW) • Cooling unit (power 150 kW)	• Heat exchanger for urban heating network (needs 410 kW) • Natural ventilation and air fans	• Heat exchanger for urban heating network (needs 410 kW) • Natural ventilation and air fans
ENERGY	*Performance of the envelope*	• Regulatory UBAT = 0,53 • Heating = 47 kWh FE / m² / year	• UBAT = 0, 44 • Heating = 42 kWh FE / m² / year	• Heating = 28 kWh FE / m² / year
	Energy efficiency and production	• Urban heating network EF = 298 g C02 / KWh • Cooling units EF = 65 g C02 / KWh	• Urban heating network EF = 298 g C02 / KWh	• Urban heating network EF = 100 g C02 / KWh

02 OPTIMISATION BY PROJECT

E - INDUSTRIAL HERITAGE IN REGENERATED WASTELAND - RESULT SHEET

POTENTIAL OF GLOBAL EMISSION REDUCTION

kg eq CO2 / m² for 50 years



CRT

53 years - - - - - - - - 28 years - - - - - - - - 17 years - - - ->

- New CPE*
- Retained CPE
- Removed CPE
- Energy
- Water
- Site

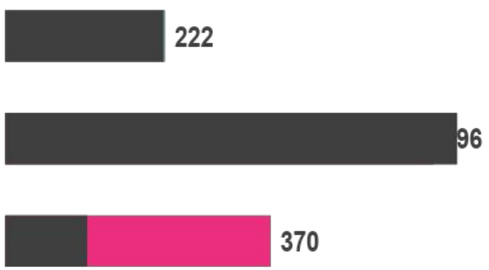
SAVING BREAKDOWN

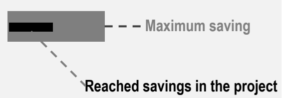
kg eq CO2 / m² for 50 years

Material and equipment

Performance of the envelope

Energy source





ZOOM ON SOME LEVERS

kg eq CO2 / m² for 50 years

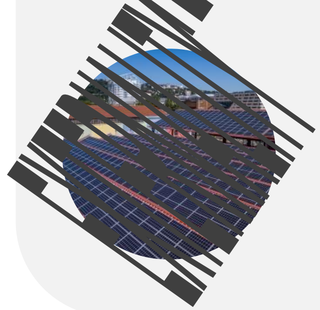
Reinforcement of the performance of the existing envelope preferred to a "box within a box" type strategy.

kg eq CO2 / m² for 50 years

Use of wood preferred to steel and concrete for the mezzanine and interior joinery.

kg eq CO2 / m² for 50 years

Implementation of a cooling strategy using air fans instead of installing a cooling unit.



kg eq CO2 / m² for 50 years

Implementation of photovoltaic panels on the roof of the sheds.

F – MAJOR RENOVATION FOR RECENT CORPORATE REAL ESTATE - PROJECT SHEET

IBOX TOWER PROJECT

PARIS (75)

Actors	TERAO / GECINA
Construction date	1973
Programmation	Core and shell office restaurant and shared company cafeteria
Area per function	20569 m² total area or 19401 m² net area 1035 m² RIE, 73 m² fitness, 300 m² business centre
Number of storeys and car park	N+17, 4 N+17, 4 underground levels. Basement car park (SS4) but not included in the renovation work
Nature of work	Heavy renovation
Cost estimation	Unknown
Planning	Construction Permit December 2015 APD PRO May 2016 TD July 2016 Work start November 2016 Delivery April 2019
Old assignment	Office
Specific constraints	Specific regulation for tower buildings (IGH) Total asbestos removal for the tower
Other specificities	- **Carbon footprint reduction " Factor 4"** strategy, from Climate Gecina roadmap 2020 - Certification NF HQE Tertiary buildings 2015 - Certification LEED BD+C GOLD - Certification WELL Core & Shell GOLD - Label BBC Effinergie 2013 - **Energy commitment: 69 kWhEF/m²/year** - Urban farming in the roof (Sous les Fraises)

F – MAJOR RENOVATION FOR RECENT CORPORATE REAL ESTATE

ASUMPTION SHEET

Carbon exemplarity +

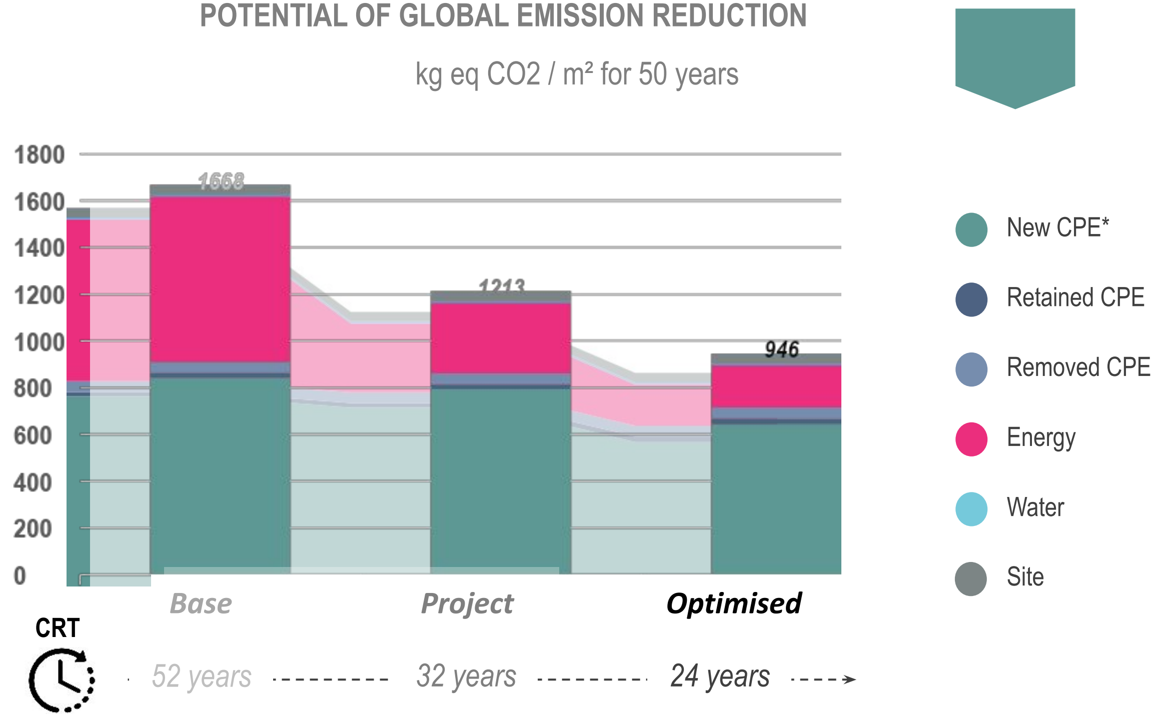
		BASE	PROJET	OPTIMISATION
CPE	*Roads and networks, structure, masonry*	• Structural refurbishment with degraded concrete • Roof waterproofing – asphalt membrane • Vegetal roofing– standard substrate • Accessible roof – concrete slabs • Aluminium railing	• Structural refurbishment with standard concrete • Roof waterproofing –PVC membrane • Vegetal roofing– standard substrate • Accessible roof – wood + grating • Steel railing	• Structural refurbishment with optimised concrete • Roof waterproofing –PVC membrane • Vegetal roofing– recycled substrate • Accessible roof – wood decking • Steel railing
CPE	*Lining, joinery, facades, finishing*	• New partitions • PU ITI • New interior ceiling • New technical floor • PU ETI • Composite glass fibre cladding • Standard carpet	• New partitions • Glass wool ITI • New interior ceiling • New technical floor • Glass wool ETI • Composite glass fibre cladding • Recycled carpet	• Partially retained partitions • Bio-sourced wool ITI • Retained interior ceiling • Retained technical floor • Wood fibre ETI • Wood cladding • Recycled carpet
CPE	*Technical batches*	• Gas boiler (power 405 kW) • Cooling unit (power 224 kW)	• Exchanger for urban heating network (needs 385 kW) • Exchanger for urban cooling network (needs 560 kW)	• Exchanger for urban heating network (needs 385 kW) • Exchanger for urban cooling network (needs 560 kW)
ENERGY	*Performance of the envelope*	• Regulatory UBAT • Heating = 49,4 kWh FE / m² / year	• BBC Effinergie 2013 • UBAT = 0,86 • Heating = 17,9 kWh FE / m² / year	• Heating = 17 kWh FE / m² / year
ENERGY	*Energy efficiency and production*	• Gas boiler EF = 243 g C02 / KWh • Cooling unit EF = 65 g C02 / KWh	• CPCU EF = 166 g C02 / KWh • Climespace EF = 7 g C02 / KWh	• Urban heating network EF = 100 g C02 / KWh • Climespace EF = 7 g C02 / KWh

02 OPTIMISATION BY PROJECT

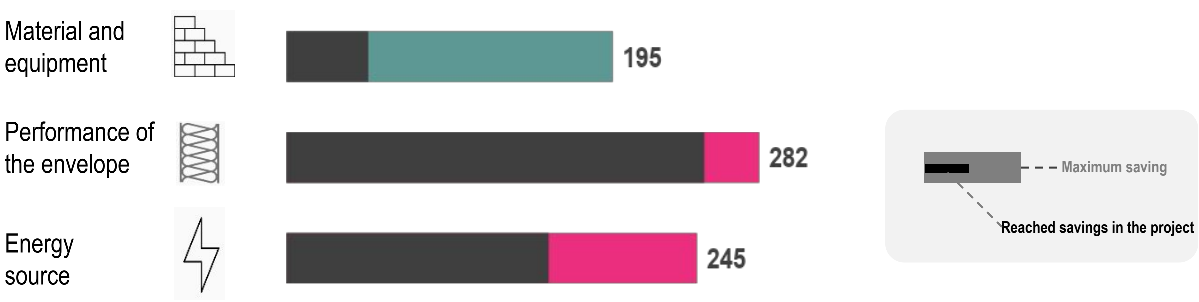
F – MAJOR RENOVATION FOR RECENT CORPORATE REAL ESTATE - RESULT SHEET

POTENTIAL OF GLOBAL EMISSION REDUCTION

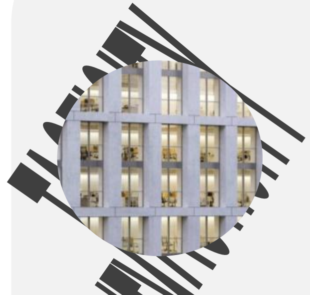
kg eq CO2 / m² for 50 years



SAVING BREAKDOWN



ZOOM ON SOME LEVERS



kg eq CO2 / m² for 50 years

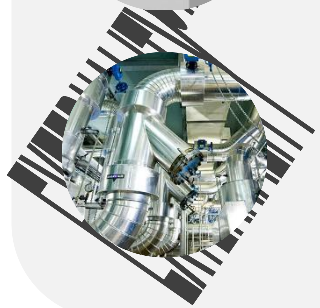
Reduction made possible by optimisation of structural refurbishment on the existing work and use of low-carbon cement on 60% of the concrete work.

kg eq CO2 / m² for 50 years

Use of mixed wood-aluminium glazed frames.

kg eq CO2 / m² for 50 years

Use of 50% recycled blinds from reuse or optimised carbon weight approach of textile blinds with the manufacturer (hypothesis of reduction by 2).

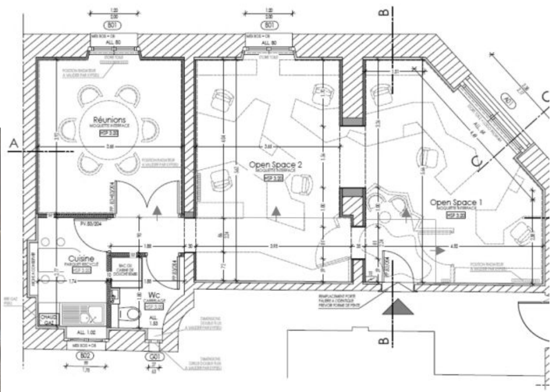


kg eq CO2 / m² for 50 years

Optimization of the RRE rate of the heating network and connection to an optimised cooling network instead of mono-block cooling units.

G - URBAN GROUND FLOOR TO BE ACTIVATED - PROJECT SHEET

WIGWAM OFFICE, RETAIL SPACE IN A HISTORICAL BUILDING GROUND FLOOR
NANTES (44)



Actors	WIGWAM - CONSEIL
Construction date	1904
Programmation	Office
Area per function	Office: 70 m²
Number of storeys and car park	N+1 (no car park)
Nature of work	Heavy renovation
Cost estimation	Unknown
Planning	2014: area acquisition 2015: work start April 2016: April 2016 : Wigwam moving in the renovated area.
Old assignment	1905-1945: grocery store 1945-1990: 1990: commercial area of a small carrier 1990-2014: office area for SNCF
Specific constraints	Located close to the Château des Ducs de Bretagne, facade interventions of the buildings are submitted to ABF (architectural heritage preservation).
Other specificities	HQE Performance test participation for Circular Economy: the project includes reuse of material and retaining part of existing material

02 OPTIMISATION BY PROJECT

G - URBAN GROUND FLOOR TO BE ACTIVATED – ASSUMPTION SHEET

Carbon exemplarity - +

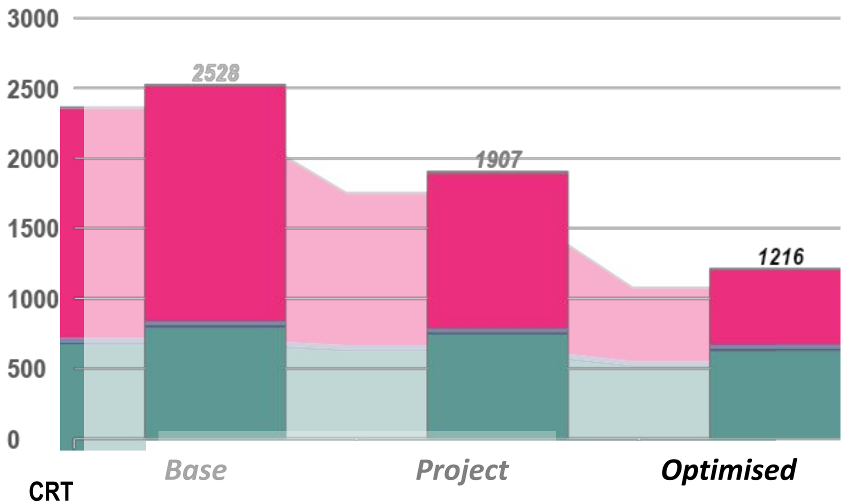
		BASE	PROJECT	OPTIMISATION
CPE	*Roads and networks, structure, masonry*	• Structural refurbishment – Steel beams and posts	• Structural refurbishment – mixed steel and wood beams and posts	• Structural refurbishment – wood beams and posts
CPE	*Lining, joinery, facades, finishing*	• Cork panel ITI (Very penalising environmental data) • Loose glass wool ITI • Aluminium window • Interior PVC lining • Mineral wool false ceiling • PVC floor covering • Solvent metallic paint	• Cork panel ITI (Very penalising environmental data) • Loose cellulose ITI • Aluminium window • Interior wood lining (Reuse cladding) • No false ceiling • Recycled carpet • Solvent metallic paint	• Flax, hemp, cotton panel ITI • Loose cellulose ITI • Mixed aluminium wood window • Interior wood lining (Reuse cladding) • No false ceiling • Recycled carpet • Water metallic paint
CPE	*Technical batches*	• Gas boiler • Water radiators	• Gas boiler • Water radiators	• Decentralised dual flow air handling unit • No radiators
ENERGY	*Performance*	• Regulatory UBAT = 1,08 (case by case) • Heating = 123 kWh FE / m² / year	• UBAT = 0,58 • Heating = 81 kWh FE / m² / year	• Heating = 53 kWh FE / m² / year
ENERGY	*Energy efficiency and production*	• Gas heating EF = 243 g C02 / KWh	• Gas heating EF = 243 g C02 / KWh	• Electric EF = 210 g C02 / KWh

02 OPTIMISATION BY PROJECT

G - URBAN GROUND FLOOR TO BE ACTIVATED – RESULT SHEET

POTENTIAL OF GLOBAL EMISSION REDUCTION

kg eq CO2 / m² for 50 years



- New CPE*
- Retained CPE
- Removed CPE
- Energy
- Water
- Site

CRT

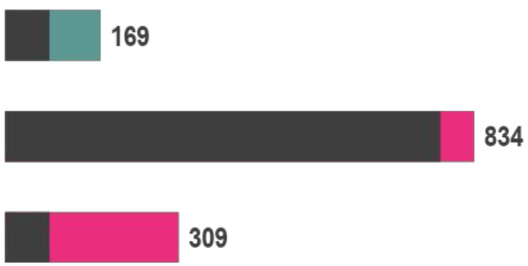
17 years -------- 13 years -------- 09 years ---->

SAVING BREAKDOWN

Material and equipment

Performance of the envelope

Energy source



ZOOM ON SOME LEVERS

kg eq CO2 / m² for 50 years

Replacement of joinery, doors and attention given to the airtightness details of the envelope.

kg eq CO2 / m² for 50 years

Preferred use of wood for vertical and horizontal structural elements.

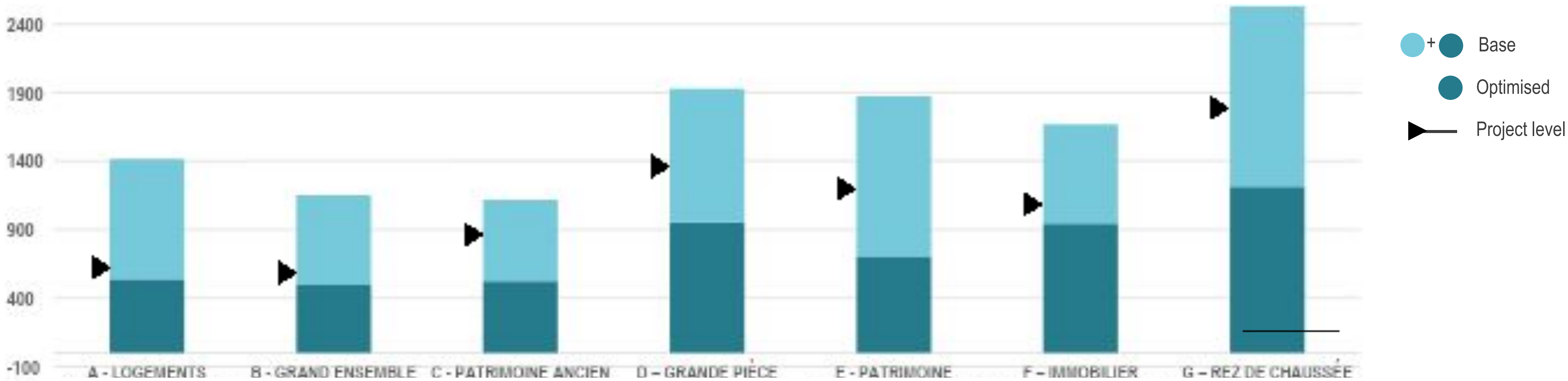
kg eq CO2 / m² for 50 years

Choice of 100% recycled carpet flooring (fishing net) instead of standard soft flooring. A reuse approach was also carried out on wall coverings (-3.5 kg eq CO2/m²) and furniture.

kg eq CO2 / m² for 50 years

Implementation of a decentralised dual-flow air handling unit with 80% efficiency energy recovery.

COMPARING THE OPTIMISATIONS – REDUCTION OF EMISSIONS



A - INDIVIDUAL HOUSING IN SPRAWLING URBAN ENVIRONMENT

B – LARGE HOUSING ESTATES IN SUBURBAN AREAS

C – ANCIENT BUILDING IN MEDIUM SIZED TOWN CENTERS

D – LARGE UNITARY URBAN AREA TO BE REFURBISHED IN THE HEART OF THE CITY

E – INDUSTRIAL HERITAGE IN REGENERATED WASTELAND

F – MAJOR RENOVATION FOR RECENT CORPORATE REAL ESTATE

G – URBAN GROUND FLOOR TO BE ACTIVATED







E, ghg,tot BASE =

E, ghg,tot OPTI =

SYNTHESIS AND PERSPECTIVES

03

COMPARING THE OPTIMISATIONS –CARBON RETURN TIME AND EFFORT BREAKDOWN







Gross carbon return time

BASE =	18 years	22 years	07 years	75 years	53 years	52 years	17 years
OPTI =	07 years	06 years	05 years	27 years	17 years	24 years	09 years

$$\frac{50 \cdot Eghg_{CPE,NEW}}{Eghg_{ENERGY,BEFORE} - Eghg_{ENERGY\ TOT.}}$$

Optimisation breakdown *Kg CO2/m²*

BASE ↓ *OPTI*

Materials

Optimisation of the envelope

Energy production

LESSONS ABOUT CARBON WEIGHT OF THE RENOVATION

We present hereafter the main lessons from the life cycle assessments carried out in the framework of the NCZ project.

LESSON N°1: CARBODIVERSITY

Prioritisation of emissions strongly varies from one case study to another. Thus, the energy impact strongly varies depending on the given possibilities concerning the intervention perimeter and the associated constraints (heritage, presence of asbestos, urban insertion...). The main contributors of construction products and equipment (CPE) are also contrasted.

For each lever, this observation invites to take into account the importance of a contextual assessment based on the singularities of the existing building.

LESSON N°2 : AFFORDABLE EXEMPLARITY

For the project panel considered, reaching the best level of the French Carbon Energy label for new buildings has been observed in most studied cases (level “Carbone 2” for 100% of the cases considering "Construction product and equipment").

Even if the exemplarity of this study should be considered, this observation shows the pertinence of a renovation, compared to demolition/reconstruction: it is possible to reach the best level of Carbon Energy label at an unbeatable price. This also invites to a soberness approach concerning the demolished parts and the extensions.

LESSON N°3: SIGNIFICANT CPE IMPACTS

Over the entire life cycle, the carbon weight of construction products and equipment of the modelled projects is in the range of 30 to 75% of the total balance. It is therefore far from being negligible, despite of the preservation of a great part of the existing structure. Promotion of renovation products and equipment with a lower carbon footprint (coming from circular economy or bio-sourced) is therefore not to be neglected in a renovation context.

LESSON N°4: NEW PRIORITIES

In the framework of the modelled projects, the fluid batches (HVAC, Electrical, Plumbing) represent a significant weight in a renovation. That’s also the case for finishing and partitioning batches which are usually considered as minor in new construction assessments (compared to the structure and the envelope). These two observations invite to go further in optimising the emissions of these contributors. They invite to a more low-tech and frugal design: question with discernment the role of the systems and eliminate unnecessary materials.

LESSON N°5: CARBON TEMPORALITY

The NZC Renovation study allowed the introduction of an indicator, the gross carbon return time of the renovation. It is defined as the time that is necessary for the reduction of emissions (linked to energy savings/carbon-free energy) to compensate the carbon investment linked to the products and equipment installed during the renovation. This indicator varies from 6 to over 70 years, depending of the carbon optimisation level of the renovation. An energy renovation is therefore not always low-carbon! This observation invites again to monitor the balance between the impact of the renovation materials and the generated carbon savings. The study also highlights the importance of changing the energy vector.

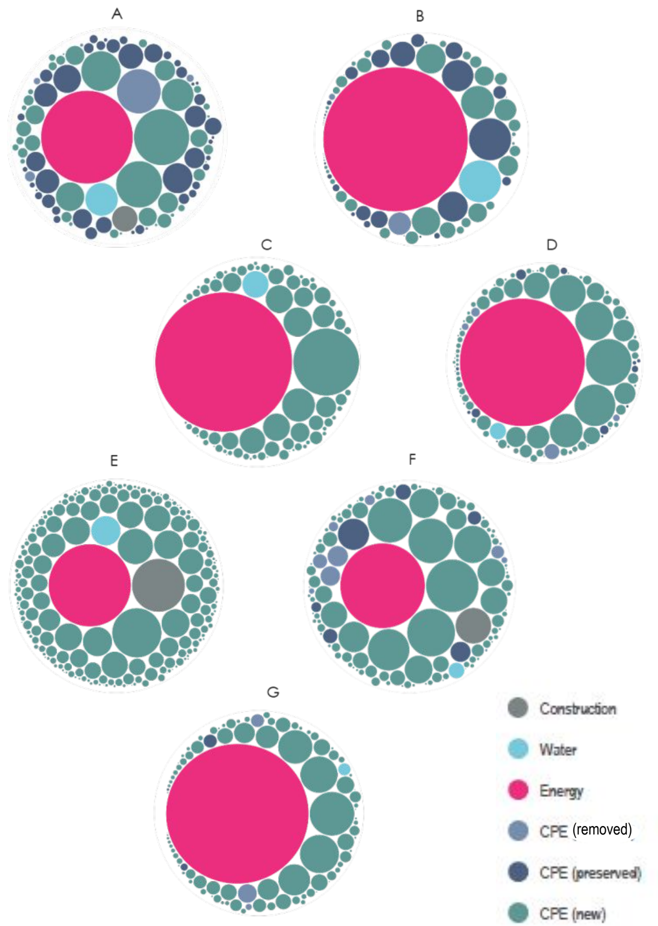


Illustration of the "carbodiversity“ of renovation operations over the 7 projects of the NZC renovation programme. Molecular picture: the size of the bubbles is proportional to the impact of each LCA contributor (The picture shows the "project" scenario).

OUTLOOKS FOLLOWING THE LESSONS OF THE NZC OPTIMISATIONS

OUTLOOK N°1: HEATING ENERGY REMAINS A PRIORITY

The projects used to establish the generic cases already integrate this issue, because most go beyond the thermal regulation applying to renovated buildings (exemplary projects, BBC Effinergie renovation, etc.).
However, the calibration of the projects "to the regulatory minimum" shows that there are major reduction levers to be integrated. The optimisation of the envelope and the use of low-carbon energy sources represent avenues for a reduction from 400 kg to more than 1000 kg/m².
The current regulation, concerning the envelope (RT case by case) considering primary energy consumption (Cep, ref), is therefore not sufficient to guarantee an effective reduction of emissions linked to energy consumptions.

OUTLOOK N°2: FRUGAL RENOVATIONS, LOW-CARBON BY NATURE

Generic cases B and C which relate to collective housing (Gavotte and Soliha) present moderate emissions and low carbon return times. The reduction levers are also moderate there. This is because these projects concern work targeted to improve the envelope with few major interventions.
In particular, **the renovation of energy sieves** (like case C) presents a low variability of the carbon return time which remains advantageous in all cases. **In this specific context, renovation is always profitable and life cycle assessment is not an absolute necessity.**

Conversely, the very heavy renovations of generic cases D, E and F, which deal with business premises including bringing up to standard and substantial equipment, have stronger emissions and optimisation issues.
The content of the work (and conversely the degree of frugality) therefore represents indicators of the issue of reducing emissions to be considered.

OUTLOOK N°3: TECHNICAL LEVERS TO BE DEEPENED AND ANALYSED IN TERMS OF EFFORT/GAIN

The levers identified for carrying out NZC optimisations mainly focus on strategies of tacticity (energy sobriety, preservation of the existing building), materiality (eco-materials) and, to a lesser extent, circularity (reuse). This observation points out the moderate maturity of the reuse channels and research still to be carried out on the two remaining levers (technicity and externality).
Technicity is well integrated in terms of energy efficiency. On this point, the study shows that the choice of equipment must be assessed according to the carbon weight ratio of the device/generated energy savings. For example, the use of a decentralised double flow ventilation system finds its relevance within the framework of the ground floor in activation which has weak levers on the envelope and the energy production equipment. It is more questionable on major renovations (case D-E-F) on which the "low-tech"* approach shows interesting results (air fan, bioclimatism, etc.).
On the other hand, **few levers have yet been identified or can be objectivised concerning the reduction of the carbon weight of equipment** : details of contributors not known and not allowing a detailed approach of reduction, levers for refurbishing/equipment of immature equipment. This is an important area of improvement for low-carbon renovation.

The "energiesprong" external insulation system for individual housing represents an opportunity to reduce emissions related to heating energy.

On occupied site and budget renovations generally focus on improving the envelope without excess of added materials. Here the example of the Gavotte project.

** Questioning the real technology needs and develop less complex and resource-consuming solutions*

OUTLOOKS FOLLOWING THE LESSONS OF THE NZC OPTIMISATIONS

OUTLOOK N°4: SPECIFIC CONSTRAINTS THAT IMPACT THE LEVERS

The specific constraints that apply to each of the selected scenarios are all constraints that limit the potential for optimisation.
The heritage context prevents the use of exterior insulation in cases C, D and G, for example. Pollution and ground instability require strong structural refurbishment in the case of the French Tech (case E). Asbestos removal requires major cleaning, leaving little room for reuse for IBOX (case F).
The levers concerning photovoltaic energy production are conditioned by the urban morphology, the possibility of using the roof and are only effective in 3 out of 7 generic cases : individual housing, large complexes and industrial assets represent in particular mainly interesting solar sources if the climate and the urban context allow it.

OUTLOOK N° 5: USE VECTOR, AN ESSENTIAL PRISM TO BE INTEGRATED

In cases where the interior surfaces are highly constrained and if there is no possibility of exterior insulation (case C Soliha and case G Wigwam), the optimisation of the envelope is in direct competition with the usable space. This parameter should be appreciated because it limits the optimisation levers and impacts the quality of use.
Putting on the same level the reduction of emissions and the reduction of the usable space constitutes a relevant approach to arbitrate on the last cm of insulation to be implemented.

Another issue is that of **taking summer comfort and climate resilience into account**. With the arrival of RE2020, we now systematically count a need for additional cold in case of exceeding comfort temperatures (a factor that can be as restrictive as reaching the Bbio/Cep). Should an additional constraint be integrated in this sense into the NZC approach on all the generic cases modelled (example: reversible heat pump, air fan, solar protection, free cooling, etc.)?
Another parameter affecting the carbon footprint in operation, the **impact of interior furniture** is not currently taken into account in the LCA and deserves to be assessed (frequent renewal, reuse opportunities, etc.) in particular for case G (ground floor in activation).

OUTLOOK N°6: POSITIVE CONTEXTUAL EXTERNALITIES TO BE OBJECTIVATED

Beyond the already mentioned photovoltaic production, few "externality" type levers could effectively be integrated into the proposed optimisations.
This observation responds to a dual difficulty:
- on the one hand, **these externalities are not always objectivable, because feedbacks on carbon savings are poorly documented or absent**. This is particularly the case of the positive externalities linked to renovation on reducing carbon-consuming transportation (local services, maintaining activity as close as possible to home).
- on the other hand, **the current calculation method does not make it possible to value externalities**. This is particularly the case for strategies of sharing and pooling or optimisation of use by playing on the complementarity of occupancies.

It would therefore appear relevant to develop specific methodologies to integrate these avenues into the NZC strategy.

Solar sources strongly conditioned by urban morphology. The industrial heritage wasteland represents a substantial source without affecting the identity of the built asset.

The provision of premises outside the occupancy schedules, an opportunity to reduce carbon emissions expressed as use value of the project. The impact of too frequent renewal of interior furniture could also be integrated into the approach.

NZC GLOSSARY

REFERENCE SERVICE LIFE (RSL):

The Reference Service Life is the theoretical service life for the CPE. It is mentioned in the Environmental Product Declaration (EPD or FDES).

REMAINING SERVICE LIFE:

The remaining Service Life is the difference between the Reference Service Life of the element and its already achieved service life in the initial building, that means remaining Service Life = Reference Service Life – achieved Service Life.

PROGRAMMATIC ENTITY:

A programmatic entity is a group of spaces with the same activity, under the responsibility of the same project owner.

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 impacts.

BEPOS INDICATOR :

BEPOS is an energy performance indicator of the Carbon Energy Standard (Bâtiment à Energie Positive = Positive Energy Building). It is defined by the difference, expressed as primary energy, between the amount of neither renewable nor recovered energy used by the building and the amount of renewable or recovered energy produced and injected in the network by the building and its immediate area.

CEP :primary energy consumption indicator
BBIO : energy demand indicator

CPE OR ELEMENT:

Construction Products and Building Equipment.

DED

Stands for Default Environmental Data : when there is no EPD for an element, a default entry can be chosen. DED generally includes a penalizing factor. For the relevance of comparisons and analysis, the use of this kind of data should be avoided as much as possible.

CARBON ENERGY" STANDARD / E+C- STANDARD:

The "Carbon Energy" standard (or E+C- standard) is a French environmental certification 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 news Environmental Regulation (RE2020) which was released in 2022. More information in the dedicated French website.

BBC EFFINERGIE RÉNOVATION STANDARD:

The "BBC Effinergie Rénovation" is a French environmental certification and methodology which aims to assess energy performance of renovated buildings. Usually, it entails that the renovated building will consume 40% less than the applicable national regulation. This standard has been used during the NZC programme in order to identify best practices in terms of energy performance for renovated buildings.

INIES DATABASE:

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

ELODIE SOFTWARE :

ELODIE is a French LCA software developed by the CSTB (Scientific and Technical Buildings Center) using FDES / EPDs/ PEPs from the INIES Database. Other compatible LCA softwares exist : EQUERRE, ARCHIWIZARD, VIZCAB, CLIMAWIN….

RT CASE BY CASE:

A method from the french national energy regulation for existing building (RT). It consists, for certain existing buildings, to check the compliance of the energy renovation with some specific performance requirements defined by the regulation (enveloppe and systems).

U BAT:

Average thermal transmittance at the scale of the whole building. It quantifies the rate of transfer of heat through the building envelope. For example, a hightly insulated building has a low Ubat.

CARBON RETURN TIME / CRT :

The gross carbon return time corresponds to the time needed for the savings of resources generated by the renovation in operation to compensate the initial investment in construction products and equipment. The carbon neutrality approach applied to the NZC project therefore consists primarily in reducing as much as possible the carbon return time.

RT: french thermal regulation for buildings
ETI : external technical insulation
ITI : external technical insulation
PU : polyurethane insulation
EF : CO2 emissions factor for energy (g C02 / KWh)