METHODOLOGY FOR ASSETS SELECTION AND IMPACT MEASUREMENT

Positive Impact Covered Bond Program

June 2019

WILD

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Executive Summary

Context:

Société Générale has defined a Positive Impact Covered Bond Framework to refinance mortgages for low carbon residential properties located in mainland France via Positive Impact Covered Bonds issued by its subsidiary: SG SFH (Société Générale Société de Financement de l'Habitat).

Referring to the existing standards relative to low carbon building sector[1], eligible mortgages are those backing properties that belong to the top 15% in terms of carbon efficiency in their local area, in line with a zero-carbon trajectory towards 2050.

In order to identify low carbon residential properties and assess their potential environmental benefits, Société Générale has mandated WILD TREES.

Purpose of document:

This document describes the methodology used for identifying eligible mortgages backing the top 15% carbon efficient dwellings - and assessing its environmental benefits.

Scope of the methodology:

- The French residential building stock (single family houses, multi-family houses and rentals)
- GHG emissions related to the use phase of buildings (Scope 1 and 2[2]): directly linked to energy consumption.
- Assessment of two main indicators:
  - GHG emissions (tCO_2eq)
  - Energy savings (kWh)

Analysis of other potential positive externalities is provided at the end of the methodology.

Data sources:

The methodology relies on the latest statistical data and building codes in order to assess energy and carbon performance of residential buildings:

- The French Environnement & Energy management Agency "ADEME" (*Agence de l'Environnement et de la Maitrise de l'Energie*) annual data[3]
- The French Research and economic center on energy "CEREN" (Centre d'études et de recherche sur l'énergie) annual data[4]
- The Survey on the performance of homes, equipments, energy needs and uses, including energy performance diagnosis "Phebus" survey[5]
- The French Thermal Regulation 2012 "RT 2012"
- The National Institute of Statistics and Economic Studies "INSEE" general data on the French residential park (metrics and prices)

[1] Such as Climate Bonds Initiative Standards and the recent proposition of EU Green Bonds Standard (June 2019)
[2] See scope definitions in the lexicon
[3] https://www.ademe.fr/en
[4] https://www.ceren.fr/
[5] https://www.statistiques.developpement-durable.gouv.fr/enquete-performance-de-lhabitat-equipements-besoins-et-usages-de-lenergie-phebus

Results:

Based on the most recent sources of information, the methodology has confirmed the following:

- New dwellings have a better energy performance than older constructions. Therefore, dwellings constructed in compliance with most recent thermal regulation requirements (i.e. RT 2012) are the most efficient of the French residential building stock in terms of energy consumption.
- There is a strong correlation between the reduction of energy consumption over the years and the reduction of GHG emissions. Therefore, dwellings constructed in compliance with RT 2012 requirements can also be considered as the most efficient in terms of related GHG emissions.
- As at January the 1st of 2019, dwellings in compliance with the RT 2012 represent approximatively 7.1% of the French metropolitan residential building stock:

Therefore, dwellings built in accordance with the French RT 2012 belong to the top 15% most efficient buildings in terms of GHG emissions (Scope 1 et 2).

Eligibility Criteria:

Eligible mortgages are the ones for which the underlying property meets the following characteristics:

- Is located in **Metropolitan France**, i.e. mainland France

  The DOM TOM (offshore territories) are excluded from the selection because energy performance data cannot be compared between metropolitan territories and offshore territories due to significant difference in climatic characteristics.

- Is **owner-occupied**

  Secondary residences are excluded since they usually feature unfavorable ratios of usage per occupant with regards to their environmental impacts.

- Is compliant with the thermal regulation **RT 2012**

  To ensure that the properties selected are compliant with the normative requirements of the thermal regulation RT 2012, only loans (i) with an effective starting date after January 1st,2015 and (ii) for which the purpose of the loan is the acquisition of a new housing are selected.

Climate benefits:

Based on Phebus survey data, which measures the energy consumption of the mainland French residential building stock, the energy consumption baseline has been estimated considering the distribution of the residential dwellings per floor area:

- 158.0 kWh_{FE}/sqm/year for multi-family residential buildings
- 192.4 kWh_{FE}/sqm/year for single-family residential buildings

The energy consumption of RT 2012 dwellings is also estimated:

- 108.8 kWh_{FE}/sqm/year for multi-family residential buildings
- 117.3 kWh_{FE}/sqm/year for single-family residential buildings

This results in the following energy savings:

⇨ multi-family residential buildings: 49.2 kWh_{FE}/sqm/year

⇨ single-family residential buildings: 75.1 kWh_{FE}/sqm/year

NB: Estimated energy savings look more advantageous for individual house because the estimate is made per sqm. Would it be estimated per inhabitant; it would be less advantageous.

Estimated climate benefits are then calculated on scope 1 & 2 based on the carbon emission factor of the French residential energy mix, which is weighted per energy sources and is equal to 0.1756kgCO2eq/KWh.

This results in the following climate benefits:

- 8.64 $kgCO_2eq$/sqm/year for multi-family residential buildings
- 13.19 $kgCO_2eq$/sqm/year for single-family residential buildings

Calculation of the environmental benefits generated by the portfolio of eligible mortgages:

The floor area of each underlying dwellings has been estimated based on market value and geographical real estate prices sourced from the national notary transaction database.

Multiplying this floor area by the estimated climate benefits per square meter provides the following results for the identified eligible portfolio (as of 31/05/2019):

Type of dwellings	Energy savings (MWh)	Climate benefit – avoided GHG emissions (tCO_2eq)
Single-family	55 143	9 683
Multi-family	35 552	6 243
Total	90 695	15 926

Introduction

I) Background: SG SFH's Positive Impact Covered Bond Framework

A Positive Impact Covered Bond program dedicated to refinance a portfolio of residential mortgages backing low carbon properties

Société Générale has mandated WILD TREES to develop eligibility criteria and impact measurement methodology in the context of the definition of its Positive Impact Covered Bond Framework.

This Positive Impact Covered Bond Framework is aligned with UNEP FI's Principles for Positive Impact Finance (2017) and ICMA's Green Bond Principles (2018).

Under this Framework, the objective is for Société Générale to refinance a portfolio of eligible residential mortgages via Positive Impact Covered Bonds issued by its subsidiary: Société Générale Société de Financement de l'Habitat (SG SFH).

Eligible residential mortgages will be selected within SG SFH's cover pool according to their positive contribution to Climate. The eligibility criterion is the carbon performance of the underlying property: they should belong to the top 15% carbon efficient residential properties amongst the whole French residential building stock.

WILD TREES is also mandated to define, according to the Positive Impact Finance approach, a measurement of the eligible portfolio's positive impacts and describe how potential negative externalities are managed at the eligible portfolio level.

II) Scope of work

WILD TREES presentation

WILD A company specialized in real estate environmental and societal issues

WILD TREES is a French consulting company for innovative players, created in 2015.

WILD TREES founder has been working for 10 years in France and abroad with the main real estate players on sustainable issues (SIIC, SGP, Property developers, ASPIM, Plan Bâtiment Durable, OID, ADEME, CBI, RICS, GABC, GRESB, etc.)

WILD TREES' core expertise includes real estate, urban planning and sustainable development.

In this context, WILD TREES supported Société Générale in defining the selection methodology and impact measurement associated to its Positive Impact Covered Bond Framework

Purpose of the document

This document describes the different steps and methodological approaches for the asset evaluation and selection and the impact measurement under SG SFH's Positive Impact Covered Bond Framework:

- Provide background information on the real estate sector's climate change contribution
- Explain the eligibility criteria used to select the mortgage portfolio to be refinanced by Positive Impact Covered Bonds, including related hypothesis, approaches, data and sources of information.
- Underline how those eligibility criteria ensure the identification of the top 15% of residential buildings in terms of energy and carbon performance.
- Describe the methodological and technical approaches developed to assess the environmental and social benefits generated by the Positive Impact Covered Bonds. Environmental benefits consist of estimated energy savings and avoided GHG emissions.

Climate impact of the building sector

I) Residential buildings: a significant impact in terms of carbon footprint

Weight of the building sector in terms of carbon footprint

At European level, residential and commercial buildings are responsible for approximately **40% of the total energy consumption and 36% of the generated GHG emissions.**[6]

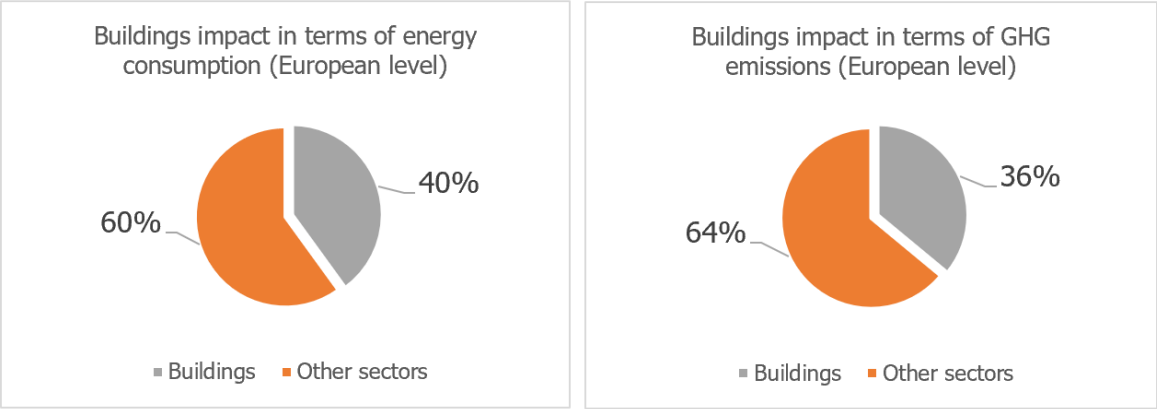


Figure 2 and 3: Building sector energy and climate impacts

At a national scale, the building sector is responsible for **19% of the total amount of GHG emissions[7] in France**. This figure grows to 27% if the GHG emissions related to heating and energy production are considered. If all the direct and non-direct related GHG emissions of a building's construction were considered (including building material use or transportation), **the sector impact would represent more than one third of the total national GHG emissions[8]**.

[6] European Commission: https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings
[7] https://www.ecologique-solidaire.gouv.fr/sites/default/files/15147-7_strategie-bas-carbone_light.pdf
[8] https://www.wbcsd.org/Programs/Cities-and-Mobility/Sustainable-Cities/Science-based-targets/Resources/framework-carbon-emissions-management-building-construction-value-chain

The actual carbon impact of a building can be estimated by considering its direct (Scope 1 and 2) and indirect (Scope 3) GHG emissions during its whole life cycle.

Life cycle assessment (LCA) is increasingly used to evaluate the potential environmental impacts of products, services and related resources consumption. This method is also used in the building sector, where the most important impacts in terms of energy and resources consumption are not exclusively related to the use phase[9].

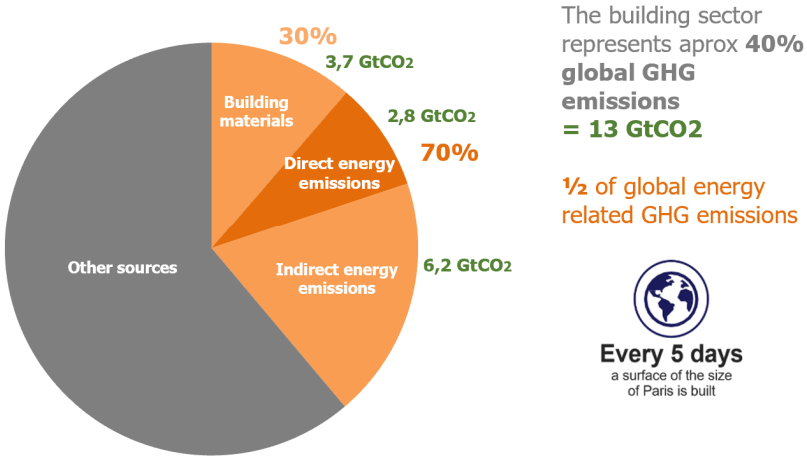


Figure 4: Building sector impact at international level[10]

The life cycle assessment allows the understanding of the **main sources of a building's related GHG emissions such as:**

Energy consumption (Use phase)

- Transportation, communication axis
- Construction materials (resources, transport, etc.)
- Resources during construction phase (water, energy, etc.)

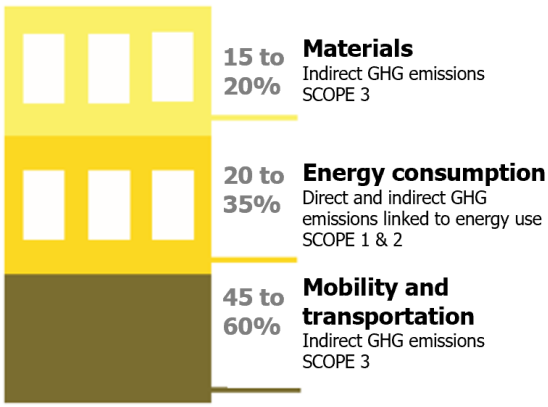


Figure 5: Repartition of a building main carbon footprint sources[11]

[9] Introduction to LCA of buildings: https://www.trafikstyrelsen.dk/~/media/Dokumenter/09%20Byggeri/Baredygtigt%20byggeri/TBST-2016-02-Introduction_LCA_english.pdf
[10] WBCSD, SBT4 Building, GABC, A framework for carbon emissions management along the building and construction value chain https://www.wbcsd.org/Programs/Cities-and-Mobility/Sustainable-Cities/Science-based-targets/Resources/framework-carbon-emissions-management-building-construction-value-chain

Residential buildings: a significant contributing sub-sector

The residential sub-sector is highly concerned by climate and energy performance issues as the **French building stock is formed of more than 70% of residential buildings** (in terms of floor area)[12].

According to ADEME (2018), the residential building sector represents approximately **14.5% of the total amount of French GHG emissions**[13].

Environmental performance politics in the residential sector are challenging because they target **private persons**. Different levers are taken into consideration by public authorities to increase the energetic and climate performance of existing buildings such as advantageous loan policies (éco-PTZ[14]), reduced VAT rates, energy transition tax credits (Cite[15]), energy improvement works financing reliefs for old residential buildings (Anah[16]) or supply specific energy advisor organisms (ALEC[17]) on the territory. These tools allow the promotion of the renovation of buildings by reducing its cost by 17% on average for French households.

II) Regulatory and normative context

The regulatory context is currently evolving toward a greater integration of carbon-related issues. A large panel of new goals and standards to come highlights the public authorities' will to reduce the carbon footprint of the different territory activities.

Carbon commitments and goals

Paris Agreement

In the 2015 Paris agreement on climate change adopted at the COP21, around 200 countries agreed to **limit the global temperature increase to 1.5 - 2.0 °C**, above pre-industrial levels, since this would substantially reduce the risks and effects of climate change. Today, the world has already reached a global increase of 1.0°C above pre-industrial levels. In order to hold this commitment, **the reduction of worldwide GHG emissions from 40 to 70% is required by 2050**.

[11] OID, Baromètre de la Performance Energétique - https://www.o-immobilierdurable.fr/hc_ressources/barometre-2018-de-la-performance-energetique-et-environnementale-des-batiments-tertiaires/
[12] Breakdown of residential building area by European countries : https://ec.europa.eu/energy/en/eu-buildings-datamapper
[13] 2016 survey from the 2018 ADEME report- "*Climat, Air et Energie*" : https://www.ademe.fr/sites/default/files/assets/documents/2018-climat-air-energie_chiffres-cles-010354.pdf
[14] Zero comision loan (PTZ : Prêt à taux zéro)
[15] Tax credit for the energy transition e
[16] National housing agency « *Agence Nationale de l'Habitat* »
[17] Local Agency of Energy and Climate« *Agence Locale de l'*Énergie *et du Climat* »

French Low Carbon Strategy

Countries have adapted their national plans and strategies toward this urgent common carbon reduction goal. At national level, France is committed to the **reduction of 75% of its GHG emissions by 2050** (from 1990, on scope 1 and 2). This strategy is oriented by sector and carbon budgets, which are updated according to the followed carbon trajectory. For the Real Estate sector, in comparison with 2013, the target is to reduce the emissions by 54% until the third carbon budget (2024-2028), and by at least **87% by 2050.**

The definition of the scopes can be found in the Lexicon.

Energy commitments and goals

Loi de Transition énergétique pour la croissance verte (LTECV)

Since 2014, EU countries had to submit **long-term renovation strategies**[1] that foster investments in the renovation of buildings. As of 2019, these strategies will form a key part of EU countries' integrated national energy and climate plans. In this context, France prolongs the renovation obligation with the 2015 LTECV (art. 17)[1]: the goal is to achieve **-60% of final energy consumption by 2050 from 2010**.

The LETCV (art. 173-VI) brings investors obligation to report on their financial risks linked to climate change. By chain effect, societies, in the real estate sector, see the reporting attempts evolve[1]. **Energy, carbon and climate indicators and risks analysis are more and more required by investors**.

Nowadays, the regulatory context is evolving toward a better integration of energy and climate-related issues in the real estate sector. In France, this evolution is particularly visible in terms of thermal regulation. These norms have existed since 1974, after the first oil shock, and their criteria have tightened on each update.

French norms on new buildings: thermal regulations

Thermal regulations outline minimum requirements for new constructions in terms of energy performance, insulation or summer comfort. Since 2005, renewable energies and bioclimatic aspects are integrated in the constructive norms of new buildings. In 2012, energy consumption thresholds for residential buildings decreased. In accordance with RT 2012, which refers to the Low Energy Buildings (BBC) label of RT 2005, all new residential buildings constructed after January 1, 2013 should have a primary energy (PE) consumption below the threshold of **50 kWh$_{PE}$/sqm/year** (on average and on the regulatory 5 uses[18]). This threshold varies according to the climate regions[19] defined by the regulation (see the figure below) and **enables every new building to achieve A and B level under the Energy Performance Certificate system (EPC[20])**.

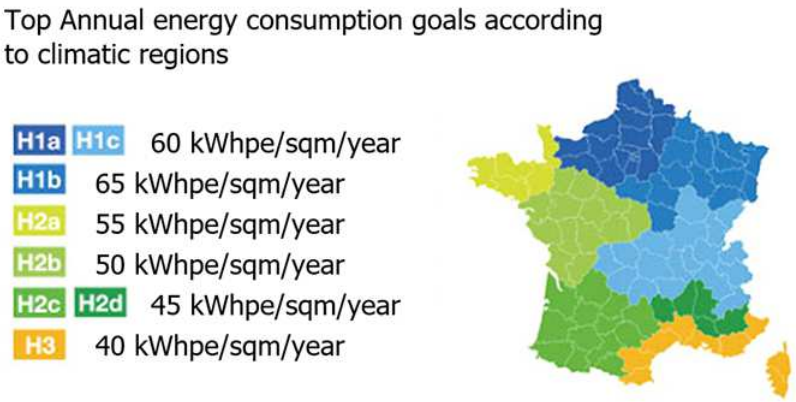


Figure 6: Annual energy consumption RT 2012 thresholds according to climatic regions

RT 2012 requires stringent criteria in terms of thermal insulation and heating systems. Energy consumption calculation methodology under RT 2012 considers the following features: natural lighting and renewable energy sources.

The criteria of RT 2012 are the following:

- Minimum energy efficiency requirement for the 'bioclimatic need' – "Biomax" of the building (isolation, efficiency of heating and lighting systems)
- Maximum average primary energy consumption of the building below 50 kWh$_{PE}$/sqm/year – "Cmax"
- Summer comfort requirement (maximum interior temperature for 5 consecutive summer days) to encourage bioclimatic architecture

[18] See Lexicon
[19] See Lexicon
[20] See Lexicon

By introducing more stringent requirements over time, the purpose of the new construction norms is to gradually reduce the theoretical level of energy consumption (as illustrated by the figure below[21]) **in order to set the pace towards Nearly zero-energy buildings (NZEB) and positive energy buildings (BEPOS) for 2020.**

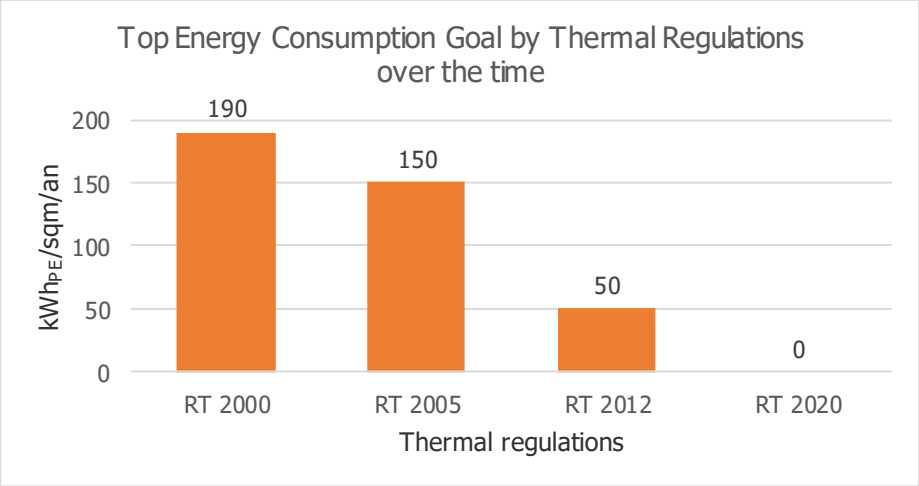


Figure 7: Top Energy Consumption Goal by Thermal Regulations over the time

From thermal regulation to environmental regulation

Climate issues will be a major concern in the new environmental regulation "RE 2020": integrating the notion of carbon impact is clearly the challenge for new constructions.

In anticipation of the **future environmental regulation** for new constructions (RE 2020), the E+C- label was launched in 2016 as an experimentation to test the feasibility of the shift induced by the RE 2020 regulation, which will replace RT 2012.

Two aspects are counted in this state label: **Energy and Carbon**. The goal of the French state is to incentivize the real estate market to move towards an integrated vision of buildings (building during all its life cycle, building in its different phases, building in the value chain). Great efforts will be necessary to improve the buildings' energy performance, but also the conception processes and carbon performance during all the building's life cycle. Renewable energy production or use will be a great lever to respect the new thresholds too.

As for thermal regulation, the future RE2020 norms will accelerate the transition trajectory of the buildings construction sector towards the national zero carbon emission targets.

[21] ADEME 2018 report- "*Climat, Air et Energie*" : https://www.ademe.fr/sites/default/files/assets/documents/2018-climat-air-energie_chiffres-cles-010354.pdf

Methodology

Conscious of the carbon impact of the residential real estate sector, Société Générale has set up a Positive Impact Covered Bond Framework to refinance a portfolio of mortgages on residential properties that belong to the top 15% carbon efficient residential buildings in mainland France.

I) Definition of the 15% most efficient residential buildings

GHG emission scopes under consideration: scope 1 and scope 2

National policies such as the **French Low Carbon Strategy** are defined on Scope 1 and 2's related emissions.

While **future Environmental Regulation** may include Scope 3 emissions (i.e. GHG emissions from construction material production and use), the current thermal regulation RT 2012, applied on the overall French territory, allows to address Scope 1 and 2: for buildings, it can be summarized by GHG emissions related to energy consumption.

Current available data on environmental performance of residential buildings are consolidated only on energy performance. The climate performance of buildings is currently addressed through GHG emissions related to energy consumption.

Most commonly used Green Bonds standards in residential building sector are also focused on Scope 1 and 2 GHG emissions to measure the environmental performance of buildings. For example, the Climate Bonds Initiative recognizes local buildings codes that establish minimum standards for building energy/emissions performance and energy ratings or labels like Energy Performance Certificate (EPC) ratings in the UK as proxies to establish which buildings are within the top 15% and can be considered as green assets[22]. EPC systems (or "DPE" in French) focus on the energy performance of buildings and on GHG emissions related to energy consumption (Scope 1 and 2).

In order to select the most environmentally efficient residential buildings, **the methodology** relies on the local building code RT 2012, which is directly linked to EPC levels, and which allows to address both energy performance and Scope 1 and 2 related emissions.

[22] CBI residential buildings standard
https://www.climatebonds.net/standard/buildings/residential

Thermal regulation 2012: Targeting energy efficient new dwellings

Energy performance of residential buildings is usually provided by a regulatory tool: The **Energy Performance Diagnosis** (DPE). This tool, developed in France in 2006, is the equivalent of EU's **Energy Performance Certificate** (EPC) defined in the building's energetic performance European Directive of 2002[23].

According to the DPE Observatory[24] of the French Environment and Energy Control Agency (ADEME)[25] :

- More than half of the residences built before 2013 are labelled D and E (figure 8)
- Residences built after January 1st, 2013, compliant with the energy performance requirement of the RT 2012, are mostly (i.e 88% of them) labelled A and B (figure 9)

In other words, more than 88% of new residences (compliant with the RT 2012) display energy consumptions related to regulatory uses of less than 90 kWh_{PE}/sqm/year while 95% of the residences previously built (before January the 1st 2013), show energy consumptions above 91 kWh_{PE}/sqm/year.

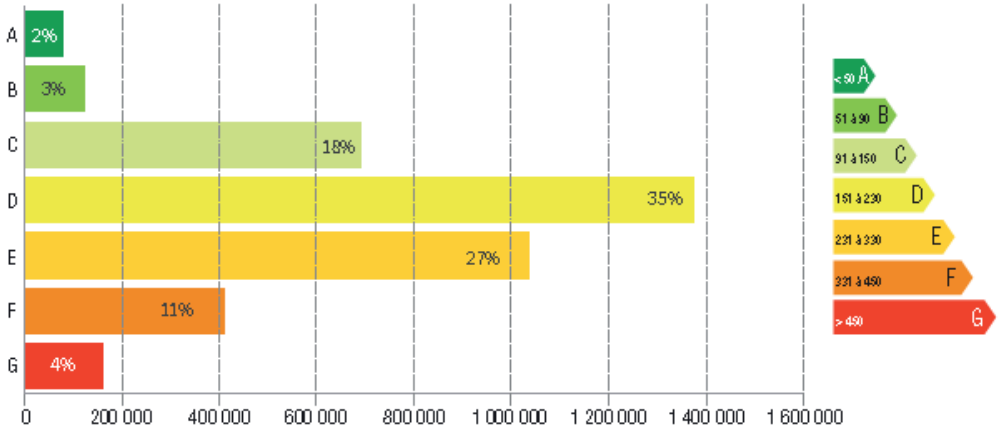


Figure 8: Distribution of the DPE (Energy Performance Diagnosis) for residences built before the application of the RT 2012 (before the 01/01/2013)[26]

[23] Energy performance of buildings directive 2002/91/EC or EPBD.
https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=celex:32002L0091
[24] Décret n° 2011-807 of July the 5th of 2011 on DPE transmission
https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000024317077
[25] DPE Observatory (ADEME)
https://www.observatoire-dpe.fr/
[26] DPE Observatory

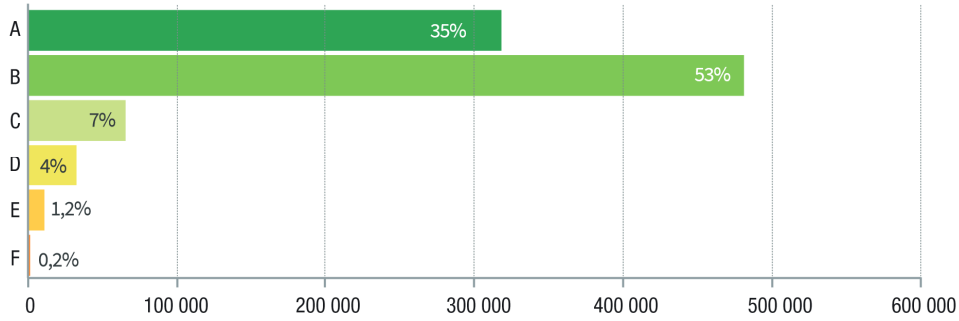


Figure 9 Distribution of the DPE (Energy Performance Diagnosis) for residences built after the 01/01/2013, compliant with RT 2012[27]

The comparison of the new residences' EPC (for dwellings built after January 1st, 2013, compliant with the RT 2012 requirements) with the EPC breakdown of the rest of the French residential building stock underlines a clear improvement of the energy performance of residences over time. The gradual reduction of energy consumption of new buildings is intrinsically linked to the application of the new constructive codes according to more ambitious environmental performance requirements. Due to the learning time necessary for the application of new standards and the improvement of practices by the actors of the real estate ecosystem (study offices, promotors, certification agencies, craftsmen, etc.), this improvement tendency is generally continuous.

Most recent dwellings have a better energy performance than older constructions.

The limitations of the DPE system

- By imposing a 50 kWh_{PE}/sqm/year regulatory average threshold on energy consumption for conventional uses[28], the RT 2012 allows most of the new dwellings (88%) to be labelled A or B in terms of energy performance.
- For several reasons, not all new dwellings are labelled A. Firstly, RT 2012 sets different performance thresholds depending on the climatic regions e.g. the threshold is higher than 50 kWh_{PE}/sqm/year in some northern regions. Because of the climatic characteristics of these regions, energy consumption will be more important (in terms of heat needs for example). Residences in these regions will be compliant with the RT 2012 while being granted a B label. In addition, a normative derogation[29] was granted to new collective dwellings allowing them to reach up to 57 kWh_{PE}/sqm/year (level B). Finally, there are currently three different methods for the EPC calculation (see below) that explain such repartition.

[27] The update of the DPE labelling repartition is done according to the data provided by the DPE Observatory : https://www.observatoire-dpe.fr/index.php/statistique

Since there is no approach that allows to distinguish each method of DPE calculation, and in order to avoid the bias that could be generated, this methodology proposes to consider **real energy consumption data** in order to confirm that **most recent dwellings have a better energy performance than older constructions**.

Real energy consumption data represents all the energy consumptions rates that are influenced by external factors such as: occupancy, temperatures (outdoor and indoor), internal intakes, sun radiation, etc.

For the purpose of the present methodology, DPE statistics and results are presented as a complement to our top 15% assessment.

Nevertheless, the chosen approach for this methodology is based on a different proxy in relation with the construction date of the dwellings, thus, allowing an analysis through new dwelling's real average performance.

A survey carried out by the ADEME (see figure 10 below), illustrates the **progressive reduction of real** (or final) **energy consumption** of buildings according to their year of construction. This curve is projected in correlation with the dates of effectiveness of the different thermal regulations and other policies, illustrating the impact of the norms.

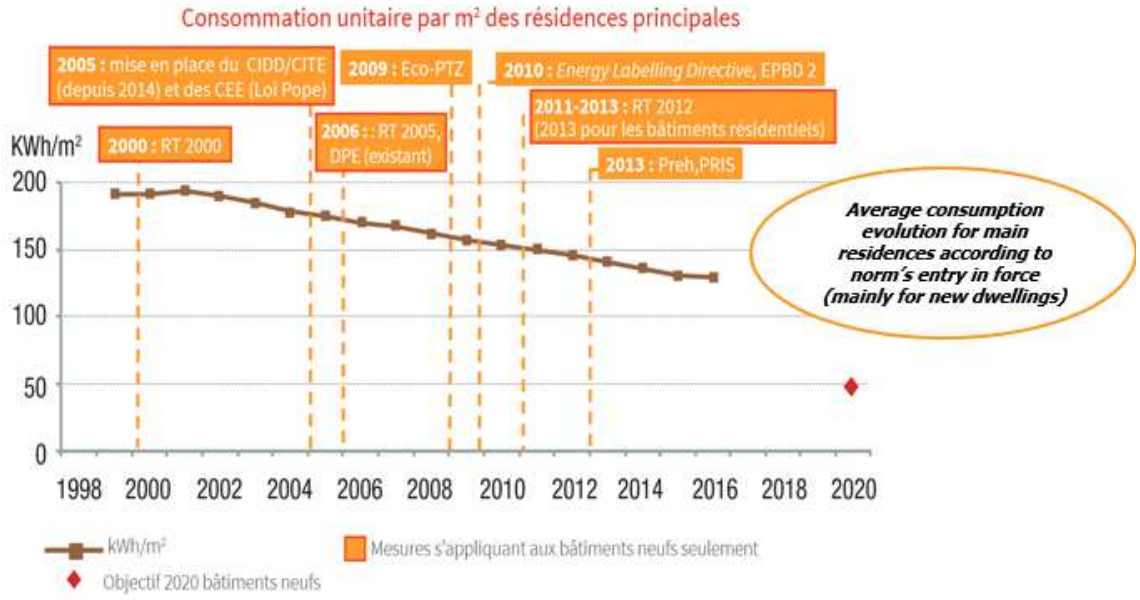


Figure 10: Evolution of the French residential buildings' real energy consumption by year of construction[30]

[30] ADEME 2018 – Key figures
https://www.ademe.fr/sites/default/files/assets/documents/2018-climat-air-energie_chiffres-cles-010354.pdf

The energy performance of the French residential building stock is gradually improving. Indeed, according to the figure below (figure 11) and the tendency observed, dwellings constructed "after 2006", and therefore after 2013, consume less than 140 kWh_{FE}/sqm/year[31], or 25% less than the average energy consumption of the residential French park of 186 kWh_{FE}/sqm/year[32]. This general trajectory being supported and paced by the application of building codes and norms that fix performance requirements in terms of energy performance and consumption. Considering that future norms will integrate carbon performance requirements (as the RE2020, following the 2050 carbon neutrality global objective of the French Low Carbon Strategy), and because energy consumption reduction is a lever of a building's carbon performance, the average energy performances of the French residential building stock may still reducing over time.

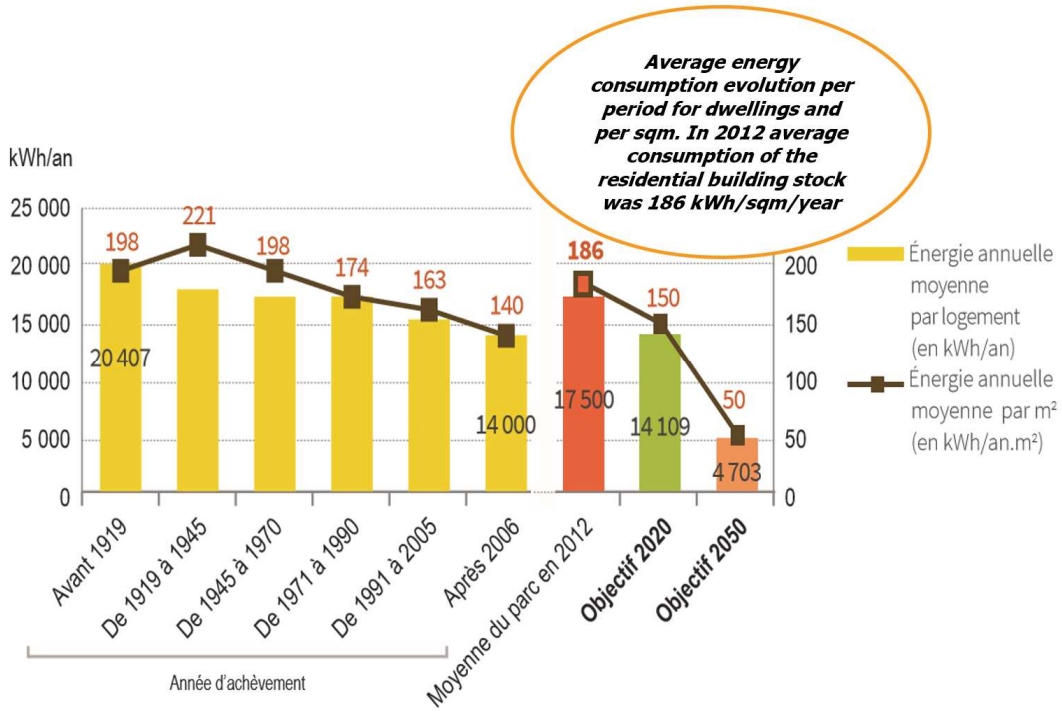


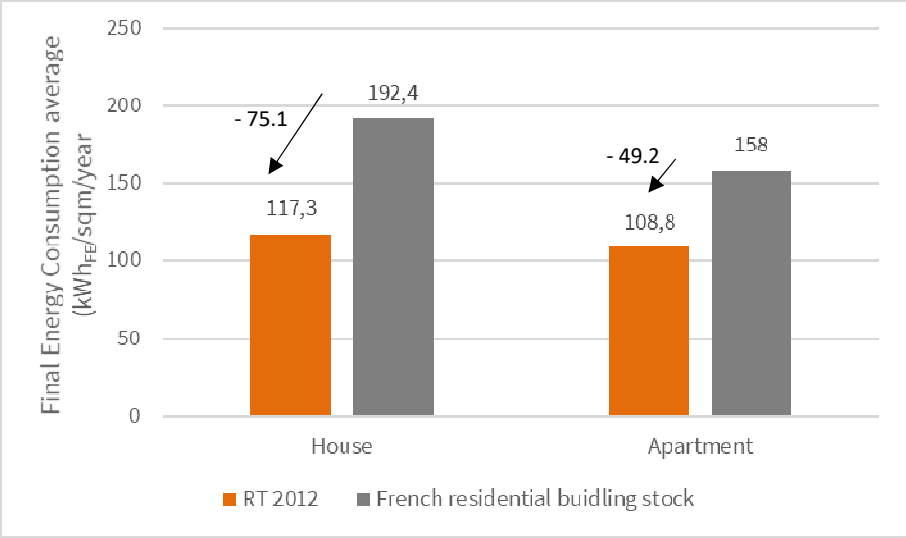
Figure 11: Evolution of residential buildings real energy performance per construction period, PHEBUS survey

As illustrated by Figure 11, the average energy consumptions of the residential French building stock progressively reduced thanks to the arrival in the market of lower energy consuming residences. The newer the construction, the more performant in terms of energy use. This observation is consistent with the observation previously made by the EPC.

[31] Average consumption for residential buildings constructed between 2006 and 2013.
[32] These data can be updated with ADEME annual reports (chiffres clés Climat Air Energie)

Since most recent dwellings show a better average energy performance than the French residential building stock, dwellings constructed under the most recent thermal regulation (i.e. RT 2012), are the most efficient of the residential building stock in terms of energy consumption.

This point will be further detailed in the description of the methodology used to assess environmental benefits.



Average energy performance of RT 2012 residential buildings by type comparing to the total French residential building stock

The energy combustion for the transformation of fossil energy resources and their final use is responsible at a global scale of 80% of GHG emissions. The energy consumption of the residential sector in France is responsible for 30% of the national energy consumption and one fifth of the GHG emissions relied to energy combustion[33].

In order to apprehend the relation between energy and climate performance, it is necessary to study **the evolution of the energy mix used in the French residential building stock**, particularly for heating, which is the main energy consumption in a residential building.

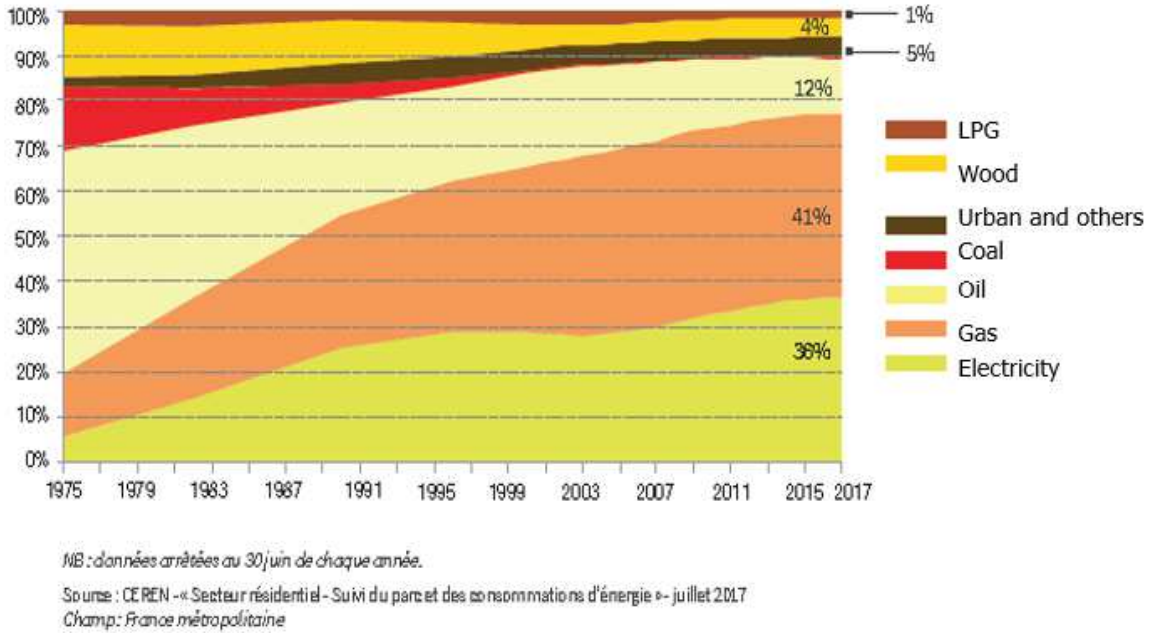


Figure 12: Evolution of the energy mix used in the French residential park

Electricity and gas are the most common types of energy used for heating in residential buildings. According to the Ceren in 2017, **41% of main dwellings used gas for heating and 36% used electricity** (against 14% and 6% respectively in 1975) [34]. The progressive replacement of oil by natural gas and electricity for residential heating[35] contributes to the reduction of the GHG emissions in the French energy mix.

[33] Commissariat général au développement durable- Les facteurs dévolution des émissions de CO2 liées à l'énergie en France entre 1990 et 2016 (DATALAB - Août 2018)
https://www.statistiques.developpement-durable.gouv.fr/les-facteurs-devolution-des-emissions-de-co2-liees-lenergie-en-france-entre-1990-et-2016?rubrique=&dossier=1286

[34] CEREN key figures (2015)
http://multimedia.ademe.fr/catalogues/chiffres-cles-2015-climat-air-energie/common/data/catalogue.pdf

[35] This tendancy can be explained by the important rise of oil prices and public aids on gaz boiler acquisition (**Crédit d'impôt transition énergétique** (Cite) ou les **Certificats d'économies d'énergie** (CEE)).

Since the most commonly used types of energy by new dwellings are nowadays natural gas and electricity (see figure 13) - which have a lower carbon emission factors [36] (their extraction, production, routing and transformation generate less GHG emissions) – new dwellings have a lower carbon footprint.

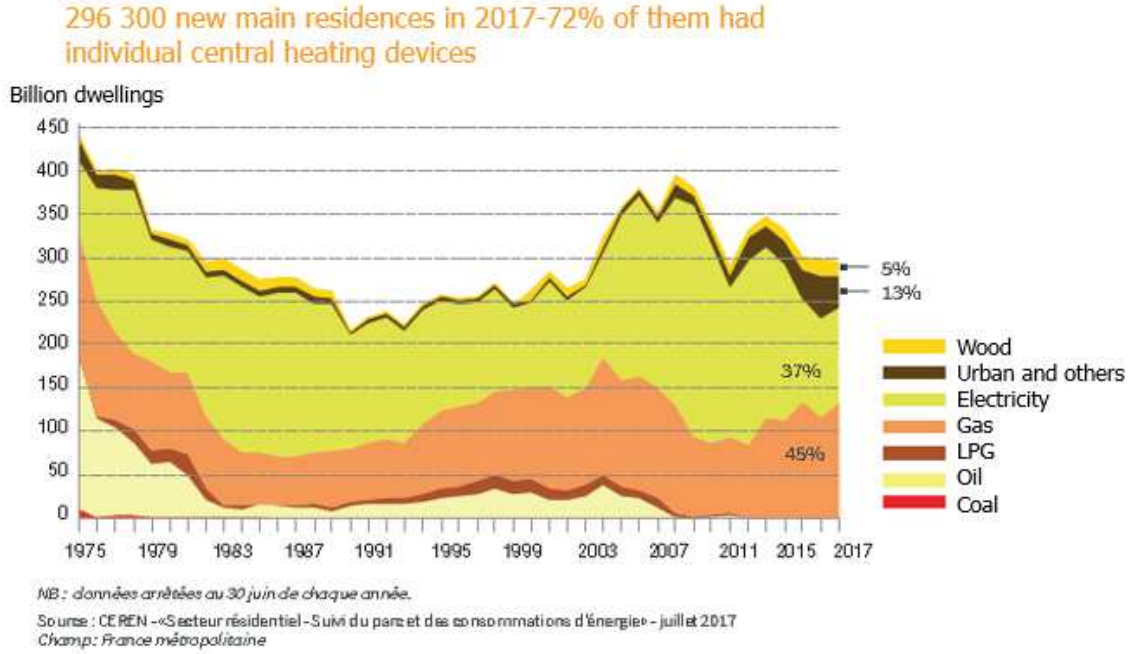


Figure 13: Evolution of the sources of energy used for heating in main residences

[36] Arrêté of frebruary the 8th of 2012
https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000025509925&categorieLien=id
See GHG emissions coefficients in Annex 2

The following figure presents the average **GHG emissions generated by type of energy used by the French residential building stock**.

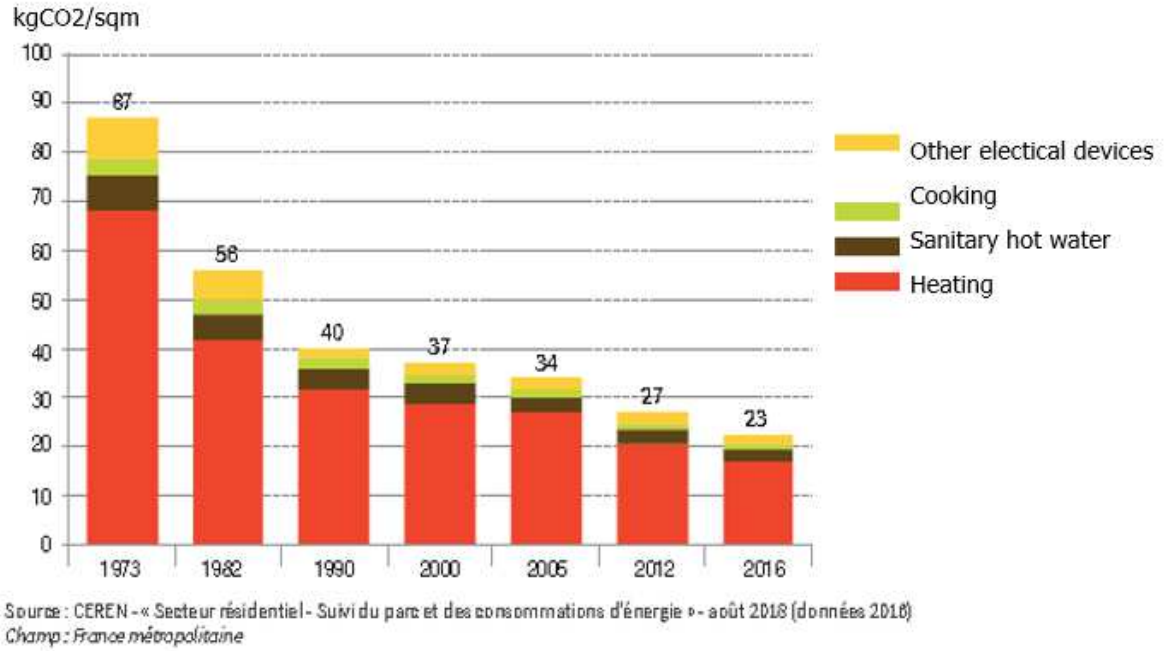


Figure 14: Evolution of GHG emissions per use of main residences depending their construction year

The survey of the GHG emissions of the residential park per year of construction indicates a reduction of 20% of the GHG emissions between the dwellings constructed in 2006, and those constructed in 2012. This follows the decrease of both general and specific energy consumption (specific energy consumption (within Scope 2): emissions due to electric equipment, cooking, heating and sanitary hot water).

The reduction of energy consumption per square meter coupled with the improvement of the energy performance of the electronic devices and heating equipment installed and the general reduction of the carbon emissivity of the energy mix are factors contributing to the general reduction of the GHG emissions linked to energy consumption in the residential sector since 2006[37].

As for the energy performance tendency, we can therefore consider that most recent dwellings and therefore dwellings constructed in compliance with the RT 2012 requirements are the less emissive in terms of GHG emissions considered under scope 1 & 2.

[37] Commissariat général au développement durable- Les facteurs dévolution des émissions de CO2 liées à l'énergie en France entre 1990 et 2016 (DATALAB - Août 2018)
https://www.statistiques.developpement-durable.gouv.fr/les-facteurs-devolution-des-emissions-de-co2-liees-lenergie-en-france-entre-1990-et-2016?rubrique=&dossier=1286

Slow growth of the French residential building stock

As at January 1st, 2019, the French metropolitan territory had **36.7 million dwellings**[38] of an average floor area[39] of 90.9 sqm. These values allow to approach the total floor area of the French mainland residential building stock to **3.33 billion sqm.**

The French residential building stock is characterized by a slow renewal rate. Indeed, for the past thirty years, the residential park presented an average annual growth of **1.1%**[40] (see figure 17). Because of this, the stock evolves slowly and can be described as follow:

- About 3 out of 10 dwellings were constructed before 1949
- 24% (31% of the multi-family residential buildings) was constructed between 1949 and 1974
- 40% (43% of single-family residential buildings) were constructed after 1975[41].

Between January 1st, 2013 and January 1st, 2019, about 2,615,600 construction permits were delivered in mainland France, and 2,280,100 new residential building projects were started. The number of delivered construction permits is a proxy allowing to estimate the number of dwellings in compliance with the energy performance requirements of RT 2012 for new constructions.

Evolution of authorized new residential buildings:

Period	Number of authorized pure individual dwellings	Number of authorized grouped individual dwellings	Number of authorized collective dwellings	Number of authorized residence dwellings	Total number of authorized dwellings
2013	130 800	57 900	207 500	26 200	**422 400**
2014	112 700	45 300	188 800	33 300	**380 100**
2015	118 000	47 400	207 600	32 000	**405 000**
2016	131 600	50 300	245 400	35 500	**462 800**
2017	144 700	49 700	258 200	37 000	**489 600**
2018	130 700	50 600	241 400	33 000	**455 700**
[2013-2017]	**637 800**	**250 600**	**1 107 500**	**164 000**	**2 159 900**
[2013-2018]	**768 500**	**301 200**	**1 348 900**	**197 000**	**2 615 600**

[38]As at January the 1st 2018, the French residential building stock is composed by **36.3 million dwelling**. Between January 2018 and January 2019, **455,700 dwellings** were authorized. The addition of these values allows us to assess the French residential building stock as at January the 1st of 2019 to **36.7 million dwellings**.
[39] Survey INSEE 2017 – surfaces, nombre de pièces, espaces attenants
https://www.insee.fr/fr/statistiques/2586024?sommaire=2586377
[40] Survey INSEE
https://www.insee.fr/fr/statistiques/3620894#documentation.
[41] Insee Références, éditions 2017 – Vue d'ensemble- Le logement en France depuis trente ans.
https://www.insee.fr/fr/statistiques/2586003?sommaire=2586377

Evolution of started projects of new residential buildings:

Period	Number of started pure individual dwellings	Number of started grouped individual dwellings	Number of started collective dwellings	Number of started residence dwellings	Total number of started dwellings
2013	125 300	46 100	165 500	21 100	**358 100**
2014	105 700	39 300	166 400	26 000	**337 300**
2015	104 900	38 800	175 200	27 500	**346 400**
2016	115 000	41 500	195 700	30 600	**382 800**
2017	129 700	44 700	227 500	34 600	**436 500**
2018	123 200	42 400	223 700	29 700	**419 000**
[2013-2017]	**580 600**	**210 400**	**930 300**	**139 800**	**1 861 100**
[2013-2018]	**703 800**	**252 800**	**1 154 000**	**169 500**	**2 280 100**

Proportion of RT2012 compliant dwellings within the French mainland residential building stock as at January the 1st of 2019.

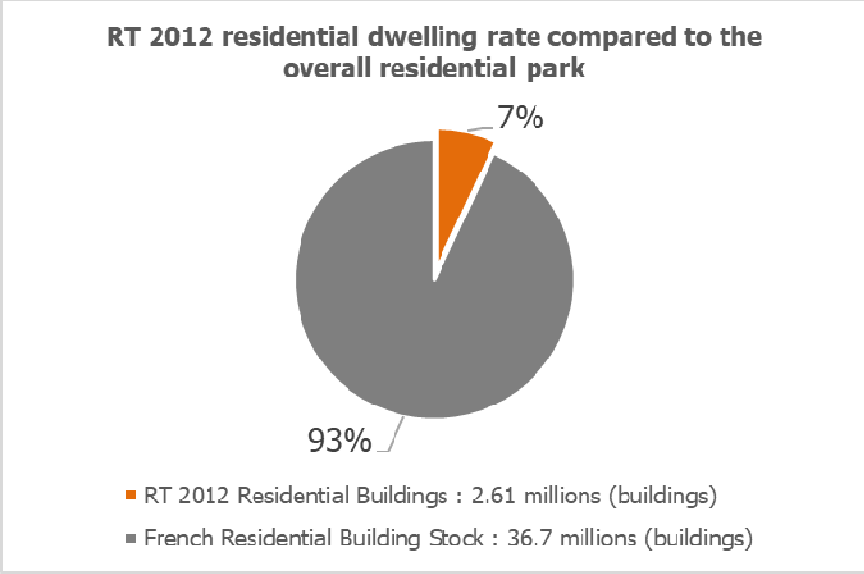


Figure 15: Evolution of the French residential building stock since 2013

Thus, **as at January 1st, 2019, dwellings in compliance with the RT 2012, represent close to 7.11% of the French mainland residential building stock**.

It is important to outline that this value is probably overestimated, since the real number of RT 2012 buildings actually constructed could be lower. This is due to the fact that this value is based on the validation date construction permits, whereas construction permits have, according to French law, a 3 years period of applicability. Therefore, construction permits delivered in 2017 may not exactly correspond to actual realized constructions.

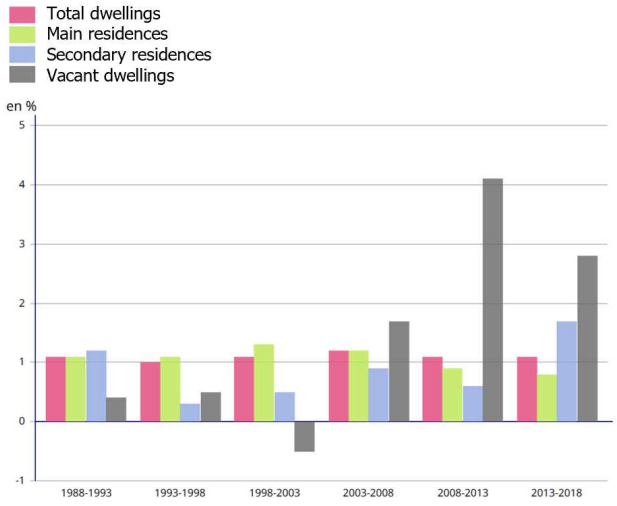
Year after year, the evolution of the building stock is globally constant in terms for overall dwellings: with **an average annual growth of 1.1%**. The figure below illustrates the portfolio evolution with this global scenario:

Date (January, 1st)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Projected number of new dwellings		0,40	0,41	0,41	0,42	0,42	0,43	0,43	0,44	0,44	0,45	0,45
Projection of the total number of RT2012 buildings (millions)	2,61	3,01	3,42	3,83	4,25	4,67	5,10	5,53	5,97	6,41	6,85	7,30
Projection of the total number of dwellings in the residential building stock (millions)	36,70	37,10	37,51	37,92	38,34	38,76	39,19	39,62	40,06	40,50	40,94	41,39
Percentage of RT2012 buildings in the total building stock (%)	**7,11**	**8,12**	**9,12**	**10,11**	**11,09**	**12,06**	**13,01**	**13,96**	**14,90**	**15,82**	**16,74**	**17,64**

Number RT2012 buildings Jan 1st 2019	2,61
Average annual growth of main residences (%)	1,10

Projected evolution of the French residential building stock

It is however important to consider the evolution rates according to the residential occupancy use since they are very different (see Figure below). Indeed, the global rate is increased by secondary and vacant dwellings evolution rates.



Evolution of the French residential building stock by category of occupancy[42]

[42] https://www.insee.fr/fr/statistiques/3620894#titre-bloc-1

The evolution of main residence construction, has decreased since the period 1998-2003, going from an average annual growth of 1.3% in those years, to **0.8% in 2013-2018**. Since this Positive Impact Covered Bond issuance is only focused on main residences[43], and as the top 15% estimate has been made precisely on main residences energy consumption data (Phebus inquiry), this current evolution rate will be considered. This rate is applied by keeping a conservative approach. This, by considering in one hand, that construction rates cannot increase indefinitely and, on the other hand, that the reduction tendency being observed for the past 16 years is representative enough. In addition to this, the observed construction rate for main residences, is the most applicable to the studied asset pool. Considering that policies in terms of renovation and urban sprawl will tend to limit new construction projects, it is important to consider that this evolution rate will probably reduce further on.

Date (January ,1st)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Projected number of new dwellings	0	0,29	0,30	0,30	0,30	0,30	0,31	0,31	0,31	0,31	0,32	0,32
Projection of the total number of RT2012 buildings (millions)	2,61	2,90	3,20	3,50	3,80	4,10	4,41	4,72	5,03	5,34	5,65	5,97
Projection of the total number of dwellings in the residential building stock (millions)	36,70	36,99	37,29	37,59	37,89	38,19	38,50	38,81	39,12	39,43	39,74	40,06
Percentage of RT2012 buildings in the total building stock (%)	**7,11**	**7,85**	**8,58**	**9,31**	**10,03**	**10,74**	**11,45**	**12,15**	**12,85**	**13,54**	**14,23**	**14,91**

Number of RT2012 buildings at January the 1st, 2019	2,61
Average annual growth of main residences (%)	0,80

Projected evolution of the French main residential building stock[44]

Since the evolution of the French building stock is rather slow (0.8% of annual growth for main residences) and that it has shown a decreasing trend over time, **new constructions from January the 1st, 2013, respecting RT2012 requirements should still represent less than 15% of the total stock for the 10 years to come (until 2030)**.

It is also important to mention that single family dwellings construction rate has decreased from 1.3% of annual evolution for the 2008-2013 period, to 0.9% for 2013-2018, while it as remained in a constant rate of 1.2% per annual evolution for multi family dwellings since 2008.[45]

[43] Refer to the eligible criteria presentation
[44] According to the data of INSEE inquiry: https://www.insee.fr/fr/statistiques/3620894#titre-bloc-1
[45] https://www.insee.fr/fr/statistiques/3620894#titre-bloc-1

The assets selected for the Positive Impact Covered Bond emission are in the top 15% efficient dwellings

In conclusion, dwellings in compliance with the performance standards set by the thermal regulation RT2012:

- Are equivalent to less than 15% of the mainland French residential building stock
- Are amongst the most efficient in terms of average energy consumption
- Are amongst the most efficient in terms of GHG emissions linked to energy consumption (Scope 1 & 2).

⇨ **Are therefore amongst the top 15% most efficient residential buildings within the French mainland residential stock.**

By exclusively selecting mortgages backed by recently built residential assets, respecting RT 2012 requirements[46], the Positive Impact Covered Bonds will contribute to finance the acquisition of dwellings belonging to the 15% most efficient residences in terms of energy consumption and GHG emissions related to energy use within the territory.

This methodology is also in line with a net zero emissions pathway logic. Indeed, eligible mortgages are financing residential buildings that are compliant with the most recent environmental building code (RT 2012). This norm, amongst others, was set up to decrease the sector energy consumption and its related GHG emissions.

This methodology is expected to accompany the National Carbon Reduction Strategy and be updated in order to take into consideration the future building codes. Thus, it will keep ensuring compliance with the sector's most recent and stringent performance standards. In this respect, the future regulation to come, i.e. 2020 Environmental Regulation, will require an update of the eligibility criteria. This upcoming regulation, together with the other recent norms (from 2015), is elaborated in line with the SNBC's carbon budgets trajectory, which aims at reaching a 2050 net-zero GHG emission on the French territory for the different sectors.

As a matter of fact, by 2050, the entire French residential building stock will have to show comparable performance than the ones of BBC labeled construction[47], whereas new dwellings will have to be energy positive (BEPOS) and possess renewable energy production equipment[48].

[46] See eligibility criteria page 4
[47] i.e the Low Energy Buildings label of RT 2005
[48] SNBC objectives declined for the residential sector: **www.ecologique-solidaire.gouv.fr/sites/default/files/18222_Strat%C3%A9gie%20nationale%20bas%20carbone%20en%2010%20points.pdf**

Being aware of this upcoming evolution context, the Positive Impact Covered Bond's allocation strategy will evolve over time in order to remain aligned with a 2050 decarbonization trajectory. With the coming into force of new regulations and the portfolio evolution, newer dwellings, more energy efficient and less carbon emissive, will progressively be added to the cover pool via new mortgages, whereas the older mortgages backed by older dwellings will progressively exit. Thus, the on-going renewing of the cover pool will improve its overall environmental performance.

This Positive Impact Covered Bond program therefore supports the evolution of the residential real estate sector's performance and contributes to the projected net zero emission pathway.

Integration of most recent buildings

As the selected portfolio will evolve over time, residential loans backed by newer dwellings will enter, thus renewing the portfolio.

Each year, approximately 5 000 residential loans, for an average outstanding amount of more than 700 000 000 € are entering the pool.

By the time, more energy and carbon performant buildings than the ones previously built will enter the pool, whereas other residential loans (less recent) will progressively exit the portfolio.

The portfolio's renewal, in a French context where the building regulation evolves progressively towards more stringent performance requirements for new constructions, ensures than the entering dwellings will be even more performant than the ones previously built.

Indeed, the environmental regulation to come (RE 2020) will fix new thresholds on both energy and carbon aspects that are more stringent than the RT 2012 ones (at least from 5 to 10% for energy consumption for residential buildings)[49]

The proxy use by the methodology, which is the construction date of new residential buildings[50], ensures the continuous improvement of the environmental performances of the residential buildings considered, particularly thanks to the evolution of buildings codes.

For the bonds issued by this program, Société Générale envisages a tenor that could reach 10 years.

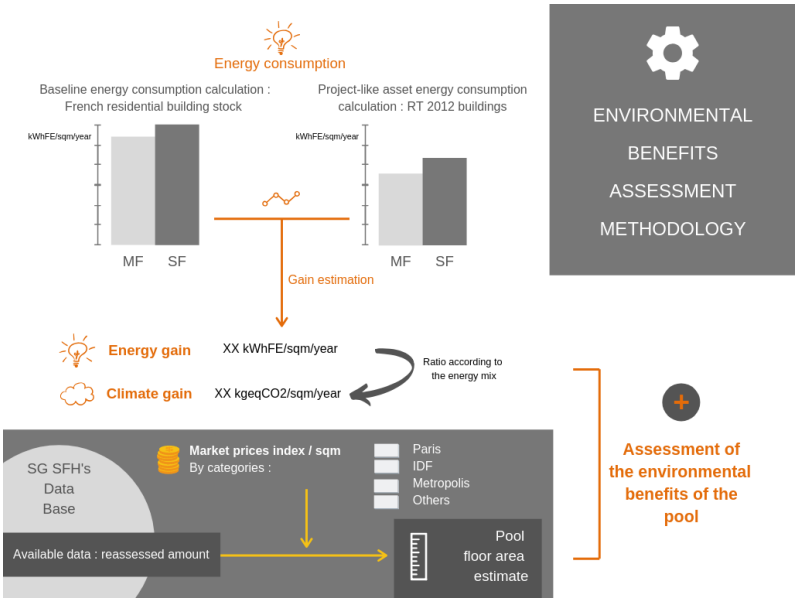
[49] Further details here : http://www.batiment-energiecarbone.fr/IMG/pdf/referentiel-energie-carbone-niveau-de-performance-2016-10.pdf
The regulation is still under discussion and will be held by 2021. The label E+C- experimentation is nevertheless an operational testing of future thresholds, more stringent than the RT 2012 ones.
[50] Further details in eligibility criteria definition

II) Environmental Benefits

Assessment of environmental benefits

The Positive Impact Covered Bonds program promotes, by supporting acquisition projects of dwellings presenting the best environmental performance, the increase of low carbon residential buildings in the French residential building stock. The generated environmental benefits by these sustainable practices, is illustrated by different indicators such as:

- The amount of saved energy (that was not consumed), expressed in **MWh**
- The amount of avoided greenhouse gas emissions (that were not generated), expressed in **tCO_2eq**



Data sources selection

Considering the scope of this methodology, the estimate of the environmental benefits is based on the PHEBUS survey data, elaborated in 2013[51]. This survey, carried out on **main residences** of the **metropolitan French territory**, assesses the **final energy consumption** for dwellings (not only regulatory uses).

Besides, the PHEBUS survey, allows to distinguish the energy consumption information per types of residential buildings (single-family, multi-family).

In the PHEBUS survey, energy consumption is expressed in Ton of Oil equivalent (toe). The values will thereafter be converted in kWh_{FE} according to the following conversion factor: **1toe = 11 627.8 kWh_{FE}.**

[51] The PHEBUS Survey presents the final energy consumption per type of dwelling and year of construction (Commissariat Général au Développement Durable, Chiffres et statistiques, n°645, juin 2015 – Consommation énergétique des ménages en 2012). This survey was carried out on a panel composed by 5 405 dwellings.

In order to establish the energy consumption baseline for each dwelling type, it is necessary to estimate their average floor area.

Using the ratio between the average consumed energy per dwelling and the average consumed energy per square meter[52], we estimate the average floor area for single-family and multi-family residential buildings.

Dwelling floor area sub-categories	Average consumed energy per dwelling (toe/dwelling/year)		Average consumed energy per sqm (toe/sqm/year)		Average floor area per dwelling (sqm)	
	Single-family	Multi-family	Single-family	Multi-family	Single-family	Multi-family
x<70 sqm	1.225	0.646	0.023	0.014	53.3	46.1
70<x<100 sqm	1.567	1.035	0.018	0.013	87.1	79.6
100<x<150 sqm	1.928	1.593	0.016	0.013	120.5	122.5
x>150 sqm	2.648		0.013		203.7	
Per type	1.800	0.799	Z	Z	Y	Y
TOTAL	1.505		0.016		94.1	

Figure 19: SOes, PHEBUS survey 2013

In order to estimate the single and multi-family average floor area per dwelling type (Y values in the figure 19), the breakdown of dwellings between the subcategories needs to be addressed. To achieve this, a breakdown estimate has been done on apartments as the below table underlines:

Dwelling floor area sub-categories	Multi-family (Apartments)	
	Weight%	Toe/dwelling/year
x<70 sqm	77%	0.646
70<x<100 sqm	11.5%	1.035
100<x<150 sqm	11.5%	1.593
x>150 sqm		
All	100%	0.799

Figure 20: SOes, PHEBUS survey 2013

Given the fact that the average annual energy consumption for all multi-family residential buildings (0.799 Toe/dwelling/year) is close to the one of the first sub-categories (0.649 Toe/dwelling/year), we can assume that apartments of less than 70 sqm represent an important part of the pool. Moreover, at national scale in 2013, the average floor area for multi-family residential buildings is around 63.0 sqm.[53] The retained assumptions are that most multi-family residential buildings are part of the first floor area subcategory. The breakdown calculated in figure 20 enables to reach the result of 0.799 Toe/dwelling/year for multi-family residential buildings consumption.

[52] (Average consumed energy/dwelling) / (Average consumed energy/sqm) = Average floor area/dwelling
For example: 1.225/0.023 = 53.3 sqm for house (under 70 sqm).
[53] INSEE, 2013, Les conditions de logement en 2013
https://www.insee.fr/fr/statistiques/1287961?sommaire=1912749

Such breakdown implies that **77% of the multi-family residential buildings (MFRB) have a floor area smaller than 70 sqm**, while 11.5% have a floor area between 70 and 100 sqm and 11.5% have a floor area higher than 100 sqm. This breakdown is then applied to the global table to approximate the weighted average floor area per multi-family residential buildings in the PHEBUS survey (Y in figure 19).

$$Average\ dwelling\ floor\ area = \sum(Weight \times Average\ floor\ area\ per\ dwelling)$$

$$For\ MFRB: (0.77 \times 46.6 + 0.115 \times 79.6 + 0.115 \times 122.5) = 58.8\ sqm$$

An average floor area of **58.8 sqm** is then estimated for the multi-family residential buildings. For single-family residential buildings, the estimated average floor area is then **108.8 sqm**[54]**.** Hence, we have further information in the global table:

Dwelling floor area sub-categories	Average consumed energy per dwelling (toe/dwelling/year)		Average consumed energy per sqm (toe/sqm/year)		Average floor area per dwelling (sqm)	
	Single-family	Multi-family	Single-family	Multi-family	Single-family	Multi-family
x<70 sqm	1.225	0.646	0.023	0.014	53.3	46.1
70<x<100 sqm	1.567	1.035	0.018	0.013	87.1	79.6
100<x<150 sqm	1.928	1.593	0.016	0.013	120.5	122.5
x>150 sqm	2.648		0.013		203.7	
Per type	1.800	0.799	Z	Z	108.8	58.8
TOTAL	1.505		0.016		94.1	

Figure 21: SOes, PHEBUS survey 2013

By applying the following conversion factor: **1toe = 11 627.8 kWh$_{FE}$,** we derived the average real energy consumption from the average floor area per dwelling type:

$$For\ MFRB: \left(\frac{0.799}{58.8}\right) x\ 11\,627.8 = 158.0\ kWhFE/sqm/year$$

$$For\ SFRB: \left(\frac{1.800}{108.8}\right) x\ 11\,627.8 = 192.4\ kWhFE/sqm/year$$

[54] The average floor area per dwelling of the PHEBUS survey is known (94.1 sqm). As the PHEBUS enquiry repartition for individual heating dwellings (majority of the park) is also know (29.4% for apartments and 70.6% for houses, see PHEBUS survey page 2), the following calculation permits to estimate the average house floor area: (94.1 – (58.8 * 0.294)) / 0.709 = 108.8.

The global table can be completed as follows:

Dwelling floor area sub-categories	Average consumed energy per dwelling (toe/dwelling/year)		Average consumed energy per sqm (toe/sqm/year)		Average floor area per dwelling (sqm)	
	Single-family	Multi-family	Single-family	Multi-family	Single-family	Multi-family
x<70 sqm	1.225	0.646	0.023	0.014	53.3	46.1
70<x<100 sqm	1.567	1.035	0.018	0.013	87.1	79.6
100<x<150 sqm	1.928	1.593	0.016	0.013	120.5	122.5
x>150 sqm	2.648		0.013		203.7	
Per type	1.800	0.799	0.017	0.014	108.8	58.8
TOTAL	1.505		0.016		94.1	

Figure 22: SOes, PHEBUS survey 2013

Hence, baselines of average real energy consumption for each type are:

- **Multi-family residential buildings: 158.0 kWh_{FE}/sqm/year**
- **Single-family residential buildings: 192.4 kWh_{FE}/sqm/year**

Pool energy performance evaluation: the average energy consumption of RT 2012 dwellings

In the PHEBUS survey, the most recent properties were grouped in a range called "since 2006" that included constructions built between 2006 and 2013. Since the pool of positive impact properties consists of RT 2012 compliant properties, the PHEBUS survey results were extrapolated in order to obtain an annual energy consumption for dwelling built since 2013, the effective year of the RT2012 energy performance requirements.

In order to do so, the global energy consumption reduction of main residential buildings was estimated using an **annual energy consumption reduction factor.** This factor was derived from the final energy consumption data collected by the CEREN on main residential buildings at different year[55] :

Year	Consumption in TWh/year	Consumption in kWh_{FE}/dwelling/ year	Consumption in kWh_{FE}/sqm/year	Average consumption improvement slope (kWh_{FE}/sqm/year)
1990	471.5	21 819.1	198	2.42
2000	494.4	20 318.9	184.4	3.09
2005	495.1	19 154.7	173.8	3.53
2010	461.3	16 932.6	153.7	3.11
2015	431.7	15 212.6	138	3.05
2016	424.9	14 879.1	135	-

Figure 23: Average final energy consumption for French main housing at different year, CEREN

[55] These consumption data were last updated in October 2018 for 2016 consumptions values. The next survey is planned to be carried in 2020.

The average reduction factor from each period to 2016[56] is **3.04 (kWh$_{FE}$/sqm/year)/year[57]**. A conservative approach is used here since this evolution refers to the entire French residential building stock. The assumption is that **this average reduction factor cannot be lower for RT 2012 buildings only** (considered as the most energy efficient buildings).
Then, this factor was applied to the PHEBUS survey results (see table below), in order to extrapolate the final energy consumption by period of construction survey's data (in black), to an annual average final energy consumption for more recently built dwellings (in grey):

Data source	Construction period	Energy consumption in kWh$_{FE}$/sqm/year
PHEBUS survey	Before 1919	197.7
	Between 1919 - 1945	220.9
	Between 1946 - 1970	197.7
	Between 1971 - 1990	174.4
	Between 1991 - 2005	162.8
	Since 2006 (-2013)	139.5
Yearly consumption data extrapolation	2007	136.5
	2008	133.5
	2009	130.4
	2010	127.4
	2011	124.3
	2012	121.3
	2013	118.3
	2014	115.2
	2015	112.2
	2016	109.1

Figure 24: Extrapolation of final energy consumption of main residential buildings per construction period according to the average reduction factor

The energy consumption related to the period (2006-2013) corresponds to the average energy consumption of RT 2005 buildings. The extrapolation, using the average reduction factor, aims at **estimating the energy consumption gap between RT 2005 and RT 2012 buildings**, the missing information in PHEBUS survey. The extrapolation ends in 2016 in order to be consistent with the factor, also calculated until 2016 on the CEREN data.

The mean of the extrapolated average final energy consumption for dwellings built between 2013 and 2016 is equal to **113.7 kWh$_{FE}$/sqm/year[58]** and corresponds to the average final energy consumption of the Société Générale SFH's eligible pool (Buildings constructed from 2013 and complaint to RT 2012 criteria).

[56] (X year consumption – 2016 year consumption) / (2016 – X year)
[57] Value obtained from mean calculation of the average reduction slope for each inter-period diminution.
[58] In order to validate the consistence of the results, a thermal model RT2012 dwelling's energy consumption was tested for two types of dwellings: one apartment and one individual house (considering that most collective residences tend to be connected to shared heating networks, significantly reducing their individual energy consumption). The consumption results obtained were of 111.2 kWh$_{FE}$/sqm/year for the apartment, and 107.6 kWh$_{FE}$/sqm/year for the individual house. As energy consumptions can vary from one building to another, and as the methodology uses a conservative approach in applying a factor of 3.04 (kWh$_{FE}$/sqm/year)/year (calculated for the overall park, the factor would be higher for RT2012 buildings only), the estimate of an average consumption of 113.7 kWh$_{FE}$/sqm/year for RT2012 dwellings is consistent.

In order to differentiate the average final energy consumption between RT 2012 single-family and multi-family houses, the type of heating and SHW equipment need to be refined. Indeed, collective networks are more efficient (100%) than individual devices, which present an annual performance of 80%. In order to weigh the average energy consumption with this factor, the **breakdown of collective or individual devices uses has to be estimated for each dwelling type**.

The PHEBUS survey detail on the dwelling type allows to identify the heating device used by each type (see table below).

Type of dwelling	Collective Heating or Sanitary Hot Water (SHW) (%)	Individual Heating or SHW (%)	TOTAL
Single-family	1.5	56.1	57.5
Multi-family	19.0	23.4	42.5
TOTAL	20.5	79.5	100

Figure 25: SOes, PHEBUS survey, Collective and Individual Heating or SHW repartition for each dwelling type, 2013

The PHEBUS survey confirms that in the French main residential building stock, the great majority of single-family buildings are equipped with **individual heating and SHW devices**, while multi-family buildings tend to derive their heating source with **collective networks**. In a conservative approach, the choice has been made to associate RT 2012 multi-family houses with a Collective / Individual heating or SHW mix according to the PHEBUS survey, even if most of the recent multi-family buildings are nowadays linked to a collective network. In the same logic, individual houses are assumed to have only individual heating devices.

Hence, according to the figure 25 and to the previous hypothesis, the breakdown is the following:

- **55.1% of the multi-family residential buildings use heating or SWH individual devices**
- **100% of the single-family residential buildings use heating or SWH individual devices**

As heating and SHW energy consumption represents approximately 75 kWh_{FE}/sqm/year according to TDS (thermo-dynamic simulations) realized on RT 2012 buildings, a performance of 80% for individual devices leads to an energy consumption of 94 kWh_{FE}/sqm/year, an increase of 19 kWh_{FE}/sqm/year comparing to buildings connected to collective devices (performance of 100%).

Considering heating and SHW devices' energy performance, the average final energy consumption reference for each RT 2012 dwelling type has been adjusted as follows:

- **RT 2012 single-family residential buildings: 117.3 kWh_{FE}/sqm/year**
- **RT 2012 multi-family residential buildings: 108.8 kWh_{FE}/sqm/year**

Energy savings

The difference between the energy baseline (final energy consumption of the French main residential building stock) and the final energy consumption of RT2012-compliant dwellings represents the energy savings generated by the improvement of the construction standards and related energy performance. For each dwelling type, the energy savings are as follows:

- **single-family residential buildings: 75.1 kWh_{FE}/sqm/year**
- **multi-family residential buildings: 49.2 kWh_{FE}/sqm/year**

These energy savings will be later **weighted by the eligible pool floor area** in order to assess the energy savings of the Positive Impact Covered Bond program.

These savings are expressed by sqm and are here more advantageous for single-family houses, but the trend would be different if the savings were expressed by user, as multi-family residential buildings count generally more users/sqm than houses.

Since 2000, the average residential building floor area grew above 90 sqm per dwelling[59] While the average floor area of houses increased, the apartment areas decreased. Both types have similar occupancy rates. **Hence, the energy savings per sqm will seem greater for single-family residential buildings than for multi-family residential buildings, whereas energy savings per occupant will be less advantageous for single-family residential buildings, because of their lower heating devices performance and ratio per user**.

According to 2017 INSEE data[60], in 2013, **single-family homes display 1 user for 45 sqm while a flat displays 1 user for 32.5 sqm**. As RT 2012 single-family buildings consume 117.3 kWh_{FE}/sqm/year and RT 2012 multi-family building consume 108.8 kWh_{FE}/sqm/year, and as multi-family buildings are numerous to be connected to urban networks (less emissive), **multi-family buildings generate at least 40% less GHG emissions per user compared to single-family buildings**.

[59] Insee survey: https://www.insee.fr/fr/statistiques/3676693?sommaire=3696937&q=occupatin+des+logement

[60] Les conditions de logement en France, édition 2017 - Insee Références https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwiF0Prqsd_iAhX86eAKHSPfCioQFjAAegQIARAC&url=https%3A%2F%2Fwww.insee.fr%2Ffr%2Fstatistiques%2Ffichier%2F2586024%2FLOGFRA17k2_F6.2.pdf&usg=AOvVaw0dORYxpjwTl_2W0NyqzIyT

Climate benefits

Previous energy savings assessment permits the estimate of the related climate benefits thanks to a GHG emission energy mix ratio.

In order to determine the GHG emissions linked to the real final energy use in main housing (Scope 1 & 2), the carbon emission factor for each type of energy source consumed in the **different residential uses** (residential energy mix 2017, see figure 12) has to be taken into consideration (Figure 26).

The carbon emission factors, considered for each source of energy (see table below) are applied according to the residential energy mix:

Energy source	Carbon emission factor $kgCO_2eq/kWh$	Proportion in the residential energy mix 2017	Weighted value
Coal	0.384	1%	0.0038
Wood	0.013	4%	0.0005
Oil	0.3	12%	0.0360
Natural gas	0.234	41%	0.0959
LPG gas	0.274	1%	0.0027
Electricity	0.084[61]	36%	0.0302
Urban network or other	0.126	5%	0.0063
Weighted mean carbon emission factor of the residential energy mix ($kgCO_2eq/kWh$)			**0.1756**

Figure 26: Carbon emission factor weighted by the different type of energy uses in the French residential sector

The weighted average factor is then applied to the previously calculated gap between the final energy consumption of the entire main residential French building stock, and the final energy consumed by RT 2012 compliant dwellings. This gives an estimate of GHG emission avoided by RT2012 dwellings.

For each residential building type, the climate benefit (avoided GHG emissions due to energy savings) can be described as follows:

- **Single-family residential building: 13.19 $kgCO_2eq$ /sqm/year**
- **Multi-family residential building: 8.64 $kgCO_2eq$ /sqm/year**

[61] The hereby methodology is based on this carbon emission coefficient, which is still used since 2012, on EPC diagnosis for example. However, ADEME, since January 2019, has modified the coefficient used in its "Bilan Carbone" data base. This topic has to be followed, in a context where the RE 2020 regulation will use this type of data.

Evaluating the total energy savings and related GHG emissions avoided by the pool of properties backed by eligible mortgages requires weighting the energy and climate benefits of the RT 2012 dwellings to the eligible pool's floor area (in sqm). Since this information is not directly available in SG SFH's database, intermediary calculations are needed in order to estimate the floor area concerned.

In order to do so, the mortgages' linked assets are analyzed through their updated asset values ("MNT_RVL" attribute), which are annually reviewed with INSEE indexes by Société Générale. These assets' updated value should be re-weighted by the real estate market average prices to determine the assets' floor area.

Estimating the dwellings' floor area according to their local real estate value

Because of the fluctuant French real estate market prices, the selected asset pool floor area is estimated according to the average market selling prices for new houses and apartments[62], evaluated for four geographical areas:

- The French capital (Paris)
- The peripheral capital area (Ile-de-France region)
- Major cities
- Other locations

Such granularity reduces the risk of overestimating the environmental benefits generated by the eligible pool.

By considering only the higher amounts of real estate transactions, the following methodology allows a conservative approach to estimate the floor area. Thus, avoiding any overestimate of the climate benefits generated by the eligible pool. Because of the previous, the dwelling pool's area was estimated according to the higher values of the real estate prices for each category.

Real estate market prices were obtained through the national notary transaction data base, which is based on the analysis of the observed market selling and acquisition prices for new dwellings for the previous timeframe (in this case, from October 2017 to October 2018).

[62] The real estate market values per urban area category for each type of new dwellings, is obtained by the public data of the public notary records: https://immobilier.notaires.fr

Environmental benefits generated by RT2012 dwellings

The previous stage presented the estimate of the environmental benefits that are generated by the newest main residential dwellings of the French residential building stock in terms of energy savings and related avoided GHG emissions. The following table, sums up the environmental benefits according to Société Générale's Positive Impact Covered Bond program:

Type of dwellings	Energy gain – saved energy (kWh_{FE}/sqm/year)	Climate gain – avoided GHG emissions ($kgCO_2eq$/sqm/year)
Single-family	75.1	13.19
Multi-family	49.2	8.64

The environmental benefits generated by RT 2012 dwellings, are then applied to the pool's floor area (detailed by types of dwellings).

Results are then divided by 1,000 in order to express the benefits from kWh_{FE} to MWh for energy savings and from $kgCO_2eq$ to tCO_2eq for related avoided GHG emissions. The following results are calculated for the eligible pool at May 31, 2019.

Type of dwellings	Energy savings (MWh)	Climate benefit – avoided GHG emissions (tCO_2eq)
Single-family	55 143	9 683
Multi-family	35 552	6 243
Total	90 695	15 926

Results interpretation

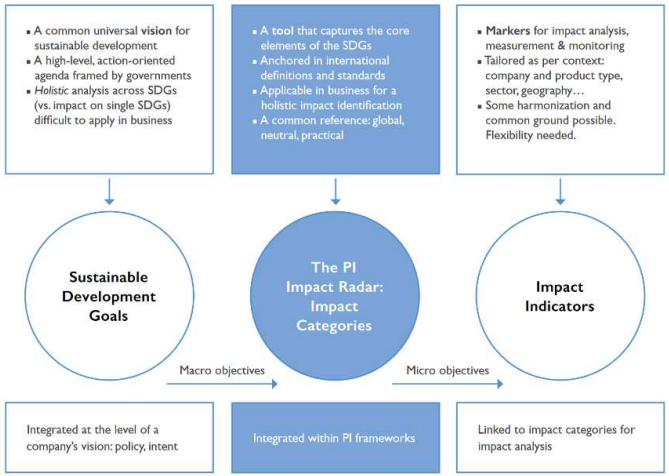
Results show higher environmental benefits for houses than for apartments. Such difference stems from different factors, as previously mentioned:

- Multi-family residential buildings tend to be equipped with urban network heating and SHW equipment which are more efficient than the individual ones found in Single-family residential buildings.
- The benefits are expressed by the floor area of use of the dwellings. Considering that apartments and houses have similar occupation rates, with houses representing a larger area, a comparison of benefits according to a user per area ratio would be different and show a greater benefit generated by apartments than by houses.

With this in mind, the results indicate that the program launched by Société Générale, generate a climatic benefit similar to the annual carbon footprint of 1,777 French citizens[63].

[63] By comparison with an average annual carbon footprint of 7 tCO2eq per person- ADEME report: https://www.ademe.fr/climat-air-energie-0

Positive externalities



Société Générale is engaged in a global Sustainable and **Positive Impact Framework** that covers its different activities.

This Positive Impact Covered Bonds program is part of this global Framework which is inspired for the Positive Impact side by the **Positive Impact Finance Framework** developed by UNEP FI. It consists, for each project, to assess related positive and negative externalities.

The projects' secondary effects can be analyzed thanks to the "**Impact Radar**", which permits, for each environmental or societal issue, to underline the positive impacts and the limited negative impacts of projects. These impact categories allow to have a multi-issue overview and to scan all potential secondary consequences of projects. Impact categories have been set up regarding the **Sustainable Development Goals** (SDG), a widely recognized framework promoted by the United Nations.

SG SFH's Positive Impact Covered Bonds program has been analyzed through both frameworks in order to measure its implication toward **international goals achievement**.

Figure 27: The Impact Radar: an intermediation tool for holistic impact identification

Figure 28: The Impact Radar

Figure 29: Sustainable Development Goals

UNEP FI Impact Category	Related SDG	General goals and frameworks	Project input	Project positive externalities	Possible indicator
Climate		The **Paris Agreement** on climate change: The main objective is to limit the global temperature increase under a 2°C value. In order to hold this commitment, the reduction of worldwide GHG emissions from 40 to 70% is required by 2050. The **French Low Carbon Strategy**: For the real estate sector, France is engaged in the reduction of 54% of its general emissions by 2024-2028, and of 87% by 2050. The Environmental regulation **RE2020**: New buildings will have to uphold the performance thresholds settled by the experimental label E+C-. These requirements include two aspects: carbon and energy.	Reduction of GHG emissions	One of the main factors influencing a building's carbon footprint is its energy consumption. By exclusively supporting the acquisition of constructions in compliance with the performance requirements of the RT2012 regulation, the bond emission allows to support the reduction of GHG emissions. In effect, buildings upholding to the RT2012, present lower GHG emissions for energy consumption than older constructions. This, resulting from the evolution of the applicable buildings codes energy performance requirements and from the evolution of the consumed energy mix, whose carbon composition is decreasing. In addition, new dwellings' share of electrical consumption is increasing for heating uses, less carbon emissive then its alternatives, thus reducing the dwellings GHG emissions. The exclusion of dwellings used as secondary residences also contributes to the positive climate performance of the overall portfolio. Indeed, in addition to energy consumption, one of the main factors influencing a building's carbon footprint is linked to the usage and to the selection of its construction materials (average of 30%, WBCSD). The ratio of the carbon footprint related to construction materials per dwelling's annual occupancy is less favorable for secondary residences and in contradiction with the carbon footprint reduction target of the real estate sector.	**GHG emissions avoided**
Energy		**The Thermal regulation RT2012**: Limit the primary energy consumption for new constructions to a maximum threshold of 50 kWh_{PE}/sqm/year.	Improving the energy performance for conventional usages.	The energy performance is at the center of the building's sustainability challenge. Several French regulations have imposed energy consumption thresholds according to the dwelling's conventional usages. The RT2012 defines a maximum consumption of 50 kWh_{PE}/sqm/year for new houses and of 57 kWh_{PE}/sqm/year for new apartments. By exclusively selecting mortgages linked to RT2012 compliant dwellings, the Positive Impact Covered Bonds program allows to support dwellings labelled with a "A" or "B" energy performance by the French EPC diagnosis tool (DPE). This evaluation tool, recognized at a European scale, informs on the construction performances and therefore positive climate contribution. Besides it is used as a lever for the market's orientation towards more sustainable constructions.	**Energy savings** (see environmental benefits calculation) **Dwellings presenting a "A" or "B" EPC label**

Inclusive, Healthy economy		**Governmental Plan for equal access to Health Care in the territory** (2018). Opening of **PTZ for rural areas** (2015): Promote, through credit tools, the renovation of existing buildings in rural areas in order to enable their revitalization. **Legal imposition dispositions on secondary residences taxation**.	Rural area dynamic	Urban migration and rural exodus are a worldwide phenomenon, including in France: Although France is the European country with the higher number of municipalities, the rural population is decreasing. Indeed, it represented 22,6% in 2006 and decreased to 20% in 2017. This rural area depopulation has important impacts on the territories' vitality and their economic dynamism, the demographic decline inducing a degradation or rarefication of public services such as transportation, healthcare, education etc. The revitalization of small towns and rural areas is a main factor for achieving an equality amongst the French territories. The real estate sector is an important lever to support the rural areas by creating economic demand for diverse activities thanks to local consumption or services demand increase thanks to new moving ins. With this context in mind, the strategy followed for the definition of this methodology is to exclude mortgages linked to assets that will be used as secondary residence. By doing so, the strategy is to not contribute to the acquisition of dwellings that will remain unused a large part of the year, impacting the local economy dynamic and increasing the real estate pressure for local residents, forced to decentralize themselves. Moreover, secondary residences, used to generate touristic profit in leisure and holiday location consist in a non-commercial lodging activity, competing with the touristic and hotelier sector.	**Ratio of assets located in rural areas**
Housing		**Legal disposition of imposition and taxation on secondary residences**. **The ALUR law** (For dwelling access and urbanistic renovation): The main objective is to reduce the real estate value for tenants, develop the rental offer and reform the co-property management. **The State personal support for housing access**: It is the first budgetary item of the housing politic. It concerns more than 6,5 million households for a budgetary cost of 16 billion euros in 2019.	Improving the access to dwelling's property acquisition for households searching for a main residence	By targeting mortgages associated to main residences only, the Positive Impact bond emission promotes residences primary use: housing. By selecting exclusively main residences, this methodology contributes to reduce the negative impact that secondary residences could induce in the real estate market prices. In a context of diversification of residential leasing modes (where more and more rentals are reserved for punctual renting), the real estate market prices are rising, creating barriers for property acquisition for local inhabitants. In this context, supporting main residential acquisition allows mitigating some negative externalities of the residential real estate sector. Simultaneously, this approach presents an interest for the economic activity and dynamism of the concerned regions. This, by sustaining real estate acquisition in the totality of the region, not only in sectors presenting a strong touristic interest, allowing to re-distribute and even the territory's activity.	**Proportion of main residences financed** **Breakdown of dwellings per asset acquisition value** **Breakdown of outstanding amount per region**

Biodiversity & Ecosystems **Soil**		The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (**IPBES**) **report:** Alerts on the current priority of reducing the pressures on biodiversity, amongst which the soil erosion due to artificialization and extensive construction. The environmental impact assessment approach according to the following sequence: Avoid, Reduce, Mitigate, compensate (**ARMC**), is applied for all urbanistic organization planification or for any construction projects or authorization procedure (environmental impact studies, Natura 2000, presence of protected species, etc.). The law for the **regain of biodiversity, nature and landscapes** (2016): This law main objectives are to suppress biodiversity lost, impulse it's gains and the imposition of the ARMC sequence for any project presenting potential impacts on biodiversity or it's related services.	Limit the negative impacts on biodiversity and avoid soil erosion	Urban sprawling is one of the main factors responsible for soil artificialization. This phenomenon is tightly linked with peri-urbanization, usually related to the multiplication of individual houses in cities or metropolis's peripheral sectors. The land use modification has consequent impacts on several activity sectors. According to Eurostat and the French Bureau of Agriculture, the proportion of agricultural land, represented 52.1% of the metropolitan territory in 2006. In 2016, it decreased to 51% while the artificialized soil proportion evolved from 8,3% to 9,3% during the same period. Whereas France possess Europe's larger agricultural area, each day, more than 220 hectares of arable land disappear (or the equivalent of 4 median farms). In 2010, the Bureau of Agriculture estimated that the arable land loss represented 82 000 hectares per year. In 10 years, the loss of arable soil represents the disappearance of an entire department's area. Thus, resulting in significant impacts on several economic sectors, as well as contributing to the primary resources scarcity in a population growth context. Meanwhile, soil artificialization impacts forest areas, wetlands, meadows, brownfields, etc. Those ecosystems are essential for the biodiversity's conservation and the preservation of their respective benefits and services protection (such as pollination). Even though certain ecosystems already count with regulatory tools in order to manage and preserve them, others, presenting good biodiversity values, are daily confronted to several pressure factors. As an example, the Notarial Real Estate Barometer of the Western territory, carried out an inventory of the coastal area of the Northern Sea Channel. Its results indicated that only 54% of the sold dwellings were destined for secondary residential use, while 62% of sold sites, for industrial use. According to the CESE, in the « Rapport annuel sur l'état de la France 2014 », individual houses are the first vector of soil artificialization. Between 1992 and 2004, the floor area occupied by individual houses has increased 37 times faster than the floor area occupied by collective housing, to reach a ratio of 25 habitable sqm for 100 artificialized sqm. Within this context, the asset selection methodology applying for this Positive Impact Covered Bond program, allows (by not considering any secondary residences in the asset's selection pool), to limit land artificialization and its consequences on soil and biodiversity erosion. In addition, the program, by supporting access to apartments, contributes to reduce the construction's soil area construction rate (the share of apartments is higher than the share of individual houses in the eligible portfolio).	**Proportion of main residences financed** **Multi family /Single family ratio**

Mobility	  	The **Paris Agreement** on climate change: The main objective is to limit the global temperature increase under a 2°C value. In order to hold this commitment, the reduction of worldwide GHG emissions from 40 to 70% is required by 2050. The **French Low Carbon Strategy**: For the real estate sector, France is engaged in the reduction of 54% of its general emissions by 2024-2028, and of 87% by 2050. **Mobilities law project** (2019): Main goals are to provide, for everyone and everywhere, alternative to individual car use, to develop new mobility solutions and innovation, to reduce the transports' carbon footprint and to invest into related infrastructures.	Support soft mobility and common transportation use	The average carbon footprint of a French citizen is annually estimated by the Bureau of Ecological Transition and the ADEME. Nowadays, it is estimated around 12 tCO_2eq/year. Amongst the emissions sources, the car usage is the main emission source with 2 tCO_2eq/year per person, indeed, 7 French citizens in 10 take their car to go to work. Car usage is the daily more emissive transportation mean in regard of its usage per person per travelled kilometer. Because of this, its reduction use is at the center of the national priorities for the achievement of the goals established by the national carbon reduction strategy (SNBC). This use is tightly linked with the travel distance between the residence ubication and the working place. It is also correlated with the public transportation service availability. Indeed, around 80% of mainland France, none of the collectivities propose daily public transport solutions. Buildings situated in major cities allows a decrease of the car use. Indeed, thanks to 1990 voluntary mobility policies in major cities, car use represents 51.7% of their modal share, when it represents 68% in medium-sized cities. With this in mind, the strategy selected by the Société Générale for the Positive Impact emissions of Covered Bonds seeks to enable the property access to multi-family and single-family building residences well served by public transportation.	**Ratio of Selected dwellings located in dense urban areas (number of dwellings):** **Split by type of dwellings**

Lexicon

Carbon or Climate performance: In this context, it represents the assessment of the portfolio assets GHG emissions in comparison with a defined threshold: the average GHG emissions of a defined perimeter (in this case, the residential buildings in metropolitan France).

Climate benefits: Calculated through the evaluation of the energy and carbon performance of the portfolio assets, eligible for a Positive Impact Covered Bond. The benefits generated are determined through the positive impacts generate on the reduction of climate change factors.

Climate regions: Due to the strong temperatures and climate conditions gradient within the metropolitan French territory, the thermal regulation RT 2012 adjusts its performance threshold in 8 sub-categories.

Energy performance: Corresponds to the assessment of the portfolio assets energy consumption according to average thresholds. Under this methodology, two reference thresholds were considered:

- a normative threshold defined by the compliance of the selected assets to the thermal regulation RT 2012. This threshold unit is expressed in primary energy and is based on theoretical consumptions;
- a calculated threshold equivalent to the average actual energy consumption of the residential Park in metropolitan France.

Energy Performance Certificate (EPC): Is a European rating scheme of building's energy efficiency and environmental impact (through GHG emissions) in the European Union. In France, the **Energy Performance Diagnosis (DPE)** is the EPC equivalence used to determine a building's environmental and energetic performance. The carbon issue (level) is assessed from energy consumption.

Final energy (FE): Corresponds to the produced energy consumed by a final user. From a primary energy source, it is then transformed, stored and transported to the consumption site. These different stages induce losses of energy, because of this, the final energy value is always lower than the one of primary energy. Conversion to primary energy is achieved by convention-based coefficient (2.58 for electrical energy; 1 for all others).

Primary energy (PE): Corresponds to the directly exploitable energy available without transformation. Primary energy is always superior to the final energy.

Real or Final consumption: Corresponds to the total energy consumed. It is influenced by external factors such as occupancy rates, outdoor and indoor temperatures, internal intakes, solar radiation, etc. Final or Real consumption differs from the theoretical one mainly because of the use and equipment or devices installed.

Regulatory uses (or RT uses): Refers to the energy "conventional uses" for heating, cooling, basic electrical consumption and sanitary hot water production (ECS).

Scopes: Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions[64]

Theoretical consumption: Corresponds to an estimate of the energy consumption according to conventional uses: related to heating, cooling, sanitary hot water (ECS), ventilation and lighting equipment. It differs from Real consumption (where data can be found on energy bills).

[64] Source: GHG Protocol, aligned with ADEME Bilan carbone's methodology.
https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf