Methodological guide to assess the greenhouse gas emissions avoided thanks to the use of solutions manufactured by Saint-Gobain

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1 Context and objectives

1.1 Context

In a global framework where the production of fossil fuels reaches a ceiling while the global demand continues to grow and where climate change is accelerating because of the increase of greenhouse gas emissions, the Saint-Gobain group has decided to become habitat leaser on sustainable construction markets by developing and manufacturing high-value construction solutions enabling a reduction of the global use of fossil fuels and thus of the related greenhouse gas emissions, especially through its insulation and glazing businesses[1], for the residential and tertiary markets.

Following a first calculation and communication done in 2015[2] during the COP21 in France, Saint-Gobain has decided to update and improve the methodology used at that time to calculate the amount of greenhouse gas avoided thanks to the use of insulation and glazing solutions, in order to :

- Comply with the most recent and recognized international guidelines regarding the calculation of avoided GHG emissions
- Extend the scope of the calculation to other significant countries where the group has operations

1.2 Objectives

The objective of this work is to enable the communication of avoided GHG emissions to all the group's key stakeholders including investors and regulators.

1.3 Main evolutions since 2015

Compared to the first version of the methodology, the following modifications have been embedded into the methodology.

	2015 situation	2020 situation
Geographical scope extension	▪ Europe	▪ Europe, USA, South Korea, Japan, India, Russia, Turkey, Canada, Ukraine, Brazil, Argentina, Colombia, South Africa, Middle-East
Energy sources scope	▪ Heating savings	▪ Heating savings ▪ Air-conditioning savings
Evolution of calculation factors during solutions lifespan	▪ Stable calculation factors	▪ HDD evolving over the next 50 years ▪ GHG emission factors for electricity evolving over the next 50 years

Regarding the evolution of parameters over the lifespan, only heating degree days and electricity emission factors will change. All other parameters (heating energy mix, average thermal resistance of buildings, etc.) will be kept stable given that it was not possible to gather reliable data on their evolution over the next 50 years.

2 Glossary

As a first step, it is important to remind the meaning of the word "avoided" used in this guide. According to the French Environmental Protection Agency (ADEME), are considered as avoided GHG emissions

[1] Insulation and glazing have a direct impact on buildings' energy savings thus on their carbon emissions; their performance is achieved in combination with the installation of other Saint-Gobain such as plaster and cement boards, façade mortars, membranes, etc.
[2] Scope: Europe only (2014 sales data); based on the same methodology, an update was published in 2017 (2016 sales data) with a rough internal estimate of the avoided emissions on an extended scope: world

all emissions which are avoided outside the activity scope of the company, for instance in clients or consumers' premises.

The following definition will be useful to facilitate the understanding of this guide:

- **LCA** (Life cycle analysis): Quantitative assessment of various environmental impacts related to the complete life cycle of one product, from the extraction of raw materials used to manufacture the product until its end-of-life

- **Thermal transfer coefficient**: The amount of heat transferred per second through a 1m² area of a given material with a given thickness, for a 1 K difference of temperature between the two sides of the material (expressed in $W.K^{-1}.m^{-2}$)

- **Thermal conductivity**: The amount of heat transferred per second through a 1m² area of a given material with a 1 m thickness, for a 1 K difference of temperature between the two sides of the area. Contrary to the thermal transfer coefficient, the thermal conductivity is an intrinsic characteristics of one material and does not depend on the thickness of the considered wall (expressed in $W.K^{-1}.m^{-1}$)

- **Degree days (heating or cooling)**: Climate indicator accounting – for each day of the considered year – the difference between the outdoor temperature (calculated as the average of the minimum and maximum temperature of the day) and a reference indoor temperature (expressed in K.day)

- **Energy performance Diagnosis (DPE)**: The assessment of the energy performance of one building, according to a French methodology

- **Emission factor**: Amount of greenhouse gas (GHG) emitted per activity unit

3 Calculation rules

3.1 General principles

The calculation is based on the comparison between the solutions manufactured and sold by Saint-Gobain and an average solution considered as the reference on the market, providing the same functionality (insulating a building).

The solutions included into the scope of the study are the insulation solutions used to insulate roofs & ceilings, walls, floors and glazing of buildings, which main function is to reduce the amount of energy consumed through heating.

- Insulating panels in glass wool and stone wool (and PUR for UK only)
- Double- and triple-glazing with low-emissive (Low-E) glass

The calculation of the amount of GHG emissions avoided is explained separately for these two categories of solutions. The results will be provided with the following distribution:

- For each country under study
- For the residential and the tertiary market
- For renovation and new construction activity
- For each building application (roofs & ceilings, walls, floors, windows)
- For each category of material (glass wool, stone wool, PUR, glazing)

Other solutions which main function is not to thermally insulate are not included in the scope of the study (internal separating walls, decoration, etc.).

3.2 Scope of the study

The following countries are included into the scope of the study:

- The European union of 28[3], as well as Norway and Switzerland
- Japan
- South Korea
- India
- The United States of America
- Turkey
- Ukraine
- Russia
- Canada
- Brazil
- Argentina
- Colombia
- South Africa
- Middle East

The above-mentioned scope represents a total of approx. 850 million of m² of insulation solutions (approx. 100% of the building insulation sales for the year 2019) and 50 million of m² of double- and triple- glazing (approx. 86% of the sales for the year 2019).

[3] Germany, Austria, Belgium, Denmark, Finland, France, Ireland, Luxemburg, Netherlands, United Kingdom, Sweden, Bulgaria, Estonia, Hungary, Lithuania, Latvia, Poland, Czech Republic, Romania, Slovakia, Slovenia, Cyprus, Croatia, Spain, Greece, Italy, Malte, Portugal

In some areas of the methodology, the following segmentation of Europe will be used:

Area	Country
Northern and Western Europe	Germany, Austria, Belgium, Denmark, Finland, France, Ireland, Luxemburg, Norway, Netherlands, United Kingdom, Sweden, Switzerland
Central and Eastern Europe	Bulgaria, Estonia, Hungary, Lithuania, Latvia, Poland, Czech Republic, Romania, Slovakia, Slovenia
Southern Europe	Cyprus, Croatia, Spain, Greece, Italy, Malte, Portugal

Sales data used to calculate the GHG emissions avoided corresponds to the year 2019 (*except for a small part of the sales -14%- for which 2018 data have been used*).

The calculation is based on energy savings generated by a reduction of heating and air-conditioning thanks to the insulation of the buildings. Savings related to air-conditioning are however calculating on a limited scope of countries where climate conditions lead to a high use of air-conditioning systems, i.e. the Southern Europe area as well as USA, India, Turkey, Middle-East, Brazil, Colombia, Argentina, South Africa.

3.3 Characteristics of the average Saint-Gobain solution

The calculation of GHG emissions avoided requires the definition of the average Saint-Gobain solution that will be compared to the reference solutions (see next section of the guide for more information about the reference situation).

The characteristics of the average Saint-Gobain solutions are calculated by weighting the characteristics of all solutions sold by the group by the related sales in each country.

3.3.1 *Roofs & ceilings, walls and floors insulation solutions*

For each insulation material category (glass wool, stone wool and PUR), application (roofs & ceilings, walls, floors), market (residential, tertiary) and activity (renovation, new construction), an average thermal transfer coefficient U_{SG} can be calculated by dividing the thermal conductivity of the material λ (in $W.K^{-1}.m^{-1}$) by the product thickness (in m). It is thus necessary to define an average thickness and thermal conductivity, from the characteristics of the solutions sold by Saint-Gobain during the year.

The average thickness and thermal conductivity were obtained from Saint-Gobain countries for the main countries of production, i.e. Germany, Denmark, France, UK & Ireland, Norway, Netherlands, Poland, Czech Republic, Spain & Portugal, Russia, Japan, Turkey, USA, Canada, Ukraine, Middle-East, Brazil, Colombia, Argentina, South Africa.

For the remaining countries of the scope, the weighted average values obtained from the countries mentioned above were used to calculate the average U_{SG}.

For information, the average thickness was obtained by countries by dividing the total volume of insulation solutions sold in the country by the total surface sold:

$$e_{eq} = \frac{\sum_{solutions} m^3}{\sum_{solutions} m^2}$$

The average thermal conductivity was obtained through a weighted average of the thermal conductivity of all solutions sold, according to the following formula:

$$\lambda_{eq} = \frac{\sum_{solutions}(\lambda_{solution\ i} * m^3)}{\sum_{solutions} m^3}$$

The thermal transfer coefficients thus calculated for each category of material, market, activity and application are summarized in the Appendix 1.

3.3.2 *Glazing insulation solutions*

Glazing insulation solutions are double- and triple-glazing relying on low-emissive glass, assembled in various configurations:

- Double-glazing: 1 low-E glass and 1 clear glass
- Triple-glazing: 2 low-E glasses and 1 clear glass

For each market (residential, tertiary) and activity (renovation, new construction), the average thermal transfer coefficient U_W of glazing can be calculated by weighting the coefficients of the different solutions sold during the year by the amount of related sales.

A first pre-treatment of available data is required given that solutions sold are recorded through the amount of low-E glass used in the solution, while the thermal transfer coefficient U is provided for an assembled double- or triple-glazing. Triple-glazing being composed of 2 low-E glasses, it is necessary to divide the surface sold by 2 in order to get the surface of triple-glazing sold.

NB : The solar factor Sw, which illustrates the ability of one glazing to let solar heat enter the building is not reflected in the average Uw for Saint-Gobain glazing, given the lack of studies to model the links between Sw and Uw.

In first approximation, as no information was obtained regarding the end-market of the glazing manufactured for the scope of our study, it was considered that 100% of the glazing manufactured was used in tertiary buildings for renovation purpose.

The thermal transfer coefficients calculated for the market mentioned above are presented in the table below.

Category	U_{SG} (range)	U_{SG} (average)
Low-E glazing	1.13 – 1.88	1.31

3.4 The reference situation

The reference situation has been updated into the new methodology in order to take into consideration the recent recommendations from international guidelines in terms of GHG emissions avoided quantification (GHG Protocol, World Resources Institute, etc.).

Notably, a distinction is now made between solutions intended to be used in new buildings and solutions that will be used for renovation projects:

- For the renovation market, the reference situation corresponds to the average thermal performance for the building stock built before 1970, i.e. before insulation started to get installed in the walls of buildings.

- For the new construction market, two approaches were considered:

    - A 1st approach aimed at calculating the emissions avoided thanks to the “insulation action”: in that scenario, the reference situation corresponds to an insulated building, and is thus the same as for the renovation market

    - A 2nd approach aimed at calculating the additional contribution of Saint-Gobain. In this scenario, the reference situation corresponds to the thermal performance that the building would have obtained in any case given the energy regulation in place in the different countries of the scope

For the “additional contribution” scenario of the new construction market, the thermal characteristics are obtained from the tool created in the framework of the European TABULA project[4], by considering the thermal performance of the most recent buildings included in the tool[5].

[4] TABULA WebTool (building-typology.eu)
[5] Except for Poland, for which real data were obtained from the following website (https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20190001065)

Except for the USA, where real data resulting from the local regulations[6] were considered, an average value is considered for countries outside Europe. This assumption is conservative given that the building stock in non-European countries can be considered as being less energy-performant than the European one, thus leading to an underestimated amount of energy saved.

3.4.1 *Insulation of external walls*

For the renovation market, the reference U-values of the building stock were obtained from the report "*Survey on the energy needs and architectural features of the EU building stock*"[7], written in the framework of the INSPIRE European project.

For the new construction market, the reference situation corresponds to the thermal performance that the building would have obtained in any case given the energy regulation in place in the different countries of the scope.

The different reference values obtained are presented in the Appendix 2.

3.4.2 *Glazing insulation*

Similar to wall insulation, the reference situation for the renovation market was obtained from the report "*Survey on the energy needs and architectural features of the EU building stock*"[8], written in the framework of the INSPIRE European project.

The thermal transfer coefficients obtained are presented in the table below.

Category	U_{REF} (range)	U_{REF} (average)
Reference glazing	2.60 – 6.00	4.61

3.5 Methodological rules to calculate the amount of GHG emissions avoided

3.5.1 *General principles*

The methodology is based on the following principles:

- The amount of GHG emissions avoided is obtained by subtracting the amount of emissions generated by the solution's lifecycle from the amount of emissions avoided thanks to the use of the Saint-Gobain solution by comparison with the reference situation
- The use of the total surfaces sold over the year to aggregate the amount of emissions avoided for the full Saint-Gobain portfolio

The calculation of the yearly amount of GHG emissions avoided, ∆GHG (considering that ∆GHG > 0 corresponds to a saving) is calculated by aggregating the amount of GHG emissions avoided for each material category (glass wool, stone wool, PUR and low-E glazing), according to the following formula:

$$\Delta\mathrm{GHG} = \sum_{\mathrm{materials}} \Delta\mathrm{GHG}_{\mathrm{material\ i}}$$

For a given solution category, the amount of GHG avoided is calculated as follows:

$$\Delta\mathrm{GHG}_{\mathrm{material}} = (\mathrm{Savings}_{\mathrm{surf.He}} + \mathrm{Savings}_{\mathrm{surf.AC}} - \mathrm{Impact}_{\mathrm{surf}}) * \mathrm{S}_{\mathrm{sales}}$$

$\mathrm{Savings}_{\mathrm{surf.He}}$($kgCO_{2eq}.m^{-2}$) : Emissions from building heating avoided thanks to the use of 1 m² of the average Saint-Gobain solution

[6] https://insulationinstitute.org/im-a-building-or-facility-professional/residential/codes-standards/
[7] WP2_D2.1a_20140523_P18_Survey-on-the-energy-needs-and-architectural-features.pdf (inspire-fp7.eu)
[8] WP2_D2.1a_20140523_P18_Survey-on-the-energy-needs-and-architectural-features.pdf (inspire-fp7.eu)

$Savings_{surf.AC}$ ($kgCO_{2eq}.m^{-2}$)	: Emissions from air-conditioning avoided thanks to the use of 1 m² of the average Saint-Gobain solution
Impact ($kgCO_{2eq}.m^{-2}$)	: Emissions generated during the lifecycle of 1 m² of the average Saint-Gobain solution
S (m²)	: Total surface sold during the year for the concerned solution material, application, activity, market and country

The emissions generated during the lifecycle of Saint-Gobain solutions are obtained either from the different LCA produced by Saint-Gobain or from the Environmental Product Declaration (EPD) available. The detail of this calculation is presented in section 3.5.6.

3.5.2 *Calculation of emissions related to heating avoided*

The emissions avoided because of a lower use of heating are calculated based on the amount of energy saved according to the following formula:

$$\mathrm{Savings_{surf,He}} = \sum_{\mathrm{heating\ sources}} \Delta\mathrm{NRJ_{source\ i.He}} * \mathrm{MIX_{source\ i}} * \mathrm{EF_{source\ i}}$$

ΔNRJ ($kWh.m^{-2}$)	: Energy savings from heating generated by the use of 1 m² of the average Saint-Gobain solution compared to the reference situation
EF ($gCO_{2eq}.kWh$)	: Emission factor of the heating energy source considered
$MIX_{source\ i}$	: Share of the energy source considered into the total heating energy mix

Energy savings from heating – for one energy source – are calculated as follows:

$$\Delta\mathrm{NRJ_{source.He}} = \frac{(\mathrm{U_{reference}} - \mathrm{U_{SG}}) * \mathrm{DD_{He}} * \mathrm{INT}}{\mathrm{EFF_{source}}} * \frac{24}{10^3}$$

A short explanation of the different calculation factors mentioned in the formula above is provided below. A more detailed explanation is available in section 3.5.4

U ($W.K^{-1}m^{-2}$)	: Thermal transfer coefficient of the considered opaque or glazed wall surfaces
DD_{He} (K.day)	: Heating degrees days
INT	: Intermittence corrective factor of heating equipment, including free heat gains
EFF_{source}	: Average efficiency of the heating equipment for the energy source considered

NB: The factor $\frac{24}{10^3}$ is used to convert the figure in $kWh.m^{-2}$.

3.5.3 *Calculation of emissions related to air conditioning avoided*

The emissions avoided because of a lower use of air-conditioning are calculated following a similar way than for heating, although the calculation is simpler given that electricity is the only type of energy used for air-conditioning.

$$\boxed{\text{Savings}_{\text{surf,AC}} = \Delta\text{NRJ}_{\text{AC}} * \text{EF}_{\text{elec}}}$$

$\Delta\text{NRJ}_{\text{AC}}$ ($kWh.m^{-2}$) : Energy savings from air-conditioning generated by the use of 1 m² of the average Saint-Gobain solution compared to the reference situation

EF (gCO_{2eq}.kWh) : Emission factor of electricity

Energy savings from heating – for one energy source – are calculated as follows:

$$\boxed{\Delta\text{NRJ}_{\text{AC}} = \frac{(\text{U}_{\text{reference}} - \text{U}_{\text{SG}}) * \text{DD}_{\text{AC}} * \text{CORR}}{\text{EFF}_{\text{AC}}} * \frac{24}{10^3}}$$

U ($W.K^{-1}m^{-2}$) : Thermal transfer coefficient of the considered opaque or glazed wall surface

DJU_{clim} (K.day) : Cooling degrees days

CORR : Corrective factor illustrating the share of buildings equipped with air-conditioning equipment and the vacancy periods

EFF_{AC} : Average efficiency of air-conditioning equipment

3.5.4 *Calculation factors used to calculate energy savings*

The calculation of energy savings involves several parameters, which calculation methodology is described below.

a) DD: Degree-days

The DD parameter aggregate – for each day of the year under study – the difference between the outdoor temperature (calculated as the average between the minimum and maximum temperature of the day) and a reference indoor temperature.

The definitions used to calculate the degree-days – for both heating and cooling – are based on the ones used by the Eurostat database[9], according to the following principles.

For heating degree-days:

- The indoor reference temperature is set at 18°C
- The temperature gap is considered only if the outdoor average temperature is lower than 15°C

For cooling degree-days:

- The indoor reference temperature is set at 21°C
- The temperature gap is considered only if the outdoor average temperature is higher than 24°C

In order to comply with the French Environment Agency (ADEME), which recommends to limit the gap between outdoor and indoor temperature at maximum 6°C when cooling, a maximum of 6°C is

[9] Energy statistics - cooling and heating degree days

considered in the calculation – even if the real gap between the outdoor average temperature and the indoor reference one is higher.

The calculation of degree-days for the next 50 years is based on the data from the international project CMIP6 – which modelling is used by IPCC scientists to calculate the evolution of temperature in the different areas of the world. The model used in our study is the one built by the French Institute Pierre-Simon Laplace (IPSL) and corresponds to the SSP1 – 2,6 scenario (conservative scenario in order to avoid overestimating savings.

In a second phase (September 2021), seven regions were added to the database (Ukraine, Middle East, South Africa, Argentina, Brazil, Canada and Colombia). The calculation of degree-days for the 2020-2070 period is based on the data from CMIP5. The indoor reference temperature is set at 18°C. No temperature gap is considered. Three time horizons are considered: short term (2035), medium term (2055) and long term (2085). Degree days values between these years are calculated by linear interpolation.

b) INT: Intermittence corrective factor for heating equipment

Real energy consumptions related to heating are usually significantly different from the theoretical heating needs calculated by considering the heat loss across internal and external walls. This theoretical amount of energy must thus be corrected to consider:

- The fact that heating equipment are not always working as soon as the temperature decreases, for instance because people usually do not spend all day at home
- The presence of other “free” sources of heat, including human beings, kitchen appliances and electronic equipment for instance

The guidance provided by the French Ministry of Environment in the frame of the energy performance diagnosis (DPE) methodology suggests setting the intermittence corrective factor at 0.7 for the most efficient heating equipment. This value will thus be considered in the calculation.

Given that the other “free” sources of heat cannot be easily modelled, and that no available documentation exists on the matter, they will be included to the intermittence corrective factor by considering a safety coefficient.
A calculation relying on simple assumptions[10] gives us a safety coefficient of 0.9 that will be included in the calculation.

A resulting INT factor of 0.6 – extrapolated to the global geographical scope – will be considered in the calculation.

c) CORR: Corrective factor applied to air-conditioning equipment

The intermittence corrective factor used for heating equipment cannot be used for air-conditioning equipment and no documentation has been found during the documentary review.

However, like heating, a corrective factor must be considered to illustrate the gap between the theoretical energy needs to cool the building and the real energy consumed. The following assumption have thus been made in the calculation:

- The presence of air-conditioning equipment in buildings: depending on the country, the share of buildings equipped with air-conditioning systems will vary according to the climate. Given that no documentation was found on this matter, and in order to stay conservative, the share will be set to 0 for all countries except for Southern Europe, India and the USA. For these three areas, the share will be set to 33%.

- Rate of occupation: air-conditioning equipment are usually working all day long (if the external temperature requires it). A rate of 100% is thus considered in first approximation, then reduced to 50% to adopt a conservative reasoning

- Free sources of heat: solar heat and other sources of “free” heating (see INT factor above) increase the indoor temperature of the building thus increasing the energy needs to cool the

[10] Voir annexe 2 pour un détail du calcul et des hypothèses considérées

buildings. Given the lack of reliable data on the matter, these "free" sources of heat are considered inexistent, which represents a conservative assumption for the calculation, given that the higher the energy consumption, the higher the savings

As a result, a corrective coefficient CORR set to 33% x 50% = 16.5% will be considered to calculate the energy savings related to air-conditioning.

d) EFF: Efficiency of heating and air-conditioning equipment

Traducing theoretical energy needs intro real energy consumptions involves another factor, the efficiency of the equipment considered.

The efficiency illustrates the ratio between the amount of energy released (for heating) or captured (for air-conditioning) and the amount of energy consumed by the equipment.

The sources below provide information regarding average efficiency factors, which are summarized in the table.

- For heating equipment, the efficiency factors are obtained from the methodological guide related to the French energy performance diagnosis
- For air-conditioning equipment, the efficiency factor (SEER) considered corresponds to the average performance of A+ et A++ air-conditioning equipment (it must be noted that this is not so ambitious, given that B-rated air-conditioning equipment cannot be sold anymore in Europe)

Type of equipment	Average efficiency
Heating - Electricity	0.95
Heating – Fossil fuel	0.60
Air-conditioning	6.1

NB #1: The efficiency factor of fossil-fuel heating equipment will be used for all other sources of energy excluding electricity, such as biomass for instance.

NB #2: Efficiency factors being unrelated to climate conditions, the same ratios will be considered for the whole geographical scope.

e) MIX: Share of energy considered in the heating energy mix

The report "*Survey on the energy needs and architectural features of the EU building stock*"[11], written in the framework of the INSPIRE European project, already used to calculate the U-value of the reference scenario, also contains information regarding the fuel mix for building heating for each different European country.

For all countries outside Europe, the European average mix is considered given the lack of available data.

3.5.5 *GHG emission factors*

The GHG emission factors of the different energy sources considered in the calculation are obtained as follows:

- For electricity, by combining scope 2 emissions (source: IEA data 2020) and scope 3 emissions related to upstream activities and to distribution losses (source: DEFRA)
- For fossil fuels (coal, fuel and gas), by combining scope 1 combustion emissions (source: IPCC 2006) and scope 3 "tank-to-well" emissions (source: DEFRA)
- For biomass, by considering the emission factor of "wood log – 20% humidity" provided by the French Environmental Agency "Base Carbone"

[11] WP2_D2.1a_20140523_P18_Survey-on-the-energy-needs-and-architectural-features.pdf (inspire-fp7.eu)

- For heat and other residual sources of energy, by considering the emission factor of biomass in a conservative way (less emissions implying less savings), given the high complexity of heat emission factor and the absence of data regarding these other energy sources

For electricity, the emission factors considered thus range from 14 $gCO2_{eq}.kWh^{-1}$ (Sweden) to 1 164 $gCO2_{eq}.kWh^{-1}$ (South Africa).

For the other sources of energy, the emission factors are presented in the table below:

Energy source	Biomass	Fuel	Gas	Coal	Heat	Others
Emission factor (gCO_{2eq}/kWh PCI)	29.5	318	228	405	29.5	29.5

3.5.6 *GHG emissions generated during the lifecycle of the average Saint-Gobain solution*

In order to calculate the net GHG emissions avoided, it is necessary to remove from the savings the amount of emissions generated during the different stages of the solutions' lifecycle (manufacturing, transportation, disposal, etc.).

These amounts of emissions are calculated following the LCA methodology and most of the time summarized in Environmental Product Declarations (EPD), verified by external third parties.

a) External walls insulation solutions

In order to calculate the impact related to the average Saint-Gobain's solution, LCA and EPDs available per country are used.

First, all countries representing more than 5% of the total European sales are identified:

- For countries where LCA can be calculated using the TEAM tool, verified by third party, this tool is used to model the average Saint-Gobain solution and obtain the resulting LCA results per m² of solution
- For countries where the LCA modelling is not available, existing EPDs are used to approximate the impact of the average solution per kg

Once the factors expressed per kg are converted into m², the different impacts obtained per country are aggregated by considering the surface of solutions sold in the different concerned countries.

b) Glazed insulation solutions

For glazing systems, EPDs are directly produced at the European level. The calculation of the GHG emissions related to the lifecycle of the glazing unit is based on the information included in the EPDs of the two following representative solutions:

- *Climaplus* 4/16/4 for all double-glazing
- *Climatop* 4/14/4/14/4 for all triple-glazing

The impacts are then aggregated by considering the surface of the different types of glazing sold (double or triple).

c) Summary of emissions generated during the solution's lifecycle

Emissions generated during the lifecycle of the different material categories are summarized in the table below:

Material category	Emission factor ($kgCO2_{eq}.m^{-2}$)
Glass wool	3.87
Stone wool	10.54
Glazing	31.10

3.5.7 *Calculation of energy savings – expressed in amount of primary energy*

The savings related to the use of the Saint-Gobain insulation solutions can be expressed in GHG emissions but also in terms of primary energy consumption.

The aggregation of the different energy sources forming the heating energy mix mentioned previously requires the use of a conversion factor to convert electrical energy into primary energy.

The European union suggests in the directive 2012/27/UE the use of a conversion factor set to 2.5 to transform electrical energy intro primary energy[12]. This factor will be used to calculate the savings in terms of primary energy consumption.

3.6 Calculation of GHG emission avoided and energy savings over the lifespan of the installed solution

The calculation described above compares the amount of GHG emissions avoided during one year thanks to the use of the Saint-Gobain solution with the amount of GHG emissions generated during the lifecycle of the solution.

However, the benefits in terms of energy savings related to the use of the Saint-Gobain insulation solutions does not stop after one year but continue during the full lifecycle of the solution.

The solutions sold and installed during the year N are going to enable energy savings during a large period of time (until the insulation material wears off or is removed from the wall). The lifespan to be considered in the calculation is based on the lifespan considered for the calculation of LCA, namely:

- 30 years for glazing units
- 50 years for walls insulation solutions

In order to reflect the evolution of several parameters over the next decades, the following evolutions are considered in the calculation.

a) Electricity emission factor

The electricity emission factor is evolving every year following the variations in the countries' electricity production energy mix. Data published by the IEA in the Energy Technology Perspectives (2017) are used in the calculation to obtain the emission factors for the coming decades, based on the reference scenario of the IEA.

It must be noted that considering the evolution of emission factors in the future in a conservative assumption for Saint-Gobain, given that energy mix usually go towards more decarbonated energy sources.

b) Degree-days

The evolution of degree-days is taken into consideration in the calculation in order to reflect climate change. Prospective data regarding climate over the next decades are obtained from the same source that the one used for 2019 data, namely the international project CMIP6 which models the evolution of the climate in all the regions of the world for the next decades.

c) Thermal characteristics of the average wall

The thermal characteristics of the existing building stock are progressively improving. However, given the very low rate of renovation programs in the world, and given the lack of precise and reliable data about the evolution of the building stock, the thermal characteristics considered for the reference situation are considered as stable for the next decades.

The remaining calculation factors (heating energy mix, equipment efficiency, intermittence corrective factors, etc.) are considered as stable over the next decades, mainly given the lack of reliable information regarding their evolution.

[12] Appendix IV of the European directive 2012/27/UE of the European parliament of October 25 2012 related to the energy efficiency of buildings

4 Information and communication

4.1 External communication guidance

All communication related to the amount of avoided GHG emission avoided by one company's solutions must be managed with the highest care in order to avoid any risk of greenwashing. The following principles shall especially be considered:

- Never communicate any amount of avoided GHG emissions without providing at the same time and in the same place the following information
  - The reference situation considered to calculate the savings,
  - The scope of solutions considered,
  - The geographical scope considered,
  - The period of time considered to calculate the amount of emissions avoided;

- Never subtract the amount of avoided GHG emissions from the total amount of GHG emissions generated by the company's activities and operations (scopes 1, 2 and 3), whatever the reason (calculating "net emissions", etc.);

- Especially, the amount of avoided GHG emissions cannot be used to satisfy any "carbon neutrality" objective or to lower the reality of GHG emissions generated by the company;

- Avoid comparing the amount of avoided GHG emissions from one year to another, given the high level of complexity of the calculation and the large number of assumptions taken, which can make comparison difficult or event irrelevant

This methodological guide has been developed in order to illustrate in a robust and transparent way the methodology used to calculate the amount of avoided GHG emissions, in accordance with the principles set in the ISO 14020 and ISO 14021 standards.

Appendix

1. Definition of the average U-value for the solutions manufactured by Saint-Gobain

Category	Activity	Market	Application	U_{SG} (range)	U_{SG} (average)
Glass wool	Renovation	Residential	Roofs & ceilings	0.15 – 0.50	0.17
			Walls	0.24 – 0.70	0.40
			Floors	0.22 – 2.13	0.32
		Tertiary	Roofs & ceilings	0.15 – 1.61	0.23
			Walls	0.24 – 0.80	0.42
			Floors	0.26 – 2.13	0.48
	New construction	Residential	Roofs & ceilings	0.12 – 0.50	0.22
			Walls	0.18 – 1.03	0.42
			Floors	0.27 – 2.13	0.40
		Tertiary	Roofs & ceilings	0.12 – 0.62	0.22
			Walls	0.18 – 0.80	0.41
			Floors	0.30 – 2.13	0.80
Stone wool	Renovation	Residential	Roofs & ceilings	0.20 – 0.78	0.43
			Walls	0.24 – 0.85	0.40
			Floors	0.36 – 1.80	0.49
		Tertiary	Roofs & ceilings	0.20 – 0.88	0.44
			Walls	0.22 – 0.85	0.44
			Floors	0.29 – 1.80	0.77
	New construction	Residential	Roofs & ceilings	0.20 – 0.78	0.40
			Walls	0.22 – 0.85	0.47
			Floors	0.30 – 1.80	0.46
		Tertiary	Roofs & ceilings	0.22 – 0.78	0.44
			Walls	0.28 – 1.17	0.57
			Floors	0.30 – 1.80	0.82

2. Definition of the U-value for the reference situation for ceilings, roofs, walls and floors

Activity	Market	Application	U_{REF} (range)	U_{REF} (average)
Renovation	Residential	Roofs & ceilings	0.40 – 3.00	2.04
		Walls	0.40 – 2.40	1.79
		Floors	0.20 – 5.50	1.78
	Tertiary	Roofs & ceilings	0.40 – 2.80	1.08
		Walls	0.60 – 2.20	1.38
		Floors	0.20 – 2.50	1.26
New construction	Residential	Roofs & ceilings	0.11 – 1.30	0.24
		Walls	0.18 – 0.80	0.24
		Floors	0.11 – 1.30	0.27
	Tertiary	Roofs & ceilings	0.10 – 1.20	0.27
		Walls	0.20 – 0.90	0.40
		Floors	0.20 – 0.80	0.43

3. Calculation of the "free" sources of heat

The methodological guide of the energy performance diagnosis provided by the French Ministry of Environment explains that the "free" sources of heat can be modelled using the following formula:

$$F = 1 - \frac{X - X^{2,9}}{1 - X^{2,9}}$$

The intermediary coefficient X being calculated as follows:

$$X = \frac{A_I + A_S}{U_{walls} * S_{walls} * DH_{He}}$$

A_I (Wh) : Internal sources of heat
A_S (Wh) : Solar heat
U_{walls} ($W.K^{-1}.m^{-2}$) : Average thermal transfer coefficient of the building
S_{walls} (m^2) : Total surface enabling heat transfer
DH_{He}(K.hours) : Heating degree-hours

Additional sources of heat are modelled using the following formula:

$A_I = 4.17 * S_H * H_{He}$ et $A_S = 1000 * E * S_{South}$

4.17 ($W.m^{-2}$) : Coefficient illustrating the energy removed naturally in the building
S_H (en m^2) : Floor space of the building
H_{Ch} (en m) : Heating hours over one year
E (en $kWh.m^{-2}$) : Average sunning over one year
S_{Sud} (en m^2) : Surface of windows exposed to the south

The assumptions taken for our calculation are summarized in the table below:

Coefficient	Value	Assumption
U_{walls} (W.K^{-1}.m^{-2})	2	U-value considered for the reference situation
S_{walls} (m^2)	190	70 m² of flooring, 65 m² of walls, 55 m² of ceiling
DH_{He} (K.hours)	63 264	Heating degree-days for France multiplied by 24
S_H (m^2)	70	/
H_{Ch} (m)	5 023	Average amount of heating hours of French departments, obtained from the methodological guide related to energy performance diagnosis (DPE)
E (kWh.m^{-2})	428	Average amount of sunning of French departments, obtained from the methodological guide related to energy performance diagnosis (DPE)
S_{South} (m^2)	3.25	Obtained considering that 25% of the 65 m² of walls is exposed to the South, and that 20% of the external wall is actually a window

4. September 2021 updates

In September 2021, the calculator was updated, adding seven countries to the calculation scope: Ukraine, Canada, South-Africa, Brazil, Argentina, Colombia and Middle-East region.
Some data collection and calculation steps were performed slightly differently than in 2020. Those differences are explained here:

- Emission factors used here are identical to those used by Saint Gobain for its GHG accounting (source: IEA, DEFRA). They were extrapolated for the 2020-2070 period using the same IEA scenario than for the 2020 update.
- U-values taken are average ones, as no specific data could be found for the seven countries mentioned above. The same approach was used for data related to energy sources for heating.
- The calculation of Heating Degree Days and Cooling Degree Days for the 2020-2070 period is based on the data from CMIP5. The indoor reference temperature is set at 18°C. No temperature gap is considered. Three time horizons are considered: short term (2035), medium term (2055) and long term (2085). Degree days values between these years are calculated by linear interpolation.