BFCM Green Bond

Climate report Methodological handbook

Recipient	Banque Fédérative du Crédit Mutuel (BFCM), Société Générale CIB
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Contents

1. General context and objectives

Banque Fédérative du Crédit Mutuel (BFCM) plans to issue a green bond in line with international and regional best practices: *Green Bond Principles*[1] and *Sustainability Bond Guidelines*[2] of the International Capital Market Association (ICMA), guidelines of the European Commission's Action Plan on Sustainable Finance, including the Green Bond Standard[3] and the European Taxonomy for Sustainable Activities[4].

Funds generated by this green bond will be used to finance or refinance environmental-related projects and assets that meet the demanding eligibility criteria set by the above-mentioned standards. The funds will be allocated to the following green categories:

- Green residential buildings
- Renewable energy production projects

As provided for in the *Sustainability Bond Guidelines*, BFCM will publish an annual impact report which will present, inter alia, the climate benefits associated with the bond's eligible loan portfolio. This guide, drafted by EcoAct, outlines the methodology used to estimate the greenhouse gas (GHG) emissions avoided by the portfolio projects.

[1] https://www.icmagroup.org/green-social-and-sustainability-bonds/green-bond-principles-gbp/
[2] https://www.icmagroup.org/green-social-and-sustainability-bonds/sustainability-bond-guidelines-sbg/
[3] https://ec.europa.eu/info/files/190618-sustainable-finance-teg-report-green-bond-standard_en
[4] https://ec.europa.eu/info/publications/sustainable-finance-teg-taxonomy_en

2. Methodological concepts

This methodology is based on several key concepts from international standards and frameworks, such as the GHG Protocol and the European Commission's Green Finance Standards.

2.1 Reference scenario

In order to calculate avoided emissions, a baseline scenario is defined, to be compared with the project scenario. This baseline can have several sources:

- Applicable regulations
- Current practices (average benchmark)
- Pre-project situation

2.2 Project scenario and emissions avoided

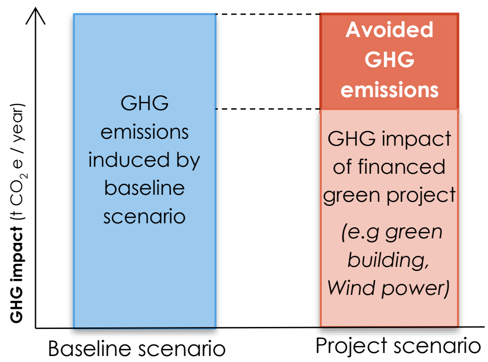
It refers to the project scenario, which is to be implemented with the funds from the bond issuance; for example, a green building or a renewable energy production project.

2.3 Avoided emissions calculation

The calculation of avoided emissions **complies** with the GHG Protocol standards and best practices, notably the following main methodological concepts.

Avoided emissions for each project result from the difference between:

i. Greenhouse gas emissions induced by the reference scenario considered, and
ii. Greenhouse gas emissions induced by the considered project.



Induced greenhouse gas emissions are obtained by multiplying:

i. Physical data related to the project activity, by
ii. Emission factors, defined as the average amount of greenhouse gas (in CO2e) generated by a unit of activity, expressed in kgCO2e per physical unit.

Activity data × Emission factors (EF) = GHG emissions (CO2e)

2.4 Uncertainty degree and conservative approach

The uncertainty degree of avoided emissions depends on several parameters:

- The type of activity data: uncertainty degree is lower with consumption / production data than with estimated data obtained from assumptions.
- The emission factors used: each contains a certain degree of uncertainty

The method adopted a conservative approach, considering the least favourable scenario in the calculations of avoided emissions. It provides a more conservative result in terms of impact and prevents overestimating avoided greenhouse gas (GHG) emissions.

2.5 Allocation of avoided emissions

In accordance with the best practices promoted by ICMA, total avoided emissions of each portfolio project were allocated to the bond issuer in proportion to its participation (share) in the total financing of the considered project. This allocation principle prevents the double counting of avoided emissions between the different investors and funders of the portfolio projects.

2.6 Temporality

The annual impact report measures avoided emissions over the last reporting year. For the 1st report, the chosen period was July 1st 2019 to June 30th 2020. Emissions avoided from projects delivered during the reporting year are calculated on a *pro rata temporis basis*.

2.7 Typology of avoided emissions

Two types of avoided emissions can be distinguished, both expressed on an annual basis:

- **Effective avoided emissions**: calculated following the asset's use or the actual production of the project, based on actual consumption or production data.
- **Potential avoided emissions**: calculated using data from theoretical calculations and estimations of energy consumption or production.

NB: At this stage, portfolio data only allow the calculation of potential avoided emissions, with a higher degree of uncertainty

Avoided emissions have also been categorised according to the status of the financed asset, distinguishing:

- Avoided emissions from assets or projects in the portfolio **in use / operation** during the reporting year
- Emissions avoided from assets or projects in the portfolio **under construction** during the reporting year

3. Avoided emissions calculation of the real estate portfolio

3.1 Context

The building sector is a key sector for the low-carbon transition, responsible in 2017 for 28% of French GHG emissions on its scopes 1 and 2, and 40% of the European Union's energy consumption[5]. In France, the building sector is lagging behind SNBC[6]'s objectives and requires massive investments in the modernisation and renovation of the current building stock in order to reach the carbon neutrality objective in 2050.

3.2 Reference scenario

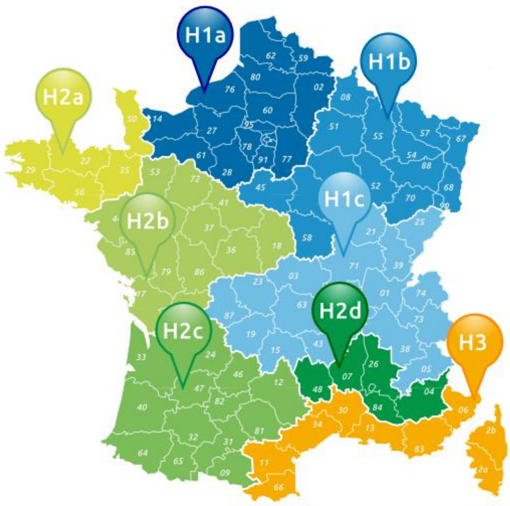
A. Average energy consumption of the residential stock

The chosen reference scenario is based on the "Energy consumption by residential use "[7] study, drafted by the Ministry of Ecological and Solidarity Transition (MTES), which allows to deduce the average energy consumption in France, by type of building:

- 157 kWh PCI/m2/year for the multi-family building
- 161 kWh ICP/m2/year for single-family building

These energy consumptions cover the following energy uses: heating, domestic hot water, cooking, specific electricity, air conditioning. These national average energy intensities **were** then broken down by climate zone, by applying correction coefficients provided by ADEME (see Appendix 1).

Dwelling	Zone	Energy intensity	Unit
Multi-family building	H1	173,0	kWhef / m² / year
	H2	141,5	kWhef / m² / year
	H3	94,4	kWhef / m² / year
Single-family building	H1	177,3	kWhef / m² / year
	H2	145,1	kWhef / m² / year
	H3	96,7	kWhef / m² / year



Climate zone distribution in France

[5] See "Going climate-neutral by 2050", European Union, 2019/07

[6] Allocated carbon budgets have been exceeded between 2015 and 2018, See "Stratégie National Bas Carbone SNBC" , Ministère de la Transition Ecologique et Solidaire, Mars 2020

[7] https://www.statistiques.developpement-durable.gouv.fr/consommation-denergie-par-usage-du-residentiel?rubrique=&dossier=168

B. Average carbon intensity of the French housing stock

These energy consumption data serve as the basis for calculating the average carbon intensity of single and multi-family buildings, expressed in kgCO2e/m2/year, according to the following formula:

$$Carbon\ intensity = \sum_{i}^{n} EUI\ (fe) * \%E\ i\ (fe) * EF\ i$$

EUI	Average energy use intensity of the dwelling, in final energy (fe)	kWhfe PCI / m2 / year
%E i	Share of energy use “i” in final energy consumption of the dwelling	%
EF i	Emission factor associated with energy “i”	kgCO2e/kWh

Emission factors used for each type of energy come from the latest version of the ADEME carbon base (see list in Appendix). After calculation, we obtain the following average carbon intensities for apartments and houses, by climate zone. These data form the basis of the **reference scenario**:

Dwelling	Zone	Carbon intensity	Unit
Multi-family building	H1	27,3	kgCO2e / m² / year
	H2	22,3	kgCO2e / m² / year
	H3	14,9	kgCO2e / m² / year
Single-family building	H1	22,2	kgCO2e / m² / year
	H2	18,2	kgCO2e / m² / year
	H3	12,1	kgCO2e / m² / year

3.3 Project scenario

A. Presentation of portfolio assets and European context

The project scenario conforms to the **Thermal Regulation 2012, known as "RT 2012", which is respected by each real estate asset in the portfolio**. This regulation is a legal requirement in France for all new buildings and applies to all residential buildings with construction permits granted after January 1, 2013. RT 2012 sets a threshold for primary energy consumption that is lower on average than **50 kwHep / m2 / year**. Note that a new regulation, know as “RE 2020”, will be implemented as of January 1st 2021, with more ambitious environmental standards.

According to the latest report on the European taxonomy of sustainable activities[8], new buildings must have a primary energy consumption 20% lower than the nationally defined **Net-Zero-Energy-Buildings standards** in order to be considered green. France considers at this stage the RT 2012 performance level as the applicable nZEB level, which may evolve with RE 2020 implementation. Consequently, only buildings with a **primary energy consumption 20% lower than the French nZEB standard** would be considered as “green” according to the EU Taxonomy, provided they comply with the other criteria - i.e. "do no significant harm" to the other social and environmental objectives.

[8] https://ec.europa.eu/info/publications/sustainable-finance-teg-taxonomy_en

B. Regulatory energy consumption of RT 2012 buildings

RT 2012 imposes a theoretical maximum threshold of primary energy consumption (known as "CEP") modulated by climate zone between 40 and 65 kWh of primary energy consumption/m²/year. This regulatory threshold integrates five uses: heating, air conditioning, lighting, domestic hot water production and ventilation, in line with those considered in the reference scenario, thus ensuring homogeneity between the two scenarios.

Maximum primary energy consumption threshold for buildings RT 2012 by climate zone

Zone	Regulatory consumption	Unit
H1a	60	kWh_{pe} / m^2 / year
H1b	65	kWh_{pe} / m^2 / year
H1c	60	kWh_{pe} / m^2 / year
H2a	55	kWh_{pe} / m^2 / year
H2b	50	kWh_{pe} / m^2 / year
H2c	45	kWh_{pe} / m^2 / year
H2d	45	kWh_{pe} / m^2 / year
H3	40	kWh_{pe} / m^2 / year

C. From regulatory energy consumption to estimated actual consumption

The Ministry of Ecological and Solidarity Transition recently pointed out the discrepancies observed between the regulatory (conventional) energy consumption and the actual energy consumption of RT 2012[9] buildings. These discrepancies are notably related to user behaviour, climatic conditions and difficulties in calculating the consumption. Given the lack of real consumption data available, the actual energy consumption of RT 2012 buildings has been estimated. In accordance with the conservative approach to the calculation of avoided emissions, the **theoretical energy consumption of each climate zone was increased by 10%**.

D. Average carbon intensity, RT 2012

As described in 3.1.B, energy consumption data are used to calculate the average carbon intensity of RT 2012 multi and single-family buildings, expressed in kgCO2e/m2/year. For the sake of homogeneity with the baseline scenario, the considered hypothesis is that the share of each energy use in the **final** energy consumption remains unchanged for each type of dwelling with respect to the baseline scenario. As the energy consumption data are expressed in primary energy, an additional conversion step should be carried out, using the formula presented below:

$$Carbon\ Intensity = \sum_{i}^{n} EUI\ (pe) * \frac{\%E\ i\ (pe)}{CF\ Ei} * EF\ i$$

[9] See report « Évaluation de la réglementation thermique de 2012 dans les bâtiments neufs en vue de la prochaine réglementation environnementale », https://www.economie.gouv.fr/files/files/directions_services/cge/reglementation-thermique.pdf

EUI (pe)	RT 2012 estimated energy use intensity by climate zone and type od dwelling, in primary energy	kWhpe / m2 / an
%E i (pe)	Share of energy use "i" in primary energy consumption (pe) of the dwelling	%
CF Ei	Conversion factor between final energy and primary energy, associated with each type of energy "i"	
EF i	Emission factor associated with each type of energy "i"	kgCO2e/kWh

After calculation, average carbon intensities by housing type and climate zone are obtained:

<u>Project scenario</u>: estimated RT 2012 carbon intensity by dwelling type and climate zone

Category	Value	Unit
H1a - Apartment average C02e emissions	7,12	kgCO2e / m² / year
H1b - Apartment average C02e emissions	7,71	kgCO2e / m² / year
H1c- Apartment average C02e emissions	7,12	kgCO2e / m² / year
H2a - Apartment average C02e emissions	6,53	kgCO2e / m² / year
H2b - Apartment average C02e emissions	5,93	kgCO2e / m² / year
H2c - Apartment average C02e emissions	5,34	kgCO2e / m² / year
H2d - Apartment average C02e emissions	5,34	kgCO2e / m² / year
H3 - Apartment average C02e emissions	4,75	kgCO2e / m² / year
H1a - House average C02e emissions	5,46	kgCO2e / m² / year
H1b - House average C02e emissions	5,91	kgCO2e / m² / year
H1c - House average C02e emissions	5,46	kgCO2e / m² / year
H2a - House average C02e emissions	5,00	kgCO2e / m² / year
H2b - House average C02e emissions	4,55	kgCO2e / m² / year
H2c - House average C02e emissions	4,09	kgCO2e / m² / year
H2d - House average C02e emissions	4,09	kgCO2e / m² / year
H3 - House average C02e emissions	3,64	kgCO2e / m² / year

3.4 Avoided emissions calculation

A. Calculation steps

After estimating the average carbon intensity for the baseline scenario (French housing stock) and the project scenario (RT 2012) by dwelling type and climate zone, avoided emissions are calculated according to the following steps:

1- Avoided emissions calculation at asset level

Avoided emissions from the project scenario (RT 2012) compared to the baseline scenario are calculated using the following formula for each asset in the portfolio:

Avoided emissions, in kgCO2e/year

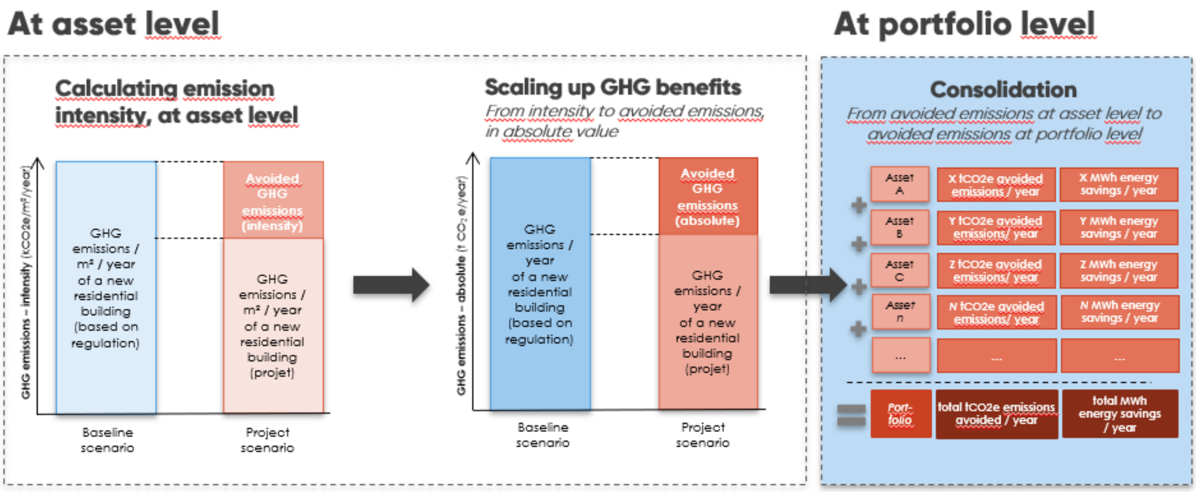
= (reference carbon intensity - asset carbon intensity), in kgCO2e/m²/year

× Asset surface area, in m²

× Share of the property financed by the issuer (%)

2- Consolidation at portfolio level

Consolidation at portfolio level is then carried out by adding up the emissions avoided by each asset. This gives an estimation of the emissions avoided over the reporting year for all the projects of the real estate portfolio.



B. Adopted hypotheses

Issuers' share of total financing (in %):	$\frac{\textit{Debt outstanding at end of reporting year}}{\textit{Total value of the asset}}$ NB: The maximum is set at 100%.
Prorata temporis	A pro rata temporis calculation is made for assets whose construction was completed during the reporting year
Scope of considered emissions	Only emissions related to energy consumption are considered in the calculation of avoided emissions. It is thus assumed that the carbon intensity related to the assets' construction is similar between the baseline scenario and the project scenario (RT 2012).
Substitution	Simply put, it is assumed that the new project assets fully substitute for the assets of the residential stock, thus neglecting the potential vacancy of these units.
Identical surface area	Similar surface areas per asset are considered between baseline and project scenarios, without considering the effect related to the growth of the residential park.
Type of avoided emissions	Avoided emissions consist in potential emissions, obtained from estimations and not from actual energy consumption data, therefore with a higher level of uncertainty.

4. Avoided emissions from the portfolio of renewable energy production projects

4.1 Context

Power production has a key role in the low-carbon transition, whose success mainly rely on two levers: decarbonising the current energy mix and controlling our consumption. The main transition scenarios for keeping the rise in temperatures below 2°C provide for a rapid transition from fossil and fissile energies to renewable energies. According to these scenarios, the current share of renewables in electricity production, which is close to 25%, should reach between 70% and 85% in 2050. Investing in renewable energies is therefore essential to achieve the international climate objectives.

4.2 Reference scenario

Electricity is produced by the country's existing means of production; the reference thus considered corresponds to the average electricity mix of each country where the projects are located. The associated emission factors are expressed in kgCO2e / kWh, and listed below:

Factor title	Total value	Scope 1 value	Scope 2 value	Scope 3 value	Unit	Source
Electricity France - 2018 - medium mix	0,057	0	0,040	0,018	kgCO2e/kWh	Base carbone ADEME 2020
Electricity Belgium - medium mix	0,262	0	0,226	0,036	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity Canada - medium mix	0,193	0	0,151	0,042	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity Chile - medium mix	0,519	0	0,438	0,081	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity Netherlands - medium mix	0,593	0	0,489	0,104	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity Spain - medium mix	0,369	0	0,293	0,076	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity United Kingdom - medium mix	0,438	0	0,349	0,089	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity USA - medium mix	0,565	0	0,456	0,109	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)

4.3 Project scenario

A. Presentation of portfolio assets and European context

The portfolio finances a renewable energy park comprising various production technologies: photovoltaic, onshore and offshore wind power. Note that these projects will automatically be **eligible for the European taxonomy for sustainable activities**, which sets a single global and technological emission threshold of **100g CO2e / kWh**, provided that they also meet the other criteria of the taxonomy ("do no significant harm to other environmental objectives and social guarantees").

B. Carbon intensity by technology type

The carbon intensity of each renewable energy production technology is obtained directly from the following emission factors, all standing well below the taxonomy threshold.

Factor title	Total value	Scope 1 value	Scope 2 value	Scope 3 value	Unit	Source
Solar PV	0,055	0	0	0,055	kgCO2e/kWh	Base carbone ADEME 2020
Wind	0,0127	0	0	0,0127	kgCO2e/kWh	Base carbone ADEME 2020
Wind offshore	0,0148	0	0	0,0148	kgCO2e/kWh	Base carbone ADEME 2020

4.4 Avoided emissions calculation

A. Calculation steps

Avoided emissions are calculated according to the following steps:

1- *Calculation of avoided emissions at the level of the production project*

Annual emissions avoided by each renewable electricity generation project are calculated according to the following formula:

Avoided emissions, in kgCO2e/year

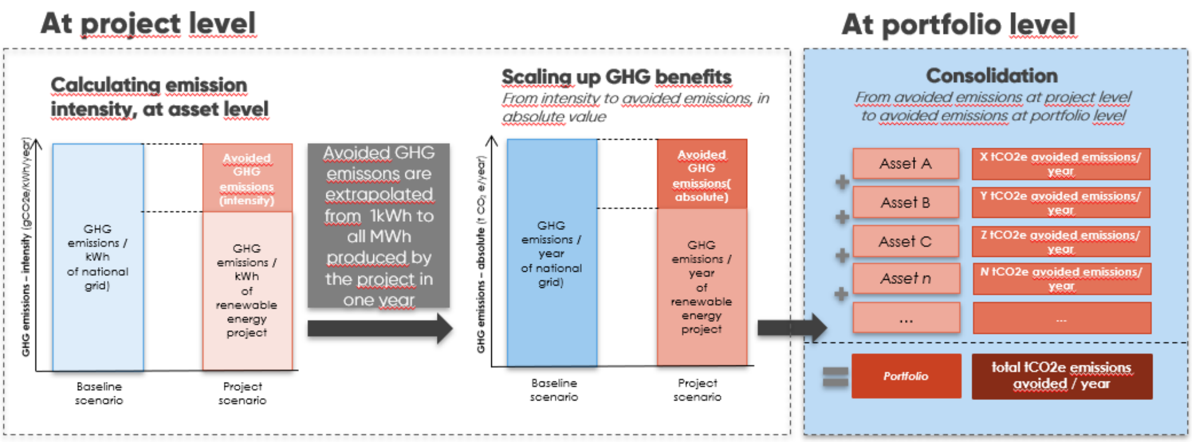
= (carbon intensity of the reference mix - carbon intensity of the project) in kgCO2e/kWh

× Output of the asset, in kWh/year

× Issuer's share of total project financing (%)

2- *Consolidation at portfolio level*

Consolidation at the portfolio level is then carried out by adding up the emissions avoided by each production project. This gives an estimation of emissions avoided over the reporting year for all projects in the renewable energy production portfolio.



B. Adopted hypothesis

Issuer's share of total financing (in %)	1. *Total capital cost of the production project* As the data related to total capital expenditure (capex) are not systematically available for each renewable production project, a systematic estimate is made for each project to ensure consistency in the methodology. This estimation is carried out based on International Energy Agency (IEA) technology cost data, see Appendix 5. These data, after extrapolation to the total project capacity, and after conversion into € at the reporting date, give a total cost for each project according to technology, expressed in €. 2. *Deduction of the project capacity financed by the emission* This first step allows to obtain the share of the project's capacity financed by the issuer, using the outstanding debt for each project: $Issuer'share\ of\ total\ financing (\%): \frac{Outstanding\ debt\ at\ end\ of\ reporting\ year}{Project\ total\ apital\ cost}$
Temporality	A pro rata temporis calculation is made for projects whose effective production date started during the reporting year. Where applicable, potential emissions induced by projects whose actual production date is scheduled to start after the reporting year are reported separately.
Scope of considered emissions	The calculation of avoided emissions covers: - The combustion of energy - Upstream energy - Downstream energy
Substitution	Put simply, it is assumed that the production of renewable energy will replace the production of the country's average electricity mix, simplifying the way the electricity grid is managed. In particular, the increase in electricity consumption is neglected, as well as the imports and exports of electricity between the different grids.
Types of avoided emissions	As actual production data for 2019 reporting are not available, avoided emissions are potential emissions, obtained from estimates and not from actual energy production data, with a correspondingly higher level of uncertainty.

5. Glossary

Term	Definition
ADEME	Ecological Transition Agency, formerly the Environment and Energy Management Agency. Public establishment under the supervision of the Ministry of Ecological and Solidarity Transition and the Ministry of Higher Education, Research and Innovation.
IEA	**International Energy Agency (IEA) :** International organization founded by the Organization for Economic Cooperation and Development in 1974 following the first oil crisis, based in Paris.
CO2e	**CO2 equivalent, u**nit created by the IPCC to compare the impacts of different GHGs on global warming and to be able to accumulate emissions.
Primary energy (ep)	All unprocessed energy products, whether used directly or imported (mainly crude oil, natural gas, biomass, solar radiation, etc.).
Final energy (ef)	Energy delivered to the consumer for their final consumption (household electricity, petrol pump, etc.).
Emission Factor	An emission factor defined the average GHG emissions rate of a given source, relative to units of activity or process/processes.
GHG	Greenhouse gases (GHG) : Gases that absorb some of the infrared light and redistribute it as radiation (heat) within the Earth's atmosphere.
GHG Protocol	The GHG Protocol establishes comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions. Launched by the *World Resources Institute and the World Business Council for Sustainable Development*
ICMA	**International Capital Market Association:** An international association working across all market segments on regulatory, market and other market practice issues affecting debt markets internationally.
IPCC	**Intergovernmental Panel on Climate Change (IPCC),** intergovernmental body of the United Nations dedicated to providing objective information to understanding the risk of human-induced climate change.
MTES	Ministry of Ecological and Solidarity Transition: French administration responsible for preparing and implementing government policy in the field of ecology.
LHV	Lower heating value (LHV) of a fuel. It gives the amount of heat released during combustion per unit of volume or mass.
HHV	Higher heating value (HHV) of a fuel. It is the energy released by combustion by recovering the latent heat from the water vapour it produces.
Scope 1	Direct emissions of greenhouse gases.
Scope 2	Indirect greenhouse gas emissions related to energy consumption.
Scope 3	Other indirect greenhouse gas emissions.
SNBC	National Low Carbon Strategy (France), Introduced by the Energy Transition Law for Green Growth, this is the French roadmap for the fight against climate change. Its two ambitions are carbon neutrality by 2050 and the reduction of the French carbon footprint.
European Taxonomy for Sustainable Activities	Proposal for a taxonomy of sustainable activities in the European Union. It is the backbone of the EU Sustainable Finance Action Plan, it should make it possible to create a common definition of sustainable activities in the European Union.

6. Source data and references

Appendix 1: ADEME correction coefficients, by climate zone

Zone	Coefficient	Source
H1	1,1	Base carbone ADEME v17, 2020
H2	0,9	Base carbone ADEME v17, 2020
H3	0,6	Base carbone ADEME v17, 2020

Appendix 2: Average Energy Intensity - Reference Case Scenario

Data	Value	Unit	Source
Average energy intensity, France multi-family building, Data 2018	157	kWhfe LHV / m2 / year	Consommation d'énergie par usage du résidentiel, MTES, dec 2019
Average energy intensity, France single-family building, Data 2018	161	kWhfe LHV / m2 / year	Consommation d'énergie par usage du résidentiel, MTES, dec 2019

Appendix 3: Conversion factors between final energy and primary energy

Source: Référentiel « Energie-Carbone » pour les bâtiments neufs, 2016, Ministère Environnement[10]

Vecteur énergétique	fp, nr
Electricité du réseau national	2,58
Gaz,charbon, produits pétroliers	1
Chaleur et froid d'un réseau local	1-taux ENRetR

Appendix 4: Average energy intensity - RT 2012

Considered data	Value	Unit	Source
RT 2012, zone H1a	60	kWh_{pe} / m^2 / year	Légifrance
RT 2012, zone H1b	65	kWh_{pe} / m^2 / year	Légifrance / CFSE
RT 2012, zone H1c	60	kWh_{pe} / m^2 / year	Légifrance / CFSE
RT 2012, zone H2a	55	kWh_{pe} / m^2 / year	Légifrance / CFSE
RT 2012, zone H2b	50	kWh_{pe} / m^2 / year	Légifrance / CFSE
RT 2012, zone H2c	45	kWh_{pe} / m^2 / year	Légifrance / CFSE
RT 2012, zone H2d	45	kWh_{pe} / m^2 / year	Légifrance / CFSE
RT 2012, zone H3	40	kWh_{pe} / m^2 / year	Légifrance / CFSE

[10] For heating networks, the "ENRetR" rate corresponds to the rate of renewable energy and recovery of the heating networks. An average rate of 50% was used for the calculations. This rate corresponds to the threshold defined by the MTES for the classification procedure of a heating or cooling network, making connection to the network mandatory. The conversion factor used for heating networks is therefore 0.5.

Appendix 5: Electricity Production Costs by Region and Technology

[Source: World Energy Model documentation, 2019 version]

Table 6: Technology costs by selected region in the Stated Policies Scenario

		Capital costs ($/kW)		Capacity factor (%)		Fuel and O&M ($/MWh)		LCOE ($/MWh)		VALCOE ($/MWh)	
		2018	2040	2018	2040	2018	2040	2018	2040	2018	2040
United States	Nuclear	5 000	4 500	90	90	30	30	105	100	105	100
	Coal	2 100	2 100	60	60	30	30	75	75	75	75
	Gas CCGT	1 000	1 000	50	50	30	35	50	60	45	60
	Solar PV	1 550	830	21	23	15	10	95	50	95	60
	Wind onshore	1 660	1 500	42	44	10	10	55	50	55	55
	Wind offshore	4 300	2 060	41	48	35	20	155	70	150	75
European Union	Nuclear	6 600	4 500	75	75	35	35	150	110	145	115
	Coal	2 000	2 000	40	40	45	45	120	145	105	125
	Gas CCGT	1 000	1 000	40	40	60	70	90	115	75	85
	Solar PV	1 090	610	13	14	15	10	110	65	105	90
	Wind onshore	1 950	1 760	28	30	20	15	95	85	95	90
	Wind offshore	4 920	2 580	49	59	20	10	140	65	135	75

Note: O&M = operation and maintenance; LCOE = levelised cost of electricity; VALCOE = value-adjusted LCOE; kW = kilowatt; MWh = megawatt-hour; CCGT = combined-cycle gas turbine. LCOE and VALCOEs figures are rounded. Lower figures for VALCOE indicate improved competitiveness.

Source: IEA *WEO-2019*

7. Emission factors

Factor title	Total value	Scope 1 value	Scope 2 value	Scope 3 value	Unit	Source
Electricity France - 2018 - medium mix	0,057	0	0,040	0,018	kgCO2e/kWh	Base carbone ADEME 2020
Electricity Belgium - medium mix	0,262	0	0,226	0,036	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
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Electricity United Kingdom - medium mix	0,438	0	0,349	0,089	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Electricity USA - medium mix	0,565	0	0,456	0,109	kgCO2e/kWh	IEA Database 2017 (scope 2) + DEFRA Database 2017 (scope 3)
Natural gas France	0,227	0,187	0	0,040	kgCO2e/kWh PCI	Base carbone ADEME v17, 2020
Urban heat network - Average - France	0,127	0	0,116	0,012	kgCO2e/kWh	Average based on Base carbone ADEME 2020
Domestic oil - France	0,325	0,272	0	0,053	kgCO2e/kWh PCI	Base carbone ADEME v17, 2020
Wood - France (log, 20% humidity)	0,030	0,0188	0	0,011	kgCO2e/kWh PCI	Base carbone ADEME v17, 2020
GPL (butane) - France	0,273	0,233	0	0,040	kgCO2e/kWh PCI	Base carbone ADEME v17, 2020
Solar PV	0,055	0	0	0,055	kgCO2e/kWh	Base carbone ADEME v17, 2020
Wind onshore	0,0127	0	0	0,0127	kgCO2e/kWh	Base carbone ADEME v17, 2020
Wind offshore	0,0148	0	0	0,0148	kgCO2e/kWh	Base carbone ADEME v17, 2020

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EcoAct is an international advisory consultancy and project developer that works with clients to help them succeed in their climate ambitions. We work with many large and complex multinational organisations to offer solutions to their sustainability challenges.

We believe that climate change, energy management and sustainability are drivers of corporate performance and we seek to address business or organisational problems and opportunities in an intelligent way.