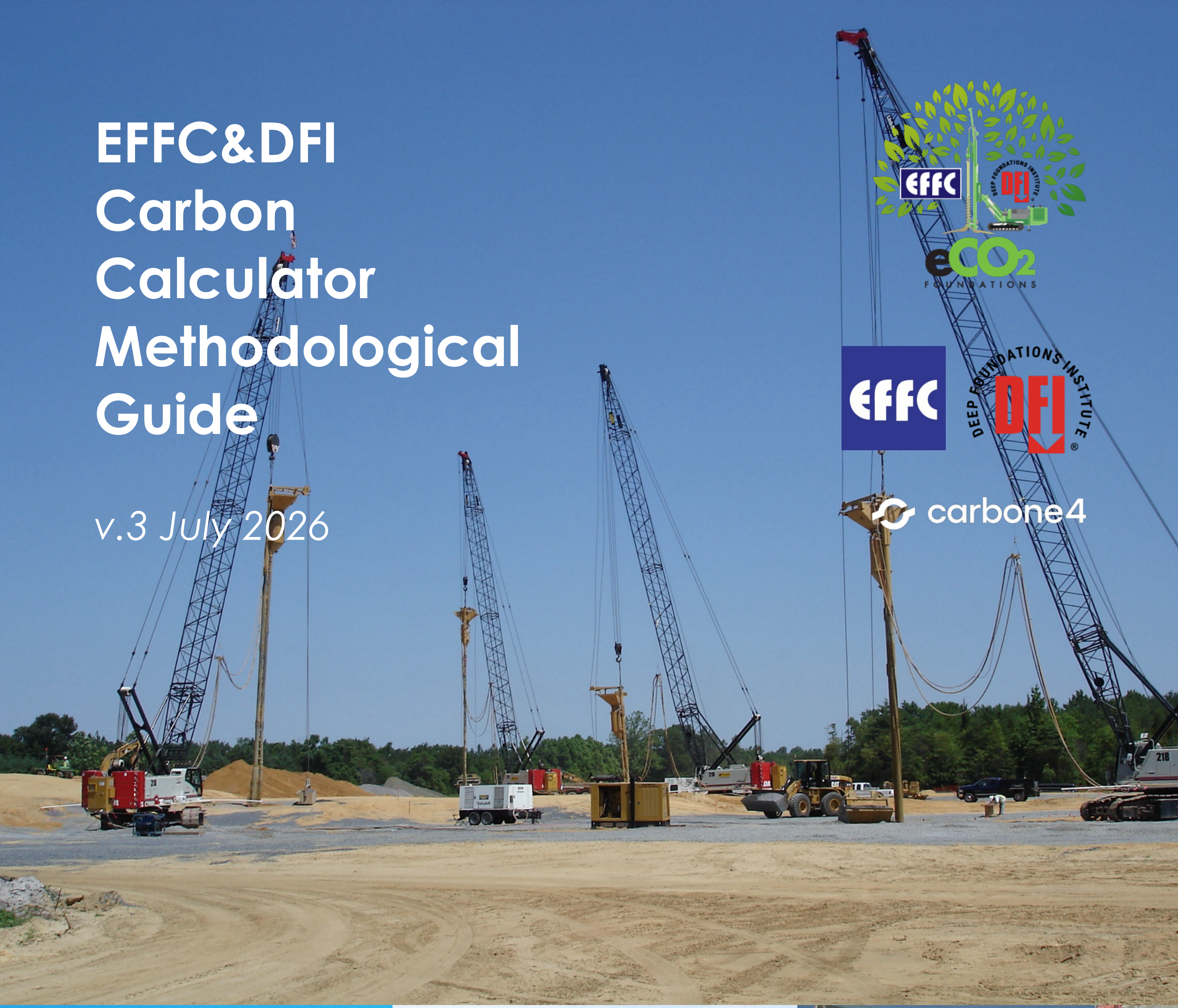
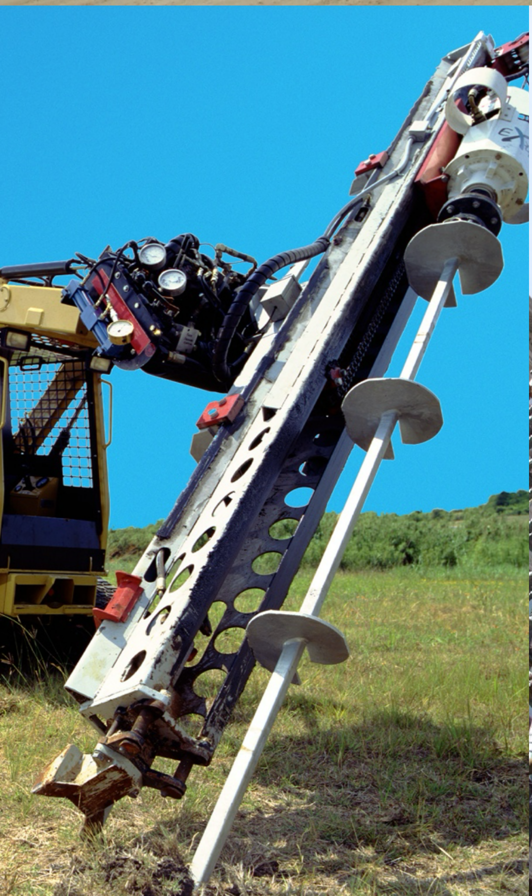
EFFC&DFI Carbon Calculator Methodological Guide

v.3 July 2026





Context

The European Federation of Foundation Contractors (EFFC) and the Deep Foundations Institute (DFI) joined forces to develop a sector-specific carbon accounting methodology and associated "carbon calculator" to make carbon footprint analyses of projects consistent and comparable across the industry.

This tool has been identified and recognised by EFRAG as the only sectorial GHG Calculator, that can help SMEs calculate their GHG emissions.

This document presents the carbon accounting method employed in the tool. The practical guide on its use is available in another document.

Document prepared by Carbone 4 (Victoire Ravillon & Aïda Tazi) - www.carbone4.com, reviewed by EFFC and DFI members before distribution.

July 2026

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1. Deep Foundation and Ground Improvement Methodology Specification

This section specifies the requirements of the EFFC DFI tool, based on the following elements: methodological principles and objectives, tool architecture and emission factor database.
The objective is to adapt existing, general standards to the specific application of deep foundations and ground improvement activities. It is also to produce an easy to use, project focused tool to compare the carbon footprint of various techniques or projects.

1.1 Standard compatibility

The proposed carbon footprint calculation tool and associated methodological guide are fully compatible with the **GHG Protocol Product Life Cycle Accounting and Reporting Standard** and with the French **"Bilan Carbone."**

ISO 14067 is in line with GHG Protocol.
Thus, this methodology is compatible with the following standards:
GHG Protocol Product Life Cycle Accounting and Reporting Standard
- Bilan Carbone
- ISO 14067

The results will be visible in different forms:
- LCA vision, following the Product Standard GHGP
- GHG P vision, following the GHG Protocol
- Module vision, to unable a vision by module A1 to A5 like a LCA product following EN 15804
- CSRD vision, that brings to the GHG P vision the CSRD energy consumption table

1.2 General principles of the carbon accounting method for EFFC DFI (derived from the GHG Protocol)

1.2.1 Relevance

"Ensure the GHG inventory appropriately reflects the GHG emissions of the project and serves the decision-making needs of users – both internal and external to the company."

By using a project-based carbon calculator, companies can compare the carbon footprints of their different techniques and promote low-carbon offers to their customers.
The tool calculates the carbon footprint of projects based on real activity data, ensuring the relevance of the calculation made.

1.2.2 Completeness

"Account for and report on all GHG emission sources and activities within the chosen perimeter. Disclose and justify any key exclusion. "
The tool always considers the same perimeter (shown in 4.1). The emission sources that are not calculated using activity data are estimated based on statistical data obtained from various relevant projects and made publicly available.

1.2.3 Consistency

"Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory perimeter, methods, or any other relevant factors in the time series."
The proposed tool and method are documented and a version numbering system proposed in order to allow change tracking.
Emission factor databases will have to be updated regularly by the EFFC and DFI to keep the tool up to date and to ensure comparability of the calculation made with other similar approaches.

1.2.4 Transparency

"Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used."
A Microsoft Excel based tool has the advantage that all the calculations are visible. All the values already in the tool are sourced with no "black box" approach. The methodology will disclose all the assumptions, and the tool will be transparent (all proposed emission factors are documented with complete references and from available public sources). Because of this principle, all emission factors integrated by the users must also be transparently sourced.

1.2.5 Accuracy

"Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information."

This principle is integrated by evaluating an emission source's importance for the covered techniques. The uncertainty is evaluated and simple ratios proposed for secondary emission sources.

1.3 Emission Sources in Deep Foundations and Ground Improvement Activities

The main emission sources in a deep foundation or ground improvement project are typically the same, although their relative significance will vary for different techniques. These can be divided into primary and secondary sources based upon their significance.

Primary Emission Sources

- Embodied carbon in materials, due to their manufacturing (cement, steel…)
- Materials transportation, from factory to construction site (trucks, train, boat...)
- Energy consumed on the construction site (grid electricity, diesel, gasoline…)

Secondary sources of emissions

- People's transportation to the construction site
- Equipment's transportation
- Equipment's manufacturing (depreciation)
- Waste transportation, from construction site to treatment site
- Waste treatment

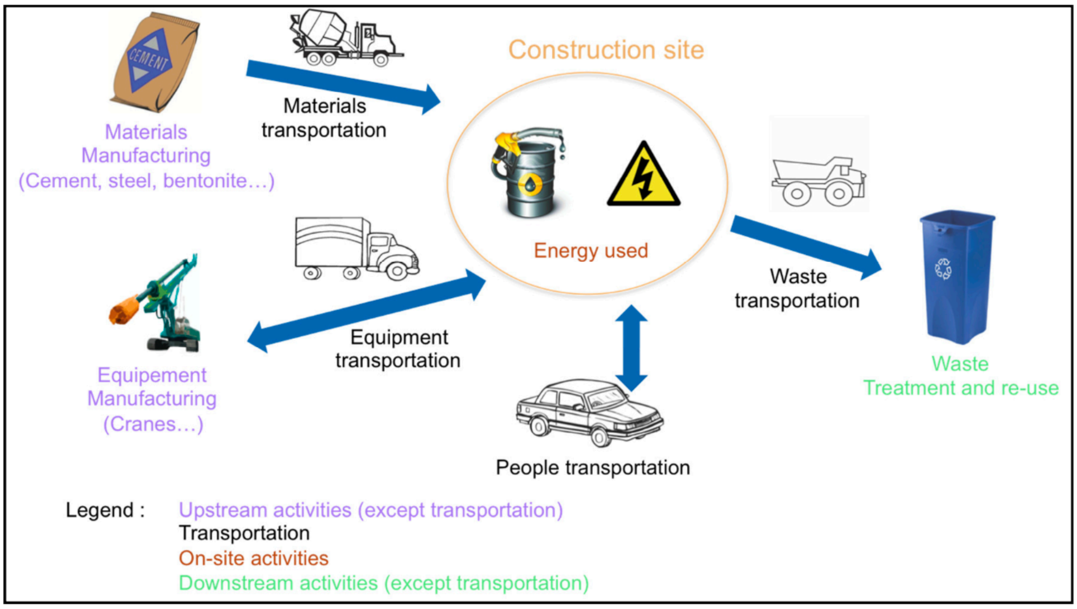


Figure 1: GHG emission sources in a deep foundation project – Carbone 4

2. Deep Foundation and Ground Improvement Techniques Carbon Accounting

This section presents the methodology for carbon accounting of EFFC and DFI activities. Seven techniques are covered:

- Bored piles
- Displacement piles
- Micro piles
- Diaphragm and slurry walls
- Sheet pile walls
- Grouting
- Soil Mixing
- Pile walls
- Anchors
- Soil Nails
- Jet Grouting
- Stone Columns
- Vibro Compaction
- Dynamic compaction
- Vertical Drains

Dewatering, underpilling and horizontal drilling have not been studied. Through, those projects can be calculated with a generic tab.
An important objective of the work is to focus on key emission sources and propose standards ratios for secondary emission sources, simplifying the calculation. The relatively small contribution of these secondary sources means that a ratio-based approach will not significantly decrease the accuracy of the calculation.

2.1 Emission sources

The generic emission sources in a deep foundation or ground improvement project are the following, with ranking depending on the technique:

- Material manufacturing, (cement, bentonite, steel, etc)
- Materials transportation, from factory to construction site,
- Energy consumed on the construction site,
- People's transport to the construction site,
- Equipment transportation (machines etc)
- Equipment manufacturing (depreciation),
- Waste transportation, from construction site to treatment site,
- Waste treatment

2.2 Prioritization of GHG emission sources

2.2.1 Primary and secondary emission sources

For each technique, 5 to 10 examples of carbon footprints have been calculated in order to analyse and classify the relative magnitude of each emission source. The samples were proposed by the members of the working group and analysed by Carbone 4.
The emission sources are divided in two categories:

- **Primary emission sources**: GHG emission sources that represent at least 5% of the global footprint for the technique,
- **Secondary emission sources**: GHG emission sources that represent less than 5% of the global footprint for the technique.

In all case studies, it was found that the total of the primary emission sources represented more than 90% of the total carbon footprint.
The 5% emission threshold is widely recognised as the standard value and often used in different carbon accounting tools and methods. It is not, however, formally defined as a standard rule by any standard setting organisation at this stage. However, based on Carbone 4 experience it can be considered appropriate.

2.2.2 Calculation process

For the calculation, the focus is put on the primary emission sources which are analysed in detail to maintain the accuracy of this dominant part of the calculation. The uncertainty level for primary emission sources is often significantly less than the uncertainty associated with secondary sources
For a simple calculation, the secondary emission sources can be estimated. No data collection is necessary for this part of the calculation as the use of specific ratios calculated during the tool's development is proposed.

The emissions calculated with a ratio will be considered as Approximative data, in the range of 5 data type proposed to measure the uncertainty.
A typical breakdown of the calculation and its data type, linked with an uncertainty level, is shown in figure 3.

The level of uncertainty associated by data type is shown in figure 2. It relies on the Methodological Guide of Bilan Carbone v8 – Annexe 1.2 Uncertainties.
By default, the data type if Order of Magnitude.

Data type	*Uncertainty associated*
Direct measurement	5%
Reliable unmeasured data	15%
Recalculated data	30%
Approximated data	50%
Order of magnitude	80%

Figure 2: Uncertainty associated by data type – Carbone 4

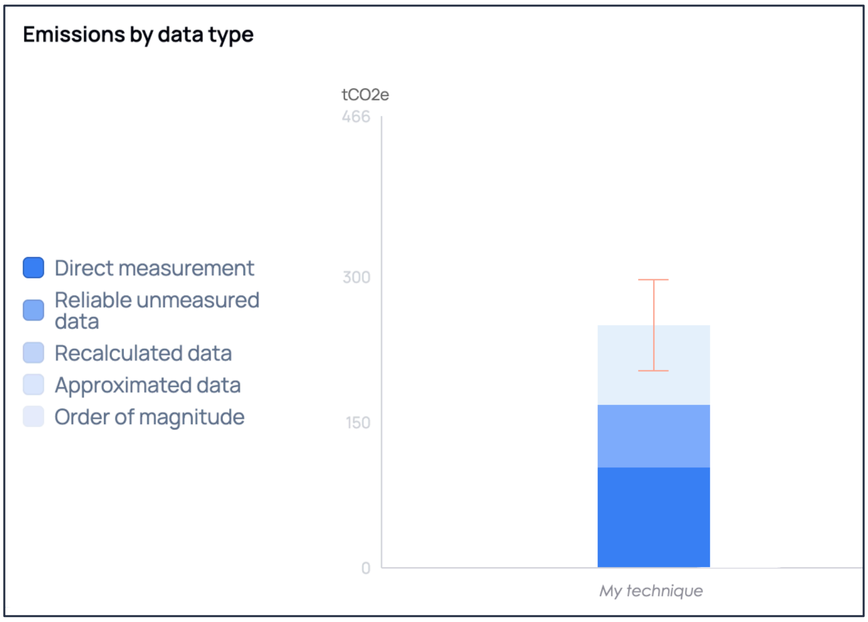


Figure 3: Emissions of a technique by data type, linked with uncertainty levels – Carbone 4

2.3 Estimation Methods for the Secondary Emission Sources

There are two ways to estimate the contribution of the secondary emission sources:

- As a percentage of the total primary emissions;
- By considering standardized activity data for a given secondary emission source.

A **percentage-based calculation** considers each secondary emission source as a percentage of the primary emissions. This percentage is an average of calculated values from sample projects. It is a direct CO2 emission calculation.

$$\text{Secondary emission source Y} = \text{Primary emission sources} \times \%_{Y}$$

A **standardized activity data-based calculation** consists of a predefined ratio or value that will represent the activity data needed for a secondary emission source. For example, to calculate the freight emissions of an incoming material, you need to know the number of vehicle kilometres travelled. This can be obtained by assuming a standard travel distance and typical load per journey. The secondary emissions can then be calculated directly from the quantity of the incoming material.

$$\text{Secondary emission source Y} = \text{Activity data needed otherwise} \times \text{Standard activity data/ratio} \times \text{Emission factor}$$

Refined mode: for a more detailed approach, the secondary emission sources can also be calculated based on real values. With the percentage-based method, the real activity data can be entered, and the applied percentage will default to 0. With the standard activity data method, real activity data can be entered in place of standardised data.

3 Detailed Carbon Footprint Methodology by Emission Source

This section describes the individual GHG accounting methodology for each source of emissions to be integrated into the analysis.

This section is valid for all deep foundation and ground improvement techniques.

3.1 Materials

The GHG emissions in this part correspond to the emission from the manufacture of the materials used.
The main materials used are:

- Cement / grout / concrete / bentonite;
- Steel used as tube, sheet, or reinforcement for concrete.

3.1.1 Cement and cement-based materials

Cement and secondary constituents' method (Detailed method)
For each technique covered in the first phase of the project, cement production is the main emission source.

Cement production accounts on its own for no less than 5% of anthropogenic GHG emissions, and this is linked to the cement production process. Cement production requires high temperatures and burns fossil fuels (coal, heavy oil), and the decarbonisation of limestone is a chemical reaction, which emits CO2.

A mean value for the carbon content of Portland cement is between 900 and 1000 kg CO2e per tonne, whereas for the other components of concrete the emission factors are below 100 kg CO2e per tonne.
Therefore, it is mandatory to evaluate the quantity of Portland cement in every cement-based material. The methodology is proposed by the sustainable concrete method.
Given that the Portland cement content is not always known, the following assumptions are made, depending on the cement type (see NF EN 197-1 and NF EN 197-5 standard):

Type	Secondary constituent 1	Secondary constituent minimum content 1	Secondary constituent maximum content 1	Secondary constituent average content 1
CEM I	**-**	0%	0%	0%
CEM II/A-V	**Fly Ash**	6%	20%	13%
CEM II/A-S	**GGbs**	6%	20%	13%
CEM II/B-V	**Fly Ash**	21%	35%	28%
CEM II/B-S	**GGbs**	21%	35%	28%
CEM II/A-D	**Silica fume**	6%	10%	8%
CEM II/A-T	**Calcined clay**	6%	20%	13%
CEM II/B-T	**Calcined clay**	21%	35%	28%
CEM II/A-LL or L	**Limestone**	6%	20%	13%
CEM II/B-LL or L	**Limestone**	21%	35%	28%
CEM II/A-M	**GGbs**	12%	20%	16%
CEM II/B-M	**GGbs**	21%	35%	28%
CEM II/C-M	**GGbs**	36%	50%	43%
CEM III/A	**GGbs**	36%	65%	51%
CEM III/B	**GGbs**	66%	80%	73%
CEM III/C	**GGbs**	81%	95%	88%
CEM IV/A	**Fly Ash**	11%	35%	23%
CEM IV/B-V	**Fly Ash**	36%	55%	46%
CEM V/A	**GGbs**	18%	30%	24%
CEM V/B	**GGbs**	31%	59%	45%
CEM VI (S-P)	**GGbs**	31%	59%	45%
CEM VI (S-V)	**GGbs**	31%	59%	45%
CEM VI (S-L)	**GGbs**	31%	59%	45%
CEM VI (S-LL)	**GGbs**	31%	59%	45%

And the secondary constituent of the CEM V and CEM VI cements:

Type	Secondary constituent 2	Secondary constituent minimum content 2	Secondary constituent maximum content 2	Secondary constituent average content 2
CEM V/A	**Fly Ash**	18%	30%	24%
CEM V/B	**Fly Ash**	31%	59%	45%
CEM VI (S-P)	**Fly Ash**	31%	59%	45%
CEM VI (S-V)	**Fly Ash**	31%	59%	45%
CEM VI (S-L)	**Limestone**	31%	59%	45%
CEM VI (S-LL)	**Limestone**	31%	59%	45%

The cement type must always be known for any deep foundation and ground improvement technique carbon footprint calculation. If this is not possible, a conservative choice of CEM I must be made, possibly leading to an overestimation of the carbon footprint of the project.
On top of its quality, the cement quantity must always be known.

Concrete method
It is now possible in the tool to directly use a Concrete emission factor from a database, by using either 3 possible data sources:
EC3 average emission factor by resistance and by country, calculated by Carbone 4. 4 different types of concrete of available: Readymix, Flowable fill, Cement grout, and Shortcrete. (more details in Section *7 Emission Factors Database*).

- EC3 emission factor chosen and filtered by the user. 4 different types of concrete of available: Readymix, Flowable fill, Cement grout, and Shortcrete.
- Specific emission factor created by the user. By using this source, that cannot be verified by EFFC/DFI, the calculation cannot be certified, and a thirst party validation is required.

In the EC3 database, only certain LCA methods are required to be aligned with the standards mentioned:

- TRACI v2.
- IPCC 2021
- EF v3.1
- CML v4.8 2016
- Recipe 2016

3.1.2 Steel

EFFC members use mainly four kind of steel:

- Bars
- Tubes
- Sheets
- Wires and cables

The EFFC team has validated that steel emission factors are taken from the Ecoinvent database.
Ecoinvent gives the embodied carbon of virgin steel slab, produced by a converter, and recycled steel slab, produced by an electric arc furnace.
The slab is then hot rolled.
The next process depends on the final shape of the steel.

Shape	Ecoinvent emission factor
Rebars	Section bar rolling, steel
Tubes	Drawing of pipes, steel
Sheets	Cold rolling, steel

Wires and cables	Wire drawing, steel

Steel sheets emission factor - RoW	New	Recycled	Units	Source
steel production, converter, unalloyed - RoW	1810		kgCO2e/t	Ecoinvent v3.11
steel production, electric, low-alloyed - roW		1400	kgCO2e/t	Ecoinvent v3.11
Hot rolling, steel - Row	274	274	kgCO2e/t	Ecoinvent v3.11
Total	**2084**	**1674**	kgCO2e/t	Ecoinvent v3.11
Steel rebars emission factor - RoW	**New**	**Recycled**	**Units**	**Source**
steel production, converter, unalloyed - RoW	1810		kgCO2e/t	Ecoinvent v3.11
steel production, electric, low-alloyed - roW		1400	kgCO2e/t	Ecoinvent v3.11
Section bar rolling, steel - RoW	213	213	kgCO2e/t	Ecoinvent v3.11
Total	**2023**	**1613**	kgCO2e/t	Ecoinvent v3.11
Steel tubes emission factor - RoW	**New**	**Recycled**	**Units**	**Source**
steel production, converter, unalloyed - RoW	1810		kgCO2e/t	Ecoinvent v3.11
steel production, electric, low-alloyed - roW		1400	kgCO2e/t	Ecoinvent v3.11
Hot rolling, steel - RoW	269	269	kgCO2e/t	Ecoinvent v3.11
Drawing of pipes, steel - RoW	469	469	kgCO2e/t	Ecoinvent v3.11
Total	**2548**	**2138**	kgCO2e/t	Ecoinvent v3.11
Steel wires emission factor - RoW	**New**	**Recycled**	**Units**	**Source**
steel production, converter, unalloyed - RoW	1810		kgCO2e/t	Ecoinvent v3.11
steel production, electric, low-alloyed - roW		1400	kgCO2e/t	Ecoinvent v3.11
Hot rolling, steel - RoW	269	269	kgCO2e/t	Ecoinvent v3.11

Wire drawing, steel - RoW	427	427	kgCO2e/t	Ecoinvent v3.11
Total	**2506**	**2096**	kgCO2e/t	Ecoinvent v3.11

These emission factors are considered as standard values in the calculator.
Many users want to use specific emission factors (example: specific steel composition proposed by a steel manufacturer). In these cases, is it possible for the user to use a specific emission factor from the EC3 database, linked to the tool, or to create its custom emission factor. The emission factors added will appear in the result sheet.
For the custom emission factor, it should be verified by a third party to make sure it can be used in the calculation. It is the responsibility of the user to verify the custom emission factor it creates.

3.1.3 Recycled & reused materials

If a material is reused without transformation (e.g. excavated ground used for soil mixing is not transformed), there is no emission due to the material manufacturing, because the emissions have already been considered in its first life. Some emissions may occur
for the material transportation.

Emissions associated with the reuse of materials are very low.

However, a recycled material has gone through an industrial process (e.g. recycle steel must be heated again), from which the emissions must be accounted for.
In most cases, the recycling process has lower emissions than raw materials processing.

Depending on the case, the emission calculation is as follows:

- Raw material: $Q_{raw} \times EF_{raw}$
- Recycled material: $Q_{recycled} \times EF_{recycled}$
- Mix of raw and recycled material: $\%_{recycled} \times Q \times EF_{recycled} + (1-\%_{recycled}) \times Q \times EF_{raw}$
- Reused material: 0 for the material production itself.

Q: Quantity
EF: Emission Factor
$\%_{recycled}$: Recycled Content

3.2 Energy used on site

The two main energy sources used on deep foundation and ground improvement projects

are:

- Fuel
- Electricity.

The following relate to the energy used on site:

- Energy used by machines and power generators,
- Energy used to mobilize and demobilize machines and equipment,

- Energy used to heat site offices.

Fuel used by vehicles for transportation is not included here.
The emissions associated with transportation are covered by the freight section (for material transportation) and in mob/demob source (for machines & equipment transportation). Refer to relevant section below for more information.

3.2.1 Fuel

The proposed emission factor comes from the *GLEC Framework, March 2025*. This emission factor considers the fuel combustion (direct emission, Scope 1) and upstream emission (scope 3): extraction, production and transport of the oil.
Alternatives of light fuel oil are proposed with biodiesel or hydrogen.

3.2.2 Electricity

The electricity emission factor depends on the local / national production mix. The common approach in this case is to use a country-based emission factor, considering the different power plant sources.
The source used for electricity is IEA publication *IEA Emissions Factors - 2024 edition,* based on 20XX and 2023 data.

The upstream part considers the combustible upstream, the infrastructure and supply chain upstream and the upstream losses.
In most cases, the exact amount of electricity consumed is not known and will be neglected since quantities consumed in the case studies were very low.

However, in some cases switching to electricity is a good practice to reduce GHG emissions.

3.3 People's transportation

This section covers personal and business travel to reach the working site.

3.3.1 Emission factors

Cars, Scooter, soft mobility and Public transportation
The emission factors come from Carbone 4, based on ADEME, GRDF, IEA and PPE. They cover:
- Fuel combustion
- Fuel upstream
- Vehicles construction

Plane
The emission factors come from ADEME Base Carbone (v23.8). They cover:
- Fuel combustion
- Fuel upstream

Train: Europe and others World regions
The emission factors come from ADEME Base Carbone (v23.8). They cover:
- Fuel combustion
- Fuel upstream

It is important to fill the Total Working days and the Workforce in General Information to complete the calculation.

It is also possible to add direct consumption of fuel or electricity, like in the Energy section, if the vehicle fleet are tracked for example.

3.3.2 Secondary emission source assumptions

The tool proposes a simple way to calculate emissions relative to people transportation.
Assumptions do not depend on the actual technique because emissions depend only on the location of the construction site, and on the team composition.
The following assumptions are made by default:
- Daily commuting (home to work);
- All workers come by car every day (= one round-trip per worker);
- The average distance between construction site and the place they sleep (their house, hostels…) is 50 km;

It is possible (and recommended!) to adjust these values for the project, because this emission source can vary significantly from one project to another.

It is also possible to have a longer journey to site once a week. This can also be accounted for in the tool (refer to user guide).

3.4 Freight transportation

3.4.1 Road, air and sea transportation

The emission factors come from *GLEC Framework, March 2025*. They consider:

- Fuel combustion
- Fuel upstream
- Vehicles construction & depreciation.

All emission factors are proposed by tonne per kilometre and dependent of the transported load.
Air, Rail and Maritime transportation are rarely used but still, different types of energy and distance are proposed.
However, road transportation is considered very accurately. Different types of vehicles are proposed, including electrical ones, with an emission factor by kWh.
The calculation considers the material quantity entered and the distance travelled. The load considered for each vehicle is given for information, and it considers a load factor of 60%.

3.4.2 Secondary emissions source assumptions

Depending on the material category, assumptions are made for simpler calculation:

Material type	Default freight Type	Default distance (km)
Water	Rigid truck 12-20t - Diesel	0
Concrete - if made at plant	Rigid truck 12-20t - Diesel	20
Concrete - if made on site	Rigid truck 12-20t - Diesel	0
Cement	Artic truck 34-40t - Diesel	50
Sand	Artic truck 34-40t - Diesel	20
Aggregate	Artic truck 34-40t - Diesel	20
Other materials	Artic truck 34-40t - Diesel	300

These values can be modified by the user, provided all adequate information is given to support the new values (transparency principle).

3.5 Mobilization/demobilization

The mob/demob emissions source considers the transportation of machines & equipment.
The emission factors are in vehicle per km and are only for Road transportation as it is the usual transportation mode for this.
A default distance is given, of 50 km and 3 roundtrips. The mob/demob emission source can be estimated by adding an additional percentage.

3.6 Assets depreciation

In deep foundation projects, "assets" refers to the machines used such as cranes, drilling or piling rigs and power generators.

Greenhouse gases are emitted during their manufacture which needs to be accounted for in the products they produce.

Therefore, the emissions are divided by the lifetime of the equipment and then multiplied by the length of the project.

3.6.1 Emission factors

The emission factor used comes from ADEME Base Carbone (v23.8) and Ecoinvent v3.11.
The level of uncertainty is high and can be reduced by providing life cycle analysis of the equipment, or complete carbon footprint.

3.6.2 Secondary emission sources key assumptions

A precise calculation consists of evaluating the mass of machines used on site (including power generators). The depreciation is then automatically calculating by dividing the number of total working days of the subproject by a default lifetime of 10 years. It must be entered is the General information of the project.

A working year is taken to be XX0 working days. If the machine is not used during the whole project, the real time can be entered, as can the real lifetime of the machine.

Lastly, it is possible to enter a specific value upon request.

The depreciation of assets emission source can be estimated by adding an additional percentage, depending on the considered technique.

3.7 Waste emissions

The waste emissions source considers:

- Waste transportation
- Waste average treatment

The associated emission factors come from *ADEME Base Carbone (v23.8)* for the average end-of-life treatment and from *GLEC Framework, March 2025* for the transportation of the wastes.
If no waste is transported and treated for a particular project, the ratio can be set to zero in the tool.
For a more detailed approach, real transportation data is preferred, but since it is only a secondary emissions source, waste emissions can be considered with an additional ratio.
If using a ratio, the emissions considered are only the transportation ones. The advanced one is required to calculate the emissions from treatment, with accurate data.

3.8 Land use change

The land use change emissions source is due to the destock of carbon in soil by artificialization. The emission factors come from ADEME Base Carbone (v23.8) and are different depending is the surface was a meadow, a field or a forest before.

It is necessary to enter the surface of the project that is artificialized.

No additional ratio is available for this emissions source.

3.9 Ratio by default

The ratio used for default values for each technique type are the same than the previous version of the tool. They will be updated in a future update of the platform.
With the new possibility of sharing projects, the ratio could be updated through this feature, by gathering anonymized and aggregated data from real and finished projects, for each technique.

4 Emission Factors Database Management

Emission factors are updated and evolve as time goes by. Common database providers regularly release new versions of their emission factors. For example, IEA Electricity emission factors are updated every year.

Moreover, carbon calculator tool users can face projects with materials that have no emission factors in the tool's database. In this case the following approach is proposed:

1 – consider similar materials already available in the database

2 – if no comparable factors exist, then add a new material with an associated emission factor, from EC3 database or from your own source. In this last case, provide to the customer third party validated documents, demonstrating the accuracy and relevance of the emission factor.

It is recommended to question suppliers regarding the carbon content of their products. It is a recommended best practice to enlarge the emission factor database or to make it more accurate to the deep foundations sector. This will ensure that any innovations which reduce the carbon footprint of supplied products will have a positive effect on the calculated values.

The main principle is the following:

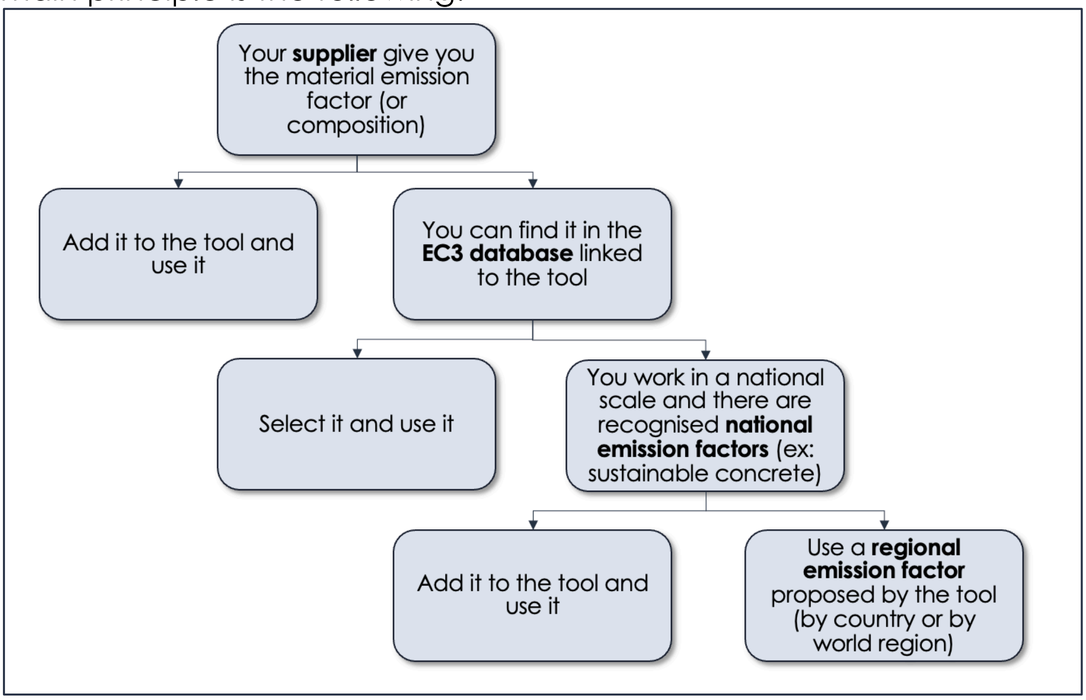


Figure 4: emission factor database choice process

The tool contains an emission factors database from public sources and product / supplier specific information. Where suppliers already communicate the carbon content of their product, users can enter this value into the tool for an individual calculation

5 Carbon Calculator Presentation

5.1 Platform objectives & principles

5.1.1 A project-based tool

The platform aims to calculate the carbon footprint of a deep foundation or ground improvement project. A project can be subdivided into different subprojects called Technique, as each of these subprojects corresponds to the use of one technique. Techniques can be created as many as required in a project.

The platform allows project comparisons, enabling the user to select the techniques with the lowest associated emissions and to compare the performance of different solutions for the same customer need.
The results of calculations performed with different techniques or by different companies, for the same project, will be comparable and the use of the EFFC DFI platform may be proposed by a customer.
The methodology chosen and deployed in this tool ensures that all the EFFC and DFI members calculate their product carbon footprints in the same way, with consistency in perimeter and emission factors. This will ensure that results calculated separately will be comparable.

5.1.2 Techniques covered

The techniques covered, depending on the version of the tool are :

Piles	**Bored piles**
	Displacement piles
	Micropiles/Minipiles
Retaining walls	**Diaphragm and slurry walls**
	Sheet pile walls
	Pile walls
Anchors	**Anchors**
	Soil Nails
Ground Improvement	**Dynamic compaction**
	Vibro compaction
	Grouting
	Jet Grouting
	Stone Columns
	Soil Mixing
	Vertical Drains
Dewatering	**Dewatering**

5.1.3 Generic principles

The tool is user driven and customer focused.

The tool is easy-to-use so that non-expert people can use it (a commercial team for example). It can be used for decision making during the design phase as well as for external/ internal communication or commercial activities.
Emission sources are analysed, organized and appear by order of importance, specific to each technique: this optimizes the time spend of the user by focusing the data collection for key emission sources. The use of statistical ratios is proposed for the secondary sources.
At any time, these ratios may be replaced by specific activity data should it be available.

5.2 Perimeter

The general life cycle perimeter - cradle-to-grave - is shown on the following figure:

Figure 5: Cradle-to-grave life cycle analysis phases from the GHG Protocol Product Life Cycle Accounting and Reporting Standar)

For the deep foundation's activity, the cradle-to-grave perimeter will be considered, which contains only the **material acquisition & pre-processing** phase, the **production** phase and **the end-of-life** of the materials (transportation and treatment).
The impact of **land use change** can be added to carbon footprint, knowing the surface concerned.
Distribution phase: The distribution and storage phase has no significance for foundations activities because the foundations are produced on site. However, the required transportation for the production phase (materials transportation for example) will be considered.
Use phase: As a foundation is a passive product, it does not consume energy. The specific case of geothermal piles is not considered here.
No greenhouse gas is released in the atmosphere during a foundation's lifetime. If some maintenance is needed, the amount of energy and materials are considered negligible compared to the construction phase.

As this is a project-based tool, all emissions from premises and office work are excluded. These should not differentiate various technique's carbon footprints

5.3 Data collection / primary and secondary emission sources

The methodology and associated tool will expose all the data needed for the calculation, for every technique, in the form of boxes to be filled.

The data can be entered in two stages:

- data concerning the main emission sources

- data concerning other emission sources

By default, the user is invited to use an advanced mode that enable him to enter all the data concerning the project, which is longer, but more accurate. A simple mode will enable the entry of only the data concerning the main emission sources, the remainder will be automatically calculated based on ratios provided by the methodology. This simple mode gives an approximated result very quickly.

5.4 Uncertainties

The aim of a carbon footprint is to calculate the order of magnitude of the emissions due to the project. There are uncertainties associated with emission factors and activity data, both of which are considered in the tool.
The global uncertainty is an indicator of the accuracy of the calculation, using the methodology described in Methodological Guide of Bilan Carbone v8 – Annexe 1.2 Uncertainties (see Section 2.2.2 Calculation Process).

5.5 Tools presentation and interface

5.5.1 Connexion page

The connexion page enables users to create an account and to connect to the tool. It also gives them access to the methodological and user guide.

5.5.2 Account page

The account page enables to modifies the information of the user: name, address, language, password, default functional units and to see their personal emission factors database.

5.5.3 Techniques & Projects page

This page is the dashboard of the user account, with an overview of all the techniques and projects created, sent and received. A technique or a project can be consulted, sent to another user or modified.

5.5.4 Technique inputs page

For each technique, a page is available to fill of the activity data concerning all the emission sources. The calculation is done at the same time the inputs are filled.

5.5.5 Technique results page

The results for each view (LCA, GHGP, CSRD, and by module) are presented on this page, with the possibility to export the Excel or PDF of results.

5.5.6 Project inputs page

For each project, a page is available to see the activity data concerning all the emission sources of the techniques linked to the project. The calculation is made in the technique page.

5.5.7 Project results page

The results for each view (LCA, GHGP, CSRD, and by module) are presented on this page, with the possibility to export the Excel or PDF of results.

5.5.8 Comparison page

The comparison between different projects and techniques are possible to create in this page, and to see the previous comparisons made.

5.5.8 Comparison page results

The results of the comparisons between different projects and techniques is visible here, for the different views available.

5.5.9 API page

The access to the API is available on this page.

6 Emission Factors Database

Emission factor name	unit	Emission factor (kgCO2 e/unit)	Emission factor database name	Emission factor database used	Uncertainty
Materials					
Acrylic acid	t	2520	Acrylic acid	Seve TP	60%
Aggregate	t	4,0	Granulats/sortie carrière	Base carbone ADEME (v23.11)	50%
Recycled aggregate	t	1,5	Production de granulats recyclés » de l'UNPG de 2017 :-	Seve TP	60%
Bentonite	t	539,0	Market for bentonite	Ecoinvent v3.9	60%
Synthetic polymer slurry	t	805,0	Polymère (polyacrylamides, ASP34, ASP20 …)	Services de l'eau et de l'assainissement (sources différentes)	60%
Cellulose-based polymer slurry	t	2,7	market for carboxymethyl cellulose, powder - GLO	Ecoinvent v3.11	60%
Calcium chloride	t	486	Ecoinvent 3.11- (soda production, solvay process (cutoff), RER)	Seve TP	60%
Carboxymethyl cellulose	t	3370	Ecoinvent 3.11- (carboxymethyl cellulose production, powder (cutoff), RER).	Seve TP	60%
CEM I - Monde	t	866,0	Ciment portland	Base carbone ADEME (v23.11)	60%
GGbs	t	83,0	Reglemetation INIES	Infociments	60%
Fly Ash	t	4,2	Fly Ash	Seve TP	60%

Limestone	t	8,0	Limestone	sustainableconcrete	60%
minor additional constituent	t	75,0	minor additional constituent	sustainableconcrete	60%
Chemicals inorganic	t	1860,0	Ecoinvent 3.11- (chemical production, inorganic (cutoff), GLO).	Seve TP	60%
EPDM-rubber	t	2312	Polypropylène/éthylène-propylène-diène, granulés (PP/EPDM), mix, RER + Extrusion de plastique (non spécifique), EU-27	Base carbone ADEME (v23.11)	60%
Polypropylene	t	2435	Polypropylène, granulés (PP), RER + Extrusion de plastique (non spécifique), EU-27	Base carbone ADEME (v23.11)	60%
PVC pipes	t	2590	PVC extrudé en tuyaux	Base carbone ADEME (v23.11)	60%
Sand	t	31,2	DED - Lit de sable [volume = 1m^3] [A4=100km]	INIES	60%
Sodium carbonate	t	1190	Ecoinvent 3.11- (soda ash production, dense, Hou's process, GLO).	Seve TP	60%
Steel sheets - World	t	2084	Steel sheets emission factor , New, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%

Steel rebars - World	t	2023	Steel rebars emission factor , New, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel tubes - World	t	2548	Steel tubes emission factor , New, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel wires - World	t	2506	Steel wires emission factor , New, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel sheets - Europe	t	1934	Steel sheets emission factor , New, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel rebars - Europe	t	1916	Steel rebars emission factor , New, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel tubes - Europe	t	2343	Steel tubes emission factor , New, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel wires - Europe	t	2306	Steel wires emission factor , New, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%

Water	t	0,132	Eau de réseau/Hors infrastructure	Base carbone ADEME (v23.11)	11%
Steel sheets - World - recycled	t	1674	Steel sheets emission factor , Recycled, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel rebars - World - recycled	t	1613	Steel rebars emission factor , Recycled, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel tubes - World - recycled	t	2138	Steel tubes emission factor , Recycled, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel wires - World - recycled	t	2096	Steel wires emission factor , Recycled, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel sheets - Europe - recycled	t	754	Steel sheets emission factor , Recycled, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel rebars - Europe - recycled	t	736	Steel rebars emission factor , Recycled, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%

Steel tubes - Europe - recycled	t	1163	Steel tubes emission factor , Recycled, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel wires - Europe - recycled	t	1126	Steel wires emission factor , Recycled, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Energy					
Gasoline - EU	liter	3,12	Gasoline - EU	GLEC Framework, March 2025	60%
Ethanol 40% maize, 35% sugar beet, 25% wheat - EU	liter	1,01	Ethanol 40% maize, 35% sugar beet, 25% wheat - EU	GLEC Framework, March 2025	60%
Diesel - EU	liter	3,48	Diesel - EU	GLEC Framework, March 2025	60%
Biodiesel 50% rapeseed, 40% used cooking oil, 10% soybean - EU	liter	1,17	Biodiesel 50% rapeseed, 40% used cooking oil, 10% soybean - EU	GLEC Framework, March 2025	60%
LPG - EU	liter	2,26	LPG - EU	GLEC Framework, March 2025	60%
Hydrogen from SMR - EU	liter	12,16	Hydrogen from SMR - EU	GLEC Framework, March 2025	60%
HVO/HEFA (SAF)50% rapeseed, 50% used cooking oil - EU	liter	1,01	HVO/HEFA (SAF)50% rapeseed, 50% used cooking oil - EU	GLEC Framework, March 2025	60%
CNG - EU	liter	3,79	CNG - EU	GLEC Framework, March 2025	60%

LNG - EU	liter	3,99	LNG - EU	GLEC Framework, March 2025	60%
Bio CNG40% maize, 40% manure, 20% biowaste - EU	liter	1,28	Bio CNG40% maize, 40% manure, 20% biowaste - EU	GLEC Framework, March 2025	60%
Bio LNG40% maize, 40% manure, 20% biowaste - EU	liter	1,49	Bio LNG40% maize, 40% manure, 20% biowaste - EU	GLEC Framework, March 2025	60%
Gasoline - US/CA	liter	2,80	Gasoline - US/CA	GLEC Framework, March 2025	60%
Ethanol 100% corn - US/CA	liter	1,19	Ethanol 100% corn - US/CA	GLEC Framework, March 2025	60%
Diesel - US/CA	liter	3,28	Diesel - US/CA	GLEC Framework, March 2025	60%
Biodiesel 100% soybean - US/CA	liter	0,73	Biodiesel 100% soybean - US/CA	GLEC Framework, March 2025	60%
HVO 100% tallow - US/CA	liter	0,62	HVO 100% tallow - US/CA	GLEC Framework, March 2025	60%
LPG - US/CA	liter	1,84	LPG - US/CA	GLEC Framework, March 2025	60%
CNG - US/CA	liter	3,49	CNG - US/CA	GLEC Framework, March 2025	60%
LNG - US/CA	liter	3,72	LNG - US/CA	GLEC Framework, March 2025	60%
Electricity - Australia	kWh	723	Electricity - Australia	Carbone 4 d'après IEA	60%

Electricity - Austria	kWh	205	Electricity - Austria	Carbone 4 d'après IEA	60%
Electricity - Belgium	kWh	190	Electricity - Belgium	Carbone 4 d'après IEA	60%
Electricity - Canada	kWh	154	Electricity - Canada	Carbone 4 d'après IEA	60%
Electricity - Chile	kWh	333	Electricity - Chile	Carbone 4 d'après IEA	60%
Electricity - Colombia	kWh	257	Electricity - Colombia	Carbone 4 d'après IEA	60%
Electricity - Costa Rica	kWh	117	Electricity - Costa Rica	Carbone 4 d'après IEA	60%
Electricity - Czech Republic	kWh	509	Electricity - Czech Republic	Carbone 4 d'après IEA	60%
Electricity - Denmark	kWh	101	Electricity - Denmark	Carbone 4 d'après IEA	60%
Electricity - Estonia	kWh	320	Electricity - Estonia	Carbone 4 d'après IEA	60%
Electricity - Finland	kWh	68	Electricity - Finland	Carbone 4 d'après IEA	60%
Electricity - France	kWh	58	Electricity - France	Carbone 4 d'après IEA	60%
Electricity - Germany	kWh	398	Electricity - Germany	Carbone 4 d'après IEA	60%
Electricity - Greece	kWh	393	Electricity - Greece	Carbone 4 d'après IEA	60%
Electricity - Hungary	kWh	200	Electricity - Hungary	Carbone 4 d'après IEA	60%
Electricity - Iceland	kWh	14	Electricity - Iceland	Carbone 4 d'après IEA	60%
Electricity - Ireland	kWh	306	Electricity - Ireland	Carbone 4 d'après IEA	60%
Electricity - Israel	kWh	513	Electricity - Israel	Carbone 4 d'après IEA	60%

Electricity - Italy	kWh	303	Electricity - Italy	Carbone 4 d'après IEA	60%
Electricity - Japan	kWh	541	Electricity - Japan	Carbone 4 d'après IEA	60%
Electricity - South Korea	kWh	512	Electricity - South Korea	Carbone 4 d'après IEA	60%
Electricity - Latvia	kWh	329	Electricity - Latvia	Carbone 4 d'après IEA	60%
Electricity - Lithuania	kWh	153	Electricity - Lithuania	Carbone 4 d'après IEA	60%
Electricity - Luxembourg	kWh	269	Electricity - Luxembourg	Carbone 4 d'après IEA	60%
Electricity - Mexico	kWh	510	Electricity - Mexico	Carbone 4 d'après IEA	60%
Electricity - Netherlands	kWh	276	Electricity - Netherlands	Carbone 4 d'après IEA	60%
Electricity - Norway	kWh	21	Electricity - Norway	Carbone 4 d'après IEA	60%
Electricity - New Zealand	kWh	116	Electricity - New Zealand	Carbone 4 d'après IEA	60%
Electricity - Poland	kWh	679	Electricity - Poland	Carbone 4 d'après IEA	60%
Electricity - Portugal	kWh	152	Electricity - Portugal	Carbone 4 d'après IEA	60%
Electricity - Slovak Republic	kWh	282	Electricity - Slovak Republic	Carbone 4 d'après IEA	60%
Electricity - Slovenia	kWh	201	Electricity - Slovenia	Carbone 4 d'après IEA	60%
Electricity - Spain	kWh	181	Electricity - Spain	Carbone 4 d'après IEA	60%
Electricity - Sweden	kWh	27	Electricity - Sweden	Carbone 4 d'après IEA	60%
Electricity - Switzerland	kWh	112	Electricity - Switzerland	Carbone 4 d'après IEA	60%

Electricity - Turkey	kWh	549	Electricity - Turkey	Carbone 4 d'après IEA	60%
Electricity - United Kingdom	kWh	237	Electricity - United Kingdom	Carbone 4 d'après IEA	60%
Electricity - United States	kWh	407	Electricity - United States	Carbone 4 d'après IEA	60%
Electricity - Albania	kWh	4	Electricity - Albania	Carbone 4 d'après IEA	60%
Electricity - Algeria	kWh	649	Electricity - Algeria	Carbone 4 d'après IEA	60%
Electricity - Angola	kWh	3XX	Electricity - Angola	Carbone 4 d'après IEA	60%
Electricity - Argentina	kWh	457	Electricity - Argentina	Carbone 4 d'après IEA	60%
Electricity - Armenia	kWh	256	Electricity - Armenia	Carbone 4 d'après IEA	60%
Electricity - Azerbaijan	kWh	580	Electricity - Azerbaijan	Carbone 4 d'après IEA	60%
Electricity - Bahrain	kWh	809	Electricity - Bahrain	Carbone 4 d'après IEA	60%
Electricity - Bangladesh	kWh	760	Electricity - Bangladesh	Carbone 4 d'après IEA	60%
Electricity - Belarus	kWh	393	Electricity - Belarus	Carbone 4 d'après IEA	60%
Electricity - Benin	kWh	749	Electricity - Benin	Carbone 4 d'après IEA	60%
Electricity - Bolivia	kWh	395	Electricity - Bolivia	Carbone 4 d'après IEA	60%
Electricity - Bosnia and Herzegovina	kWh	958	Electricity - Bosnia and Herzegovina	Carbone 4 d'après IEA	60%
Electricity - Botswana	kWh	1778	Electricity - Botswana	Carbone 4 d'après IEA	60%
Electricity - Brazil	kWh	101	Electricity - Brazil	Carbone 4 d'après IEA	60%

Electricity - Brunei Darussalam	kWh	1004	Electricity - Brunei Darussalam	Carbone 4 d'après IEA	60%
Electricity - Bulgaria	kWh	428	Electricity - Bulgaria	Carbone 4 d'après IEA	60%
Electricity - Cambodia	kWh	653	Electricity - Cambodia	Carbone 4 d'après IEA	60%
Electricity - Cameroon	kWh	308	Electricity - Cameroon	Carbone 4 d'après IEA	60%
Electricity - China	kWh	712	Electricity - China	Carbone 4 d'après IEA	60%
Electricity - Congo-Brazzaville	kWh	1053	Electricity - Congo-Brazzaville	Carbone 4 d'après IEA	60%
Electricity - Congo-Kinshasa	kWh	6	Electricity - Congo-Kinshasa	Carbone 4 d'après IEA	60%
Electricity - Cote d'Ivoire	kWh	473	Electricity - Cote d'Ivoire	Carbone 4 d'après IEA	60%
Electricity - Croatia	kWh	197	Electricity - Croatia	Carbone 4 d'après IEA	60%
Electricity - Cuba	kWh	1032	Electricity - Cuba	Carbone 4 d'après IEA	60%
Electricity - Curacao/Netherl ands Antilles	kWh	872	Electricity - Curacao/Netherl ands Antilles	Carbone 4 d'après IEA	60%
Electricity - Cyprus	kWh	691	Electricity - Cyprus	Carbone 4 d'après IEA	60%
Electricity - Dominican Republic	kWh	846	Electricity - Dominican Republic	Carbone 4 d'après IEA	60%
Electricity - Ecuador	kWh	250	Electricity - Ecuador	Carbone 4 d'après IEA	60%
Electricity - Egypt	kWh	546	Electricity - Egypt	Carbone 4 d'après IEA	60%
Electricity - El Salvador	kWh	178	Electricity - El Salvador	Carbone 4 d'après IEA	60%

Electricity - Equatorial Guinea	kWh	549	Electricity - Equatorial Guinea	Carbone 4 d'après IEA	60%
Electricity - Eritrea	kWh	1213	Electricity - Eritrea	Carbone 4 d'après IEA	60%
Electricity - Eswatini	kWh	106	Electricity - Eswatini	Carbone 4 d'après IEA	60%
Electricity - Ethiopia	kWh	5	Electricity - Ethiopia	Carbone 4 d'après IEA	60%
Electricity - Gabon	kWh	638	Electricity - Gabon	Carbone 4 d'après IEA	60%
Electricity - Georgia	kWh	148	Electricity - Georgia	Carbone 4 d'après IEA	60%
Electricity - Ghana	kWh	388	Electricity - Ghana	Carbone 4 d'après IEA	60%
Electricity - Gibraltar	kWh	619	Electricity - Gibraltar	Carbone 4 d'après IEA	60%
Electricity - Greenland	kWh	81	Electricity - Greenland	Carbone 4 d'après IEA	60%
Electricity - Guatemala	kWh	346	Electricity - Guatemala	Carbone 4 d'après IEA	60%
Electricity - Guyana	kWh	1294	Electricity - Guyana	Carbone 4 d'après IEA	60%
Electricity - Haiti	kWh	1213	Electricity - Haiti	Carbone 4 d'après IEA	60%
Electricity - Honduras	kWh	501	Electricity - Honduras	Carbone 4 d'après IEA	60%
Electricity - Hong Kong	kWh	808	Electricity - Hong Kong	Carbone 4 d'après IEA	60%
Electricity - India	kWh	1025	Electricity - India	Carbone 4 d'après IEA	60%
Electricity - Indonesia	kWh	992	Electricity - Indonesia	Carbone 4 d'après IEA	60%
Electricity - Iran	kWh	682	Electricity - Iran	Carbone 4 d'après IEA	60%

Electricity - Iraq	kWh	1256	Electricity - Iraq	Carbone 4 d'après IEA	60%
Electricity - Jamaica	kWh	830	Electricity - Jamaica	Carbone 4 d'après IEA	60%
Electricity - Jordan	kWh	482	Electricity - Jordan	Carbone 4 d'après IEA	60%
Electricity - Kazakhstan	kWh	725	Electricity - Kazakhstan	Carbone 4 d'après IEA	60%
Electricity - Kenya	kWh	178	Electricity - Kenya	Carbone 4 d'après IEA	60%
Electricity - North Korea	kWh	625	Electricity - North Korea	Carbone 4 d'après IEA	60%
Electricity - Kosovo	kWh	1106	Electricity - Kosovo	Carbone 4 d'après IEA	60%
Electricity - Kuwait	kWh	704	Electricity - Kuwait	Carbone 4 d'après IEA	60%
Electricity - Kyrgyzstan	kWh	147	Electricity - Kyrgyzstan	Carbone 4 d'après IEA	60%
Electricity - Laos	kWh	353	Electricity - Laos	Carbone 4 d'après IEA	60%
Electricity - Lebanon	kWh	625	Electricity - Lebanon	Carbone 4 d'après IEA	60%
Electricity - Libya	kWh	912	Electricity - Libya	Carbone 4 d'après IEA	60%
Electricity - Madagascar	kWh	840	Electricity - Madagascar	Carbone 4 d'après IEA	60%
Electricity - Malaysia	kWh	797	Electricity - Malaysia	Carbone 4 d'après IEA	60%
Electricity - Malta	kWh	425	Electricity - Malta	Carbone 4 d'après IEA	60%
Electricity - Mauritius	kWh	948	Electricity - Mauritius	Carbone 4 d'après IEA	60%
Electricity - Moldova	kWh	612	Electricity - Moldova	Carbone 4 d'après IEA	60%

Electricity - Mongolia	kWh	1425	Electricity - Mongolia	Carbone 4 d'après IEA	60%
Electricity - Montenegro	kWh	482	Electricity - Montenegro	Carbone 4 d'après IEA	60%
Electricity - Morocco	kWh	953	Electricity - Morocco	Carbone 4 d'après IEA	60%
Electricity - Mozambique	kWh	114	Electricity - Mozambique	Carbone 4 d'après IEA	60%
Electricity - Myanmar	kWh	436	Electricity - Myanmar	Carbone 4 d'après IEA	60%
Electricity - Namibia	kWh	54	Electricity - Namibia	Carbone 4 d'après IEA	60%
Electricity - Nepal	kWh	4	Electricity - Nepal	Carbone 4 d'après IEA	60%
Electricity - Nicaragua	kWh	393	Electricity - Nicaragua	Carbone 4 d'après IEA	60%
Electricity - Niger	kWh	1364	Electricity - Niger	Carbone 4 d'après IEA	60%
Electricity - Nigeria	kWh	543	Electricity - Nigeria	Carbone 4 d'après IEA	60%
Electricity - North Macedonia	kWh	807	Electricity - North Macedonia	Carbone 4 d'après IEA	60%
Electricity - Oman	kWh	466	Electricity - Oman	Carbone 4 d'après IEA	60%
Electricity - Pakistan	kWh	538	Electricity - Pakistan	Carbone 4 d'après IEA	60%
Electricity - Panama	kWh	405	Electricity - Panama	Carbone 4 d'après IEA	60%
Electricity - Paraguay	kWh	5	Electricity - Paraguay	Carbone 4 d'après IEA	60%
Electricity - Peru	kWh	288	Electricity - Peru	Carbone 4 d'après IEA	60%
Electricity - Philippines	kWh	913	Electricity - Philippines	Carbone 4 d'après IEA	60%

Electricity - Qatar	kWh	568	Electricity - Qatar	Carbone 4 d'après IEA	60%
Electricity - Romania	kWh	280	Electricity - Romania	Carbone 4 d'après IEA	60%
Electricity - Russia	kWh	449	Electricity - Russia	Carbone 4 d'après IEA	60%
Electricity - Rwanda	kWh	562	Electricity - Rwanda	Carbone 4 d'après IEA	60%
Electricity - Saudi Arabia	kWh	790	Electricity - Saudi Arabia	Carbone 4 d'après IEA	60%
Electricity - Senegal	kWh	734	Electricity - Senegal	Carbone 4 d'après IEA	60%
Electricity - Serbia	kWh	920	Electricity - Serbia	Carbone 4 d'après IEA	60%
Electricity - Singapore	kWh	449	Electricity - Singapore	Carbone 4 d'après IEA	60%
Electricity - South Africa	kWh	1259	Electricity - South Africa	Carbone 4 d'après IEA	60%
Electricity - Sri Lanka	kWh	602	Electricity - Sri Lanka	Carbone 4 d'après IEA	60%
Electricity - South Sudan	kWh	1051	Electricity - South Sudan	Carbone 4 d'après IEA	60%
Electricity - Sudan	kWh	307	Electricity - Sudan	Carbone 4 d'après IEA	60%
Electricity - Suriname	kWh	808	Electricity - Suriname	Carbone 4 d'après IEA	60%
Electricity - Syria	kWh	1235	Electricity - Syria	Carbone 4 d'après IEA	60%
Electricity - Taiwan	kWh	688	Electricity - Taiwan	Carbone 4 d'après IEA	60%
Electricity - Tajikistan	kWh	92	Electricity - Tajikistan	Carbone 4 d'après IEA	60%
Electricity - Tanzania	kWh	499	Electricity - Tanzania	Carbone 4 d'après IEA	60%

Electricity - Thailand	kWh	591	Electricity - Thailand	Carbone 4 d'après IEA	60%
Electricity - Togo	kWh	558	Electricity - Togo	Carbone 4 d'après IEA	60%
Electricity - Trinidad and Tobago	kWh	712	Electricity - Trinidad and Tobago	Carbone 4 d'après IEA	60%
Electricity - Tunisia	kWh	546	Electricity - Tunisia	Carbone 4 d'après IEA	60%
Electricity - Turkmenistan	kWh	1089	Electricity - Turkmenistan	Carbone 4 d'après IEA	60%
Electricity - United Arab Emirates	kWh	500	Electricity - United Arab Emirates	Carbone 4 d'après IEA	60%
Electricity - Uganda	kWh	41	Electricity - Uganda	Carbone 4 d'après IEA	60%
Electricity - Ukraine	kWh	360	Electricity - Ukraine	Carbone 4 d'après IEA	60%
Electricity - Uruguay	kWh	75	Electricity - Uruguay	Carbone 4 d'après IEA	60%
Electricity - Uzbekistan	kWh	639	Electricity - Uzbekistan	Carbone 4 d'après IEA	60%
Electricity - Venezuela	kWh	260	Electricity - Venezuela	Carbone 4 d'après IEA	60%
Electricity - Viet Nam	kWh	631	Electricity - Viet Nam	Carbone 4 d'après IEA	60%
Electricity - Yemen	kWh	955	Electricity - Yemen	Carbone 4 d'après IEA	60%
Electricity - Zambia	kWh	205	Electricity - Zambia	Carbone 4 d'après IEA	60%
Electricity - Zimbabwe	kWh	635	Electricity - Zimbabwe	Carbone 4 d'après IEA	60%
Electricity - Burkina Faso	kWh	655	Electricity - Burkina Faso	Carbone 4 d'après IEA	60%
Electricity - Chad	kWh	2089	Electricity - Chad	Carbone 4 d'après IEA	60%

Freight					
Air transport - Freighter - Short haul (<1500 km)	t.km	2,77	Air transport - Freighter - Short haul (<1500 km)	GLEC Framework, March 2025	60%
Air transport - Freighter - Long haul (>1500 km)	t.km	1,11	Air transport - Freighter - Long haul (>1500 km)	GLEC Framework, March 2025	60%
Rail transport - Average/Mixed - EU - Diesel	t.km	0,031	Rail transport - Average/Mixed - EU - Diesel	GLEC Framework, March 2025	60%
Rail transport - Average/Mixed - EU - Electric	t.km	0,011	Rail transport - Average/Mixed - EU - Electric	GLEC Framework, March 2025	60%
Rail transport - Average/Mixed - USA - Diesel	t.km	0,016	Rail transport - Average/Mixed - USA - Diesel	GLEC Framework, March 2025	60%
Rail transport - Average/Mixed - EU - Unknown traction	t.km	0,019	Rail transport - Average/Mixed - EU - Unknown traction	GLEC Framework, March 2025	60%
Rigid truck 3,5-7,5t - Diesel	t.km	0,336	Rigid truck 3,5-7,5t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 3,5-7,5t - CNG	t.km	0,317	Rigid truck 3,5-7,5t - CNG	GLEC Framework, March 2025	60%
Rigid truck 3,5-7,5t - Electric	kWh	4,40E-04	Rigid truck 3,5-7,5t - Electric	GLEC Framework, March 2025	60%
Rigid truck 7,5-12t - Diesel	t.km	0,XX4	Rigid truck 7,5-12t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 7,5-12t - CNG	t.km	0,212	Rigid truck 7,5-12t - CNG	GLEC Framework, March 2025	60%

Rigid truck 7,5-12t - Electric	kWh	3,40E-04	Rigid truck 7,5-12t - Electric	GLEC Framework, March 2025	60%
Rigid truck 12-20t - Diesel	t.km	0,191	Rigid truck 12-20t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 12-20t - CNG	t.km	0,180	Rigid truck 12-20t - CNG	GLEC Framework, March 2025	60%
Rigid truck 12-20t - Electric	kWh	2,20E-04	Rigid truck 12-20t - Electric	GLEC Framework, March 2025	60%
Rigid truck 20-26t - Diesel	t.km	0,139	Rigid truck 20-26t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 20-26t - CNG	t.km	0,136	Rigid truck 20-26t - CNG	GLEC Framework, March 2025	60%
Rigid truck 20-26t - LNG	t.km	0,152	Rigid truck 20-26t - LNG	GLEC Framework, March 2025	60%
Rigid truck 26-32t - Diesel	t.km	0,125	Rigid truck 26-32t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 26-40t - Electric	kWh	1,60E-04	Rigid truck 26-40t - Electric	GLEC Framework, March 2025	60%
Artic truck up to 34t - Diesel	t.km	0,124	Artic truck up to 34t - Diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t - Diesel	t.km	0,101	Artic truck 34-40t - Diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t SI engine- LNG	t.km	0,102	Artic truck 34-40t SI engine- LNG	GLEC Framework, March 2025	60%
Artic truck 34-40t SI engine- CNG	t.km	0,096	Artic truck 34-40t SI engine- CNG	GLEC Framework, March 2025	60%

Artic truck 34-40t SI engine- Bio-LNG	t.km	0,038	Artic truck 34-40t SI engine- Bio-LNG	GLEC Framework, March 2025	60%
Artic truck 34-40t HPDI- LNG/diesel	t.km	0,091	Artic truck 34-40t HPDI- LNG/diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t HPDI- NDG/diesel	t.km	0,087	Artic truck 34-40t HPDI- NDG/diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t HPDI- Bio-LNG/diesel	t.km	0,040	Artic truck 34-40t HPDI- Bio-LNG/diesel	GLEC Framework, March 2025	60%
Artic truck 40t incl. Lightweight trailer- Diesel	t.km	0,081	Artic truck 40t incl. Lightweight trailer- Diesel	GLEC Framework, March 2025	60%
Artic truck 40-44t - Diesel	t.km	0,090	Artic truck 40-44t - Diesel	GLEC Framework, March 2025	60%
Artic truck up to 60t - Diesel	t.km	0,070	Artic truck up to 60t - Diesel	GLEC Framework, March 2025	60%
Artic truck up to 72t - Diesel	t.km	0,047	Artic truck up to 72t - Diesel	GLEC Framework, March 2025	60%
General cargo- (0-4999 dwt) - HFO	t.km	0,026	General cargo- (0-4999 dwt) - HFO	GLEC Framework, March 2025	60%
General cargo- (0-4999 dwt) - VLSFO	t.km	0,027	General cargo- (0-4999 dwt) - VLSFO	GLEC Framework, March 2025	60%
General cargo- (0-4999 dwt) - MDO	t.km	0,026	General cargo- (0-4999 dwt) - MDO	GLEC Framework, March 2025	60%
General cargo- (5000-9999 dwt) - HFO	t.km	0,021	General cargo- (5000-9999 dwt) - HFO	GLEC Framework, March 2025	60%

General cargo- (5000-9999 dwt) - VLSFO	t.km	0,0XX	General cargo- (5000-9999 dwt) - VLSFO	GLEC Framework, March 2025	60%
General cargo- (5000-9999 dwt) - MDO	t.km	0,021	General cargo- (5000-9999 dwt) - MDO	GLEC Framework, March 2025	60%
General cargo- (10000-19999 dwt) - HFO	t.km	0,019	General cargo- (10000-19999 dwt) - HFO	GLEC Framework, March 2025	60%
General cargo- (10000-19999 dwt) - VLSFO	t.km	0,020	General cargo- (10000-19999 dwt) - VLSFO	GLEC Framework, March 2025	60%
General cargo- (10000-19999 dwt) - MDO	t.km	0,019	General cargo- (10000-19999 dwt) - MDO	GLEC Framework, March 2025	60%
General cargo- (20000-+ dwt) - HFO	t.km	0,010	General cargo- (20000-+ dwt) - HFO	GLEC Framework, March 2025	60%
General cargo- (20000-+ dwt) - VLSFO	t.km	0,010	General cargo- (20000-+ dwt) - VLSFO	GLEC Framework, March 2025	60%
General cargo- (20000-+ dwt) - MDO	t.km	0,010	General cargo- (20000-+ dwt) - MDO	GLEC Framework, March 2025	60%
Mob/demob					
Rigid truck 3,5-7,5t - Diesel	v.km	1,51	Rigid truck 3,5-7,5t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 3,5-7,5t - CNG	v.km	1,43	Rigid truck 3,5-7,5t - CNG	GLEC Framework, March 2025	60%
Rigid truck 3,5-7,5t - Electric	kWh	1,98E-03	Rigid truck 3,5-7,5t - Electric	GLEC Framework, March 2025	60%
Rigid truck 7,5-12t - Diesel	v.km	1,61	Rigid truck 7,5-12t - Diesel	GLEC Framework, March 2025	60%

Rigid truck 7,5-12t - CNG	v.km	1,53	Rigid truck 7,5-12t - CNG	GLEC Framework, March 2025	60%
Rigid truck 7,5-12t - Electric	kWh	2,45E-03	Rigid truck 7,5-12t - Electric	GLEC Framework, March 2025	60%
Rigid truck 12-20t - Diesel	v.km	2,29	Rigid truck 12-20t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 12-20t - CNG	v.km	2,16	Rigid truck 12-20t - CNG	GLEC Framework, March 2025	60%
Rigid truck 12-20t - Electric	kWh	2,64E-03	Rigid truck 12-20t - Electric	GLEC Framework, March 2025	60%
Rigid truck 20-26t - Diesel	v.km	2,17	Rigid truck 20-26t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 20-26t - CNG	v.km	2,12	Rigid truck 20-26t - CNG	GLEC Framework, March 2025	60%
Rigid truck 20-26t - LNG	v.km	2,37	Rigid truck 20-26t - LNG	GLEC Framework, March 2025	60%
Rigid truck 26-32t - Diesel	v.km	2,40	Rigid truck 26-32t - Diesel	GLEC Framework, March 2025	60%
Rigid truck 26-40t - Electric	kWh	3,84E-03	Rigid truck 26-40t - Electric	GLEC Framework, March 2025	60%
Artic truck up to 34t - Diesel	v.km	2,53	Artic truck up to 34t - Diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t - Diesel	v.km	2,42	Artic truck 34-40t - Diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t SI engine- LNG	v.km	2,45	Artic truck 34-40t SI engine- LNG	GLEC Framework, March 2025	60%

Artic truck 34-40t SI engine- CNG	v.km	2,30	Artic truck 34-40t SI engine- CNG	GLEC Framework, March 2025	60%
Artic truck 34-40t SI engine- Bio-LNG	v.km	0,91	Artic truck 34-40t SI engine- Bio-LNG	GLEC Framework, March 2025	60%
Artic truck 34-40t HPDI- LNG/diesel	v.km	2,18	Artic truck 34-40t HPDI- LNG/diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t HPDI- NDG/diesel	v.km	2,09	Artic truck 34-40t HPDI- NDG/diesel	GLEC Framework, March 2025	60%
Artic truck 34-40t HPDI- Bio-LNG/diesel	v.km	0,96	Artic truck 34-40t HPDI- Bio-LNG/diesel	GLEC Framework, March 2025	60%
Artic truck 40t incl. Lightweight trailer- Diesel	v.km	3,24	Artic truck 40t incl. Lightweight trailer- Diesel	GLEC Framework, March 2025	60%
Artic truck 40-44t - Diesel	v.km	2,16	Artic truck 40-44t - Diesel	GLEC Framework, March 2025	60%
Artic truck up to 60t - Diesel	v.km	2,52	Artic truck up to 60t - Diesel	GLEC Framework, March 2025	60%
Artic truck up to 72t - Diesel	v.km	2,03	Artic truck up to 72t - Diesel	GLEC Framework, March 2025	60%
People's transportation					
Sedan / SUV Car, Diesel B7	p.km	0,17	Sedan / SUV Car, Diesel B7	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Sedan / SUV Car, Electricity (Battery Electric)	p.km	0,092	Sedan / SUV Car, Electricity (Battery Electric)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Sedan / SUV Car, Gasoline/Ethanol	p.km	0,16	Sedan / SUV Car, Gasoline/Ethanol	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%

Sedan / SUV Car, Hybrid (Diesel)	p.km	0,16	Sedan / SUV Car, Hybrid (Diesel)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Sedan / SUV Car, Hybrid (Gasoline)	p.km	0,15	Sedan / SUV Car, Hybrid (Gasoline)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Medium-sized Car, Diesel B7	p.km	0,14	Medium-sized Car, Diesel B7	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Medium-sized Car, Electricity (Battery Electric)	p.km	0,081	Medium-sized Car, Electricity (Battery Electric)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Medium-sized Car, Gasoline/Ethanol	p.km	0,15	Medium-sized Car, Gasoline/Ethanol	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Medium-sized Car, Hybrid (Diesel)	p.km	0,14	Medium-sized Car, Hybrid (Diesel)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Medium-sized Car, Hybrid (Gasoline)	p.km	0,13	Medium-sized Car, Hybrid (Gasoline)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Car, (Bio-)Diesel	p.km	0,13	City Car, (Bio-)Diesel	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Car, Electricity (Battery Electric)	p.km	0,069	City Car, Electricity (Battery Electric)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Car, Gasoline/Ethanol	p.km	0,13	City Car, Gasoline/Ethanol	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Car, E85	p.km	0,08	City Car, E85	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Car, Hybrid (Diesel)	p.km	0,13	City Car, Hybrid (Diesel)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Car, Hybrid (Gasoline)	p.km	0,12	City Car, Hybrid (Gasoline)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%

Scooter, Electricity (Battery Electric)	p.km	0,036	Scooter, Electricity (Battery Electric)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Scooter, Gasoline/Ethanol	p.km	0,080	Scooter, Gasoline/Ethanol	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Electric Scooter, Electricity (Battery Electric)	p.km	0,023	Electric Scooter, Electricity (Battery Electric)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Electric Bicycle, Electricity (Battery Electric)	p.km	0,0089	Electric Bicycle, Electricity (Battery Electric)	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Bus, Diesel B7	p.km	0,16	City Bus, Diesel B7	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
City Bus, CNG - 100% Fossil	p.km	0,16	City Bus, CNG - 100% Fossil	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Coach Bus, Diesel B7	p.km	0,042	Coach Bus, Diesel B7	Carbone 4 basé sur l'ADEME, PPE, GRDF et AIE	60%
Aircraft, Average Size, 500–1000 km, 2023 / WITH Contrails	p.km	0,034	Aircraft, Average Size, 500–1000 km, 2023 / WITH Contrails	ADEME BC v23.8	20%
Aircraft, Average Size, 1000–2000 km, 2023 / WITH Contrails	p.km	0,034	Aircraft, Average Size, 1000–2000 km, 2023 / WITH Contrails	ADEME BC v23.8	20%
Aircraft, Average Size, 2000–5000 km, 2023 / WITH Contrails	p.km	0,017	Aircraft, Average Size, 2000–5000 km, 2023 / WITH Contrails	ADEME BC v23.8	20%

Aircraft, Average Size, >5000 km, 2023 / WITH Contrails	p.km	0,077	Aircraft, Average Size, >5000 km, 2023 / WITH Contrails	ADEME BC v23.8	20%
Passenger Train, Switzerland	p.km	0,004	Passenger Train, Switzerland	ADEME BC v23.8	20%
Passenger Train, Germany	p.km	0,067	Passenger Train, Germany	ADEME BC v23.8	20%
Passenger Train, Austria	p.km	0,024	Passenger Train, Austria	ADEME BC v23.8	20%
Passenger Train, Belgium	p.km	0,048	Passenger Train, Belgium	ADEME BC v23.8	20%
Passenger Train, Denmark	p.km	0,110	Passenger Train, Denmark	ADEME BC v23.8	20%
Passenger Train, Spain	p.km	0,051	Passenger Train, Spain	ADEME BC v23.8	20%
Passenger Train, Finland	p.km	0,045	Passenger Train, Finland	ADEME BC v23.8	20%
Passenger Train, Greece	p.km	0,066	Passenger Train, Greece	ADEME BC v23.8	20%
Passenger Train, Ireland	p.km	0,039	Passenger Train, Ireland	ADEME BC v23.8	20%
Passenger Train, Italy	p.km	0,032	Passenger Train, Italy	ADEME BC v23.8	20%
Passenger Train, Luxembourg	p.km	0,040	Passenger Train, Luxembourg	ADEME BC v23.8	20%
Passenger Train, Norway	p.km	0,040	Passenger Train, Norway	ADEME BC v23.8	20%
Passenger Train, Netherlands	p.km	0,076	Passenger Train, Netherlands	ADEME BC v23.8	20%
Passenger Train, Portugal	p.km	0,062	Passenger Train, Portugal	ADEME BC v23.8	20%
Passenger Train, United Kingdom	p.km	0,075	Passenger Train, United Kingdom	ADEME BC v23.8	20%

Passenger Train, Sweden	p.km	0,013	Passenger Train, Sweden	ADEME BC v23.8	20%
Long-distance Train / 2019, France	p.km	0,005	Long-distance Train / 2019, France	ADEME BC v23.8	20%
Passenger Train, World	p.km	0,062	Passenger Train, World	Carbone 4 basé sur IAE	60%
Passenger Train, Americas	p.km	0,039	Passenger Train, Americas	Carbone 4 basé sur IAE	60%
Passenger Train, OECD Americas (US, Canada, Mexico, Chile)	p.km	0,040	Passenger Train, OECD Americas (US, Canada, Mexico, Chile)	Carbone 4 basé sur IAE	60%
Passenger Train, Non-OECD Americas	p.km	0,027	Passenger Train, Non-OECD Americas	Carbone 4 basé sur IAE	60%
Passenger Train, Africa	p.km	0,077	Passenger Train, Africa	Carbone 4 basé sur IAE	60%
Passenger Train, Asia	p.km	0,077	Passenger Train, Asia	Carbone 4 basé sur IAE	60%
Passenger Train, ASEAN	p.km	0,084	Passenger Train, ASEAN	Carbone 4 basé sur IAE	60%
Passenger Train, Europe	p.km	0,034	Passenger Train, Europe	Carbone 4 basé sur IAE	60%
Passenger Train, European Union with UK (28)	p.km	0,031	Passenger Train, European Union with UK (28)	Carbone 4 basé sur IAE	60%
Passenger Train, Non-OECD Europe and Eurasia	p.km	0,049	Passenger Train, Non-OECD Europe and Eurasia	Carbone 4 basé sur IAE	60%
Passenger Train, Middle East	p.km	0,083	Passenger Train, Middle East	Carbone 4 basé sur IAE	60%
Passenger Train, OECD Asia Oceania	p.km	0,058	Passenger Train, OECD Asia Oceania	Carbone 4 basé sur IAE	60%

Passenger Train, Oceania	p.km	0,061	Passenger Train, Oceania	Carbone 4 basé sur IAE	60%
Assets					
Machines	t	5500	Machines/fabrication	Base carbone ADEME (v23.11)	50%
Steel sheets - Europe	t	1934	Steel sheets emission factor , New, based on Ecoinvent RER Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Steel sheets - World	t	2084	Steel sheets emission factor , New, based on Ecoinvent RoW Efs, with Carbone 4 hypothesis	Ecoinvent v3.11	60%
Waste					
Inert Waste - Rubble	t	26	Construction Waste/Mixed Inert Waste (Rubble)/Average End-of-Life - Impacts	Base carbone ADEME (v23.11)	26%
Non-Hazardous Waste (Industrial & Commercial Waste)	t	87	Construction Waste/Mixed Non-Hazardous Waste (Industrial & Commercial Waste)/Average End-of-Life - Impacts	Base carbone ADEME (v23.11)	30%
Ferrous Metals	t	938	Construction Waste/Ferrous Metals/Average End-of-Life - Impacts	Base carbone ADEME (v23.11)	20%

Concrete	t	26	Construction Waste/Concrete, Bricks, Tiles and Ceramics/Average End-of-Life - Impacts	Base carbone ADEME (v23.11)	19%
Land use change					
Direct Land Use Change (Cropland to Sealed Surfaces)	m2	19	Direct Land Use Change (Cropland to Sealed Surfaces)	Base carbone ADEME (v23.8)	70%
Direct Land Use Change (Forest to Sealed Surfaces)	m2	29	Direct Land Use Change (Forest to Sealed Surfaces)	Base carbone ADEME (v23.8)	70%
Direct Land Use Change (Grassland to Sealed Surfaces)	m2	29	Direct Land Use Change (Grassland to Sealed Surfaces)	Base carbone ADEME (v23.8)	70%

Below, the average concrete and ciment emissions factors database, based on EC3 emission factors compatible with the latest LCA methods:

- TRACI v2.
- IPCC 2021
- EF v3.1
- CML v4.8 2016
- Recipe 2016

Cement grout													
		Emissions factor for the range of resistance (kgCO2e/unit)											
Region considered	Unit / range of resistance (Mpa)	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	65-70
North America	m3	193	348	320	286	295	3XX	352	359	402	414	467	549
Monde	m3	209	295	312	296	298	328	358	363	419	404	475	534
United States Of America	m3	193	348	320	287	295	3XX	355	362	404	435	467	549

Canada	m3							232	241	285	285		
Texas	m3	114		330	291	290	317	350	356	408	470	486	
California	m3		253	305	280	296	327	342	342	380	408	354	557
Washington	m3			259		466	418		609				
Oregon	m3					419	425	558	584				
British Columbia	m3							232	241	285	285		
New Jersey	m3						408						
Georgia	m3			367			347						
North Carolina	m3					329							

Ready mix

Region considered	Unit / range of resistance (Mpa)	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	65-70
Europe	m3					266	364	320	335				
North America	m3	242	239	266	273	320	348	372	382	407	397	416	442
Monde	m3	219	231	259	267	315	344	369	380	403	391	401	413
United States Of America	m3	246	251	275	279	323	353	381	386	414	413	427	451
Canada	m3		115	141	210	XX4	241	267	293	292	301	313	352
United Kingdom	m3					272	382	336	335				
Texas	m3	247	239	254	262	301	324	344	349	381	401	406	439
California	m3	276	XX8	276	292	3XX	352	371	374	393	399	398	536
Québec	m3			207	258	281	302	334	343	338	355	337	
Florida	m3					187							
Missouri	m3					259	279	340	365				
Ohio	m3						285	282		326			
Washington	m3	130	191	258	261	309	312	327	338	348	400	395	
Oregon	m3			343	282	317	355	369	386	409	410	532	
British Columbia	m3		108	117	144	159	182	212	233	268	281	303	352
New Jersey	m3		275	294	330	372	409	447	452	496	457	483	477
Georgia	m3			293		285	332	383	400	424	411	443	
Alabama	m3					290	326	361					
North Carolina	m3			245	361	323	338	353	359	405	411	407	
Pennsylvania	m3					398	407	448	465	458			
England	m3					272	382	336	335				
Indiana	m3	74		240		274	310	342	365	295			
Utah	m3					285	334	366	374	425			
Massachusetts	m3			240	256	302	355	367	382	363			299

Minnesota	m3				268	XX2	253	279	284	285	313	308	
Connecticut	m3					301	343	345	388	459			
Colorado	m3					300	329	385	372				
Michigan	m3				245	255	329	320	341	329		290	
Wisconsin	m3					XX5	298	316	308		354		
South Carolina	m3						347						
Mississippi	m3				185	235	264	310	331	410			
North Dakota	m3						336						
Maryland	m3					252	300	3XX	330	342			
New Mexico	m3					271	276						
Kansas	m3					318	288	309	329				
Nebraska	m3						275						
New York	m3					307	367	3XX	317	343			
Shortcrete													
Region considered	Unit / range of resistance (Mpa)	20-25	25-30	30-35	35-40	40-45	45-50	50-55					
North America	m3	338	376	420	419	415	424	457					
Monde	m3	320	371	416	414	412	424	455					
United States Of America	m3	338	376	425	428	429	453	457					
Canada	m3			298	304	325	332						
Texas	m3	331	366	395	394	417	414	458					
California	m3	341	378	439	443	441	486						
Washington	m3		372	473	462	405	450						
Oregon	m3		424	411	420								
British Columbia	m3			298	304	325	332						
Georgia	m3		397										
Utah	m3		403										
Colorado	m3			433									
Flowable fill													
Region considered	Unit / range of resistance (Mpa)	0-5	5-10	10-15	20-25	25-30	30-35	35-40	40-45				
North America	m3	138	208	230	314	329	340	338	378				
Monde	m3	136	201	231	302	326	346	353	378				
United States Of America	m3	141	244	230	314	329	340	338	378				
Canada	m3	74	97										
Texas	m3	161	244		305	343	342						

California	m3	1XX	270	190									
Québec	m3	67											
Washington	m3	95											
Oregon	m3	147	163										
British Columbia	m3	77	97										
New Jersey	m3	148	240										
Utah	m3	62											
Massachusetts	m3	84											
Connecticut	m3	46											
Colorado	m3	88											
Cement													
Region considered	Unit	Emissions factor (kgCO2e /unit)											
Europe	t	860											
North America	t	819											
Monde	t	876											
United States Of America	t	840											
Canada	t	698											
Deutschland	t	810											
Italia	t	879											

7 References

7.1 Standards

Corporate standards
GHG Protocol Corporate standard
http://www.ghgprotocol.org/standards/corporate-standard
ISO 14064
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=38381
ADEME Bilan Carbone
http://www.associationbilancarbone.fr/

7.2 Emission factor databases

- Bilan Carbone v23.8

- GLEC Framework 2025
  https://smart-freight-centre-media.s3.amazonaws.com/documents/GLEC_FRAMEWORK_v3.2_21_10_25_1.pdf
- EcoInvent v3.11
  http://www.ecoinvent.org/
- IEA 2012
  http://www.iea.org/publications/freepublications/publication/name,32870,en.html
- Sustainable concrete
  http://www.concretecentre.com
- EC3
  https://buildingtransparency.org/
- Seve TP
  https://seve-tp.com/20250612_SEVE-TP_Guide_m%C3%A9thodologique_V6.1.pdf
- Infociments
  https://www.infociments.fr/
- INIES

8 Appendix - Ratio used by default

Below is a breakdown of the emission sources in the sample project for each technique.

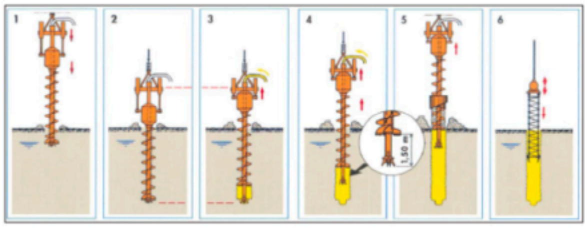
BORED PILES

Contributors to samples

KELLER

Cementation SKANSKA

SOLETANCHE BACHY

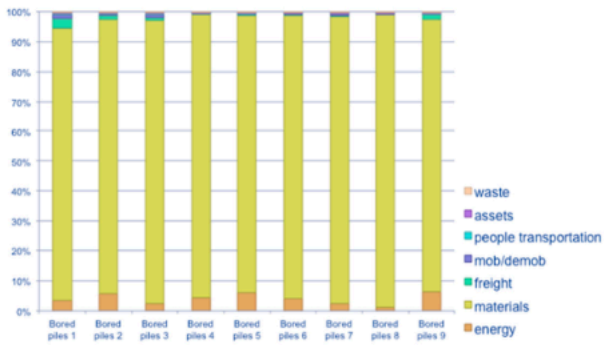


Copyright Soletanche Bachy

9 projects

- Parker Steel Warehouse
- Kühnsdorf
- Graz
- Wembley
- Radlett Place
- Barrow
- A465 Dualling Section 3
- Wigmore
- IKEA

Emissions sources breakdown



The main quantitative results and associated ratios are shown below:

Primary Emission sources – BORED PILES		**98%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	96%
Energy	Amount of energy	4%
Secondary Emission sources		**2%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	0,6%
Assets	Additional rate : 0,4%	**0,4%**
Mob/demob	Additional rate : 0,3%	**0,3%**
Waste	Additional rate : 0,3%	**0,3%**
People transportation	Standard activity data	0,2%

DISPLACEMENT PILES

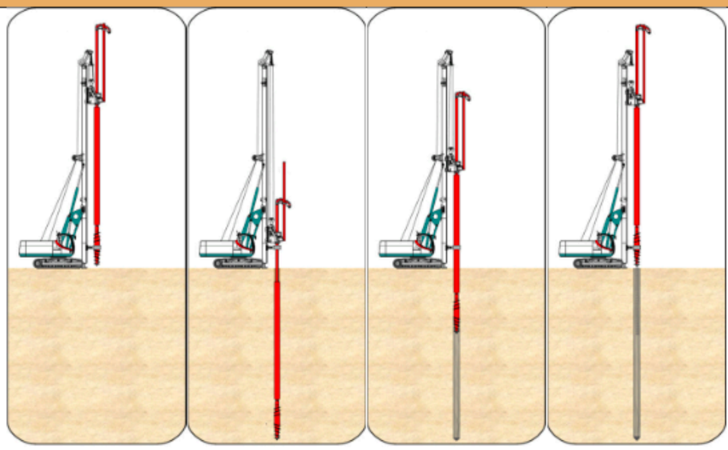
Contributors to samples

Balfour Beatty Ground Engineering

Cementation Skanska

bam infra BAM Infraconsult bv

Soletanche Bachy

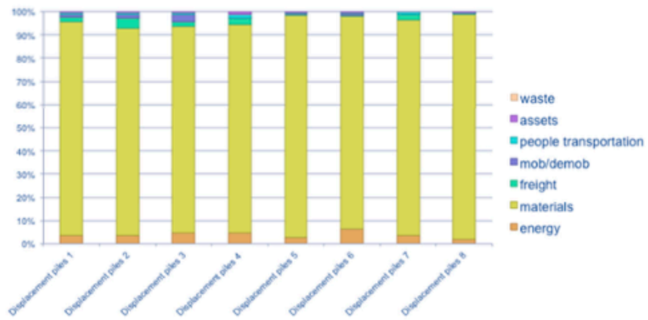


Copyright Soletanche Bachy

8 projects

- Southampton Dock
- Houses Rotterdam
- Burnley
- DP World Welfare and Workshop Block
- Rochdale
- BridgeWater
- Hoe Valley Leisure Centre
- Riverside Museum

Emissions sources breakdown



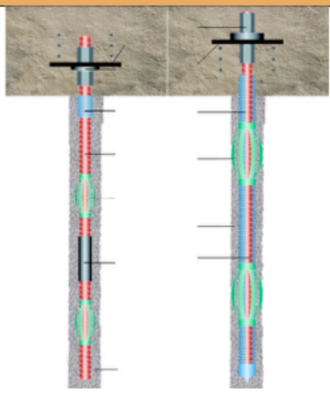
Primary Emission sources - Displacement piles		**96%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	92%
Energy	Amount of energy	4%
Secondary Emission sources		**4%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	1,9%
Mob/demob	Additional rate : 1,0%	1,0%
People transportation	Standard activity data	0,7%
Assets	Additional rate : 0,6%	0,6%
Waste	Additional rate : 0,2%	0,0%

In the sample were studied:
- Bored displacement piles
- Driven cast in situ
- Driven precast piles

The results showed that there is no need to perform the calculation differently for these 3 subtechniques.

MICROPILES

Contributors to samples

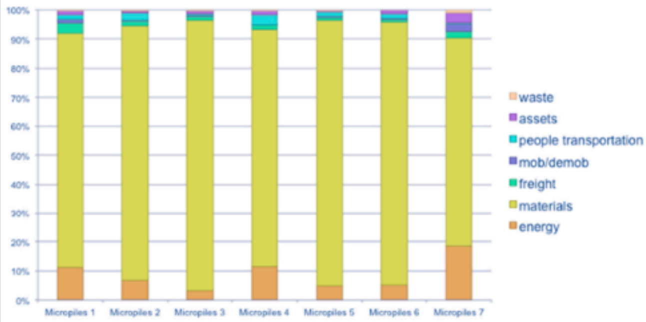


Copyright Soletanche Bachy

7 projects

- Pöls
- RD1
- Rome
- Savona
- Sèvres
- Sugarhouse Close
- Trento

Emissions sources breakdown



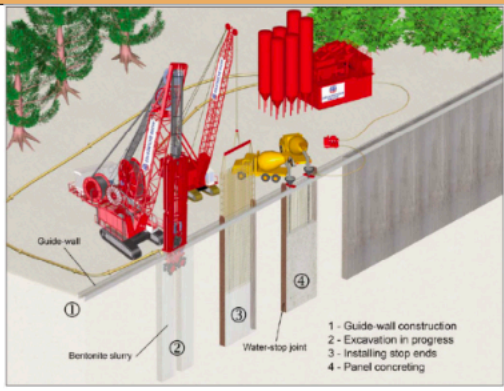
Primary Emission sources		**94%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	85%
Energy	Amount of energy	9%
Secondary Emission sources		**6%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	1,7%
People transportation	Standard activity data	1,7%
Assets	Additional rate : 1,4%	1,3%
Mob/demob	Additional rate : 0,8%	0,7%
Waste	Additional rate : 0,5%	0,4%

DIAPHRAGM AND SLURRY WALLS

Contributors to samples

Cementation SKANSKA

SOLETANCHE BACHY

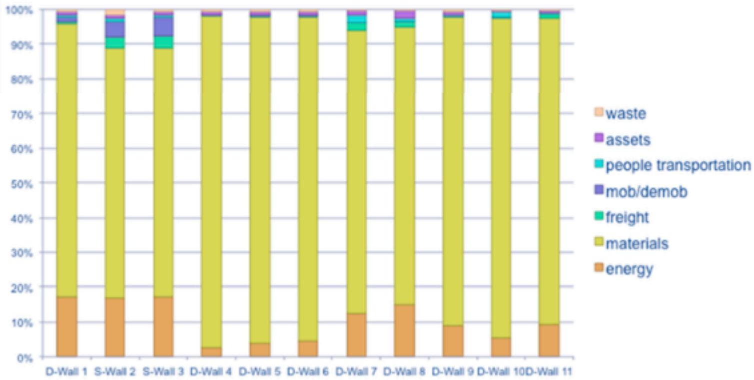


Copyright Soletanche Bachy

11 projects

- PML
- Barangaroo
- Crossrail
- Toulon
- Paddington
- TourD2
- Reservoir Enhancement
- Singapour
- ROP
- Shoreham Adur Tidal Walls East Bank
- Valenton

Emissions sources breakdown



Primary Emission sources		**95%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	85%
Energy	Amount of energy	10%
Secondary Emission sources		**5%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	1,2%
Mob/demob	Additional rate : 1,2%	1,1%
Assets	Additional rate : 1,1%	1,0%
People transportation	Standard activity data	0,7%
Waste	Additional rate : 0,6%	0,6%

SHEET PILE WALLS

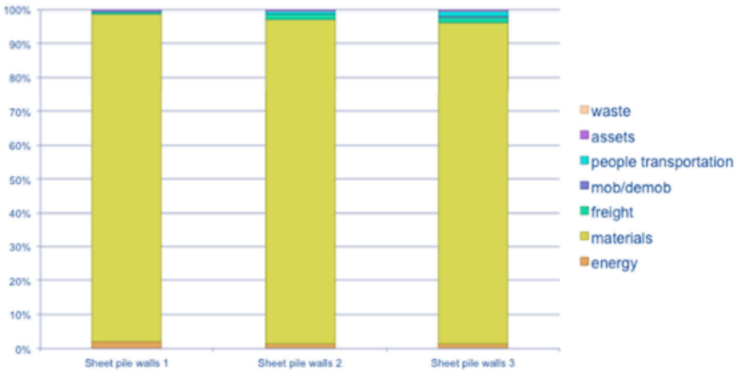
Contributors to samples

Copyright Soletanche Bachy

3 Projects

- Berges de Varennes sur Seine
- Highway A4
- FBH Klagenfurt

Emissions sources breakdown



Primary Emission sources		**96%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	96%
Secondary Emission sources		**4%**
Source	**Estimation method**	**Relative importance**
Energy	Additional rate : 1,7%	1,6%
Freight	Standard activity data (details in the freight section)	1,2%
People transportation	Standard activity data	0,9%
Assets	Additional rate : 0,4%	0,3%
Mob/demob	Additional rate : 0,1%	0,1%
Waste	No data : this emission source is neglected	0,0%

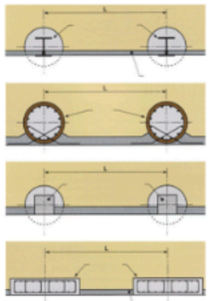
BORED PILE WALLS

Contributors to samples

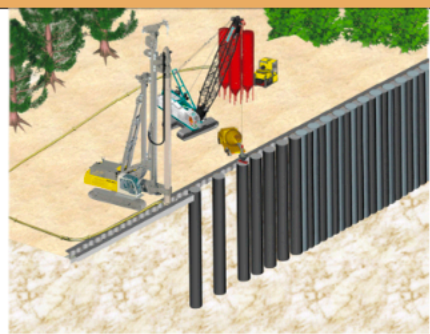
bam infra BAM Infraconsult bv

Balfour Beatty Ground Engineering

KELLER



solider pile wall



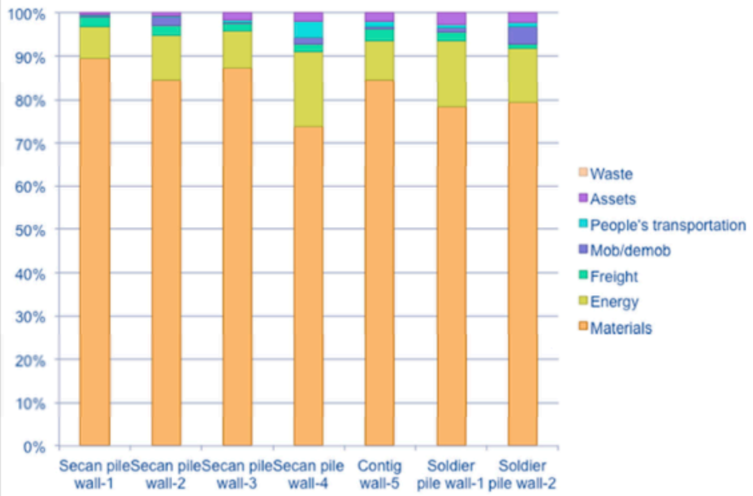
secant pile wall

Copyright Soletanche Bachy

7 Projects

- Prochazkova
- Mesdag
- Essex Waste
- Maasvlakte2
- Brussel
- Holland Park
- Metro Ceveny vrch

Emissions sources breakdown



Primary Emission sources		**94%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	84%
Energy	Amount of energy	10%
Secondary Emission sources		**6%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	2,2%
Assets	Additional rate : 1,4%	1,3%
People transportation	Standard activity data	1,2%
Mob/demob	Additional rate : 1,0%	0,9%
Waste	Waste weight if relevant	0%

ANCHORS

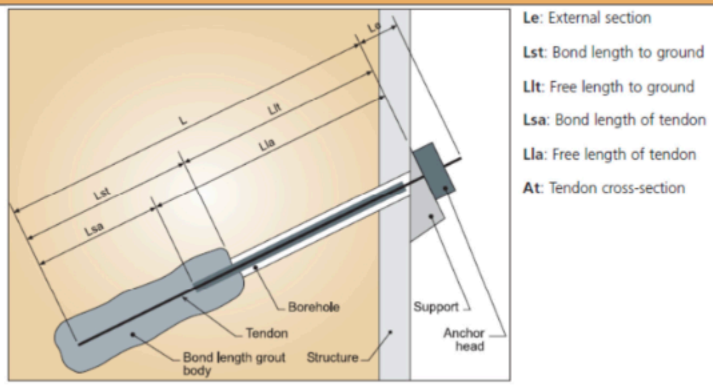
Contributors to samples

bam infra BAM Infraconsult bv

KELLER

SOLETANCHE BACHY

SERVIZI & COSTRUZIONI



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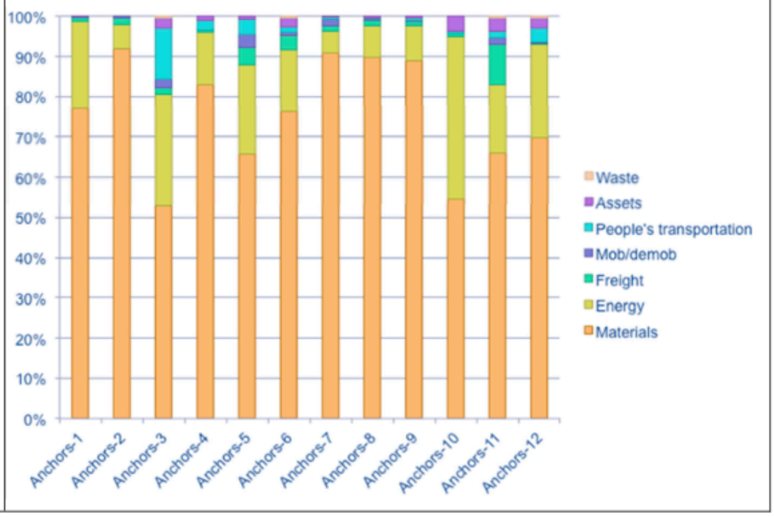
12 Projects

- Voltaire
- LKH Leoben
- "Aurelia" Bergeggi
- Bypass Bad St. Leonhard
- Zwijndrecht
- ROSAPARKS
- Terneuzen
- Schiedam
- BARANGAROO
- ALWA Donnersbach
- Anchors – 32mm – 4 rigs
- PRESSENSE

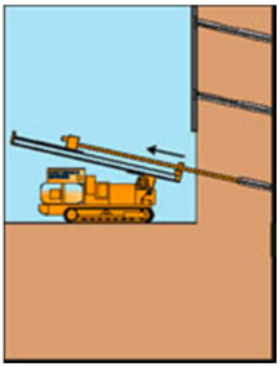
Emissions sources breakdown



Primary Emission sources		**93%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	76%
Energy	Amount of energy	17%
Secondary Emission sources		**7%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	2,3%
People transportation	Standard activity data	2,3%
Assets	Additional rate : 1,5%	1,4%
Mob/demob	Additional rate : 1,0%	0,9%
Waste	Additional rate : 0,1%	0,1%

SOIL NAILS

Contributors to samples

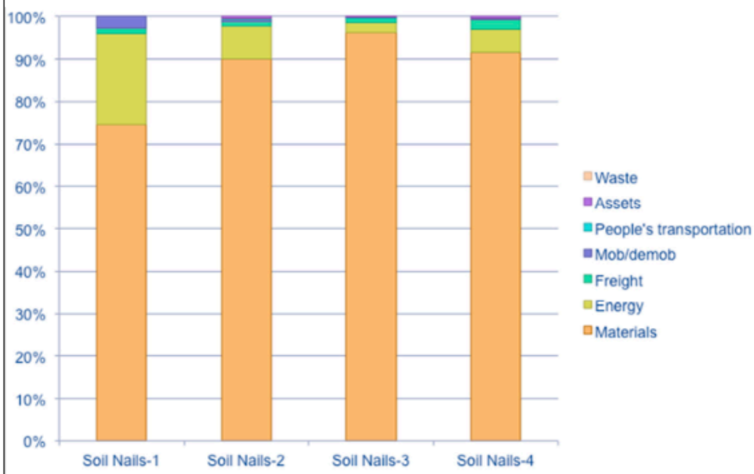


Copyright Keller

4 Projects

- Waidhofen/Ybbs
- Storehouse Triotronik
- Businesspark
- Hollow-bar
- Health resort Bad Gleichenberg

Emissions sources breakdown

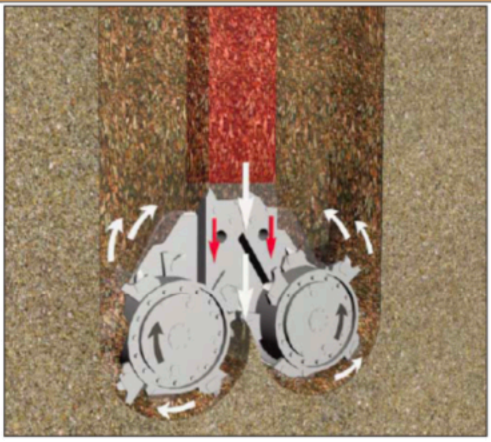


Primary Emission sources		**97%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	88%
Energy	Amount of energy	9%
Secondary Emission sources		**3%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	1,5%
Mob/demob	Additional rate : 0,9%	0,9%
People transportation	Standard activity data	0,4%
Assets	Additional rate : 0,2%	0,2%
Waste	Waste weight if relevant	0%

SOIL MIXING

Contributors to samples

SOLETANCHE BACHY

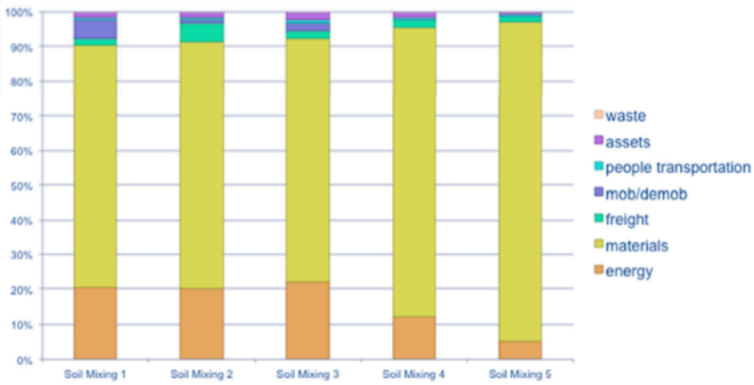


Copyright Soletanche Bachy

5 projects

- Shoreham Adur Tidal Walls East Bank
- Aigle
- Noville
- Forth Replacement
- Suisse

Emissions sources breakdown



Primary Emission sources		**93%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	77%
Energy	Amount of energy	16%
Secondary Emission sources		**5%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	2,7%
Mob/demob	Additional rate : 1,9%	1,8%
Assets	Additional rate : 1,5%	1,4%
People transportation	Standard activity data	0,7%
Waste	Additional rate : 0,1%	0,1%

STONE COLUMNS

Contributors to samples

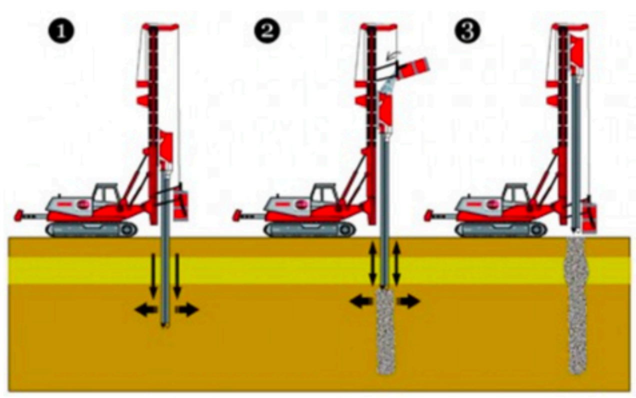
Balfour Beatty Ground Engineering

KELLER

MENARD

SOLETANCHE BACHY

GRUPO TERRATEST

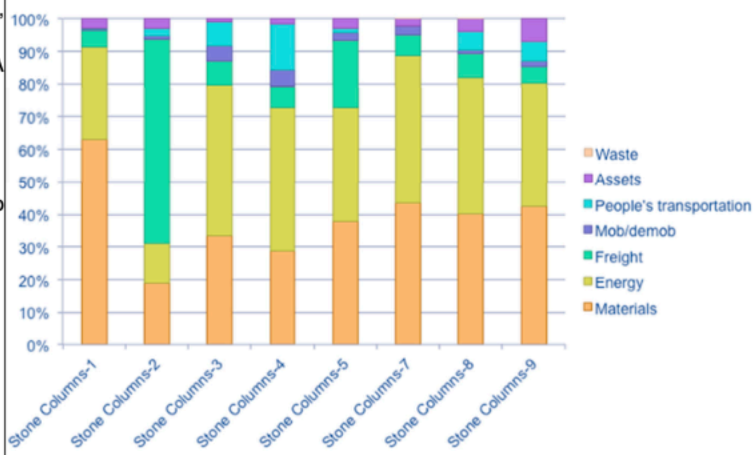


Copyright Menard

9 projects

- Esholt, Bradford, Yorkshire
- AIRPORT OF LA CORUÑA
- Leicester (UK)
- Halle Felbermayer
- Hofer Pischelsdorf
- Shopping Center Dipo Koper
- Seeresort Hautzendorf
- Coleshill 32773
- Bilston, W.Midlands UK
- Gas Station Petrol Koper

Emissions sources breakdown



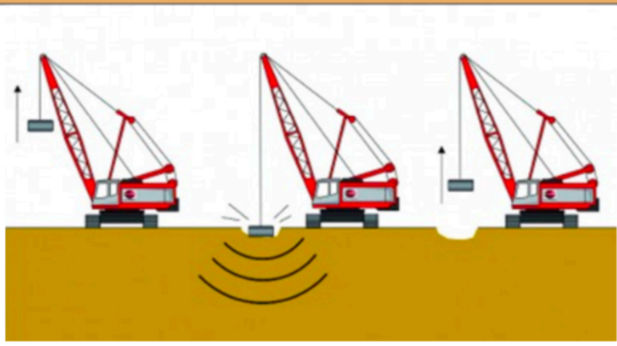
Primary Emission sources		**90%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	38%
Energy	Amount of energy	36%
Freight	Freight distances and number of trips (or load factors)	15%
Secondary Emission sources		**10%**
Source	**Estimation method**	**Relative importance**
People transportation	Standard activity data	4,7%
Assets	Additional rate : 3,3%	3,0%
Mob/demob	Additional rate : 2,4%	2,4%
Waste	Waste weight if relevant	0%

DYNAMIC COMPACTION

Contributors to samples

Balfour Beatty Ground Engineering

MENARD

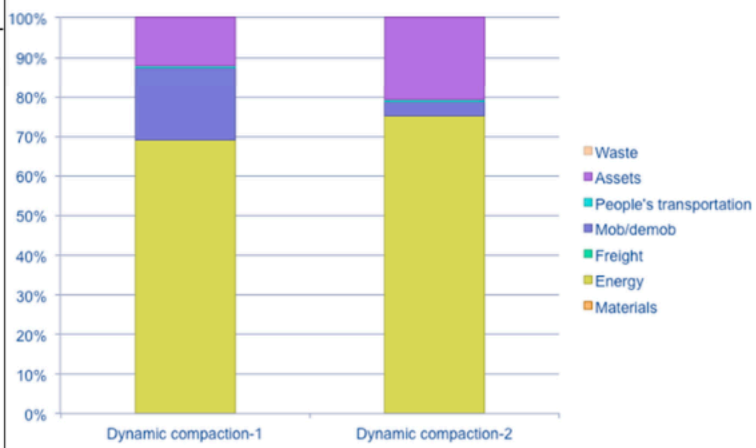


Copyright Menard

2 projects

- Cannock
- SOIL IMPROVEMENT NEW GERMAN SCHOOL

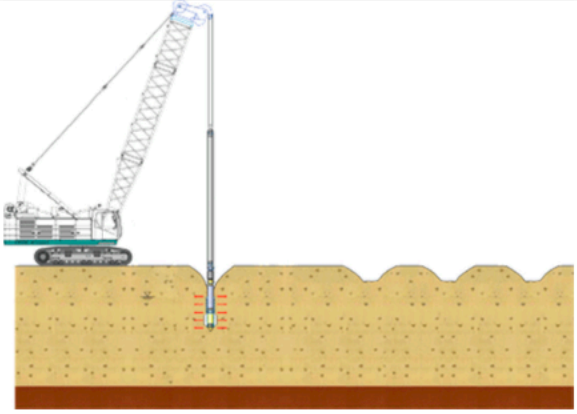
Emissions sources breakdown



Primary Emission sources		99%
Source	**Activity data**	**Relative importance**
Energy	Amount of energy	72%
Assets	Assets weight, life time and used time	16%
Mob/demob	Distance and number of trips	11%
Secondary Emission sources		**1%**
Source	**Estimation method**	**Relative importance**
People transportation	Standard activity data	0,6%
Materials	Quantity of materials if relevant	
Freight	Standard activity data	
Waste	Waste weight if relevant	

VIBRO COMPACTION

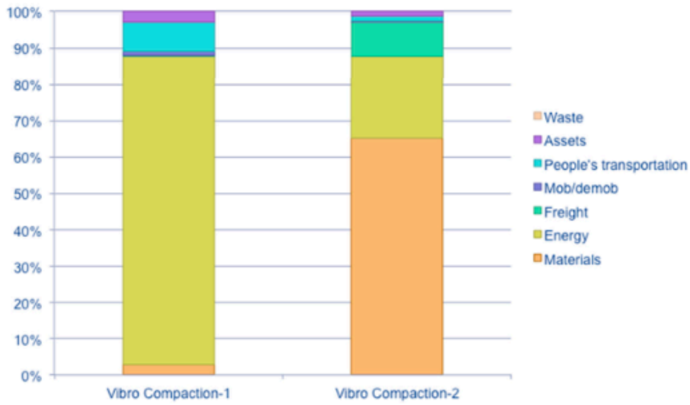
Contributors to samples


Copyright Soletanche Bachy

2 projects

- ZPA Pöls
- Agrana Pischelsdorf

Emissions sources breakdown

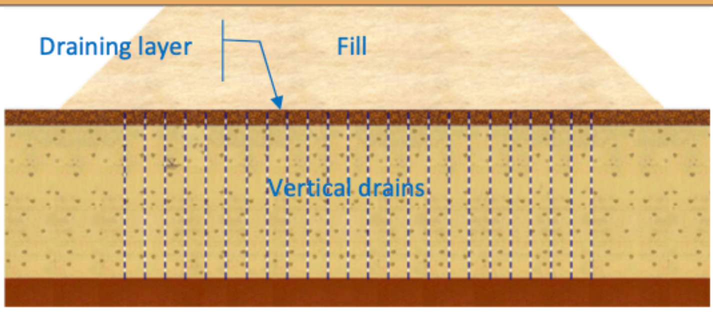


Due to the variation observed in the data it is not possible to establish standard ratios for this technique. All sources need to be considered directly, except waste which will not be significant.

Primary Emission sources	
Source	**Activity data**
Materials	Quantity of materials
Energy	Amount of energy
Freight	Freight distances and number of trips (or load factors)
Assets	Assets weight, life time and used time
Mob/demob	Distance and number of trips
People transportation	Standard activity data
Secondary Emission sources	
Source	**Estimation method**
Waste	Waste weight if relevant

VERTICAL DRAINS

Contributors to samples

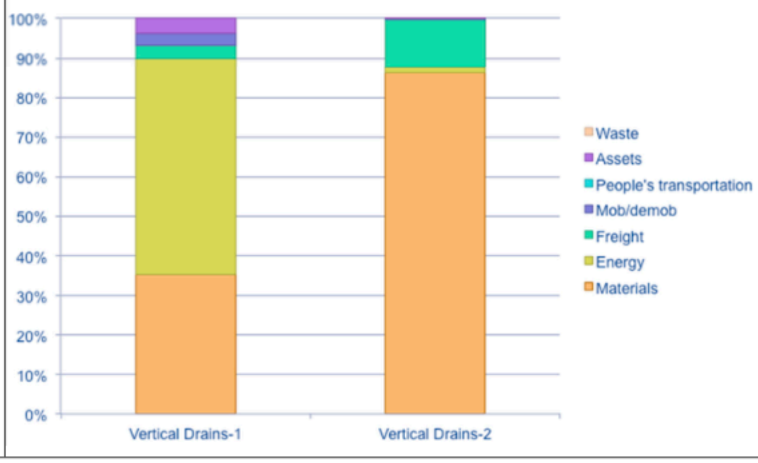


Copyright Soletanche Bachy

2 projects

- Lidl Ljubljana
- Polypropylene injection tubes

Emissions sources breakdown

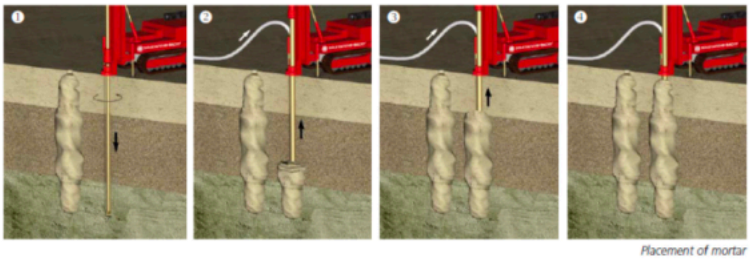


Due to the variation observed in the data it is not possible to establish standard ratios for this technique. All sources need to be considered directly, except waste which will not be significant.

Primary Emission sources	
Source	**Activity data**
Materials	Quantity of materials
Energy	Amount of energy
Freight	Freight distances and number of trips (or load factors)
Assets	Assets weight, life time and used time
Mob/demob	Distance and number of trips
People transportation	Standard activity data
Secondary Emission sources	
Source	**Estimation method**
Waste	Waste weight if relevant

GROUTING

Contributors to samples



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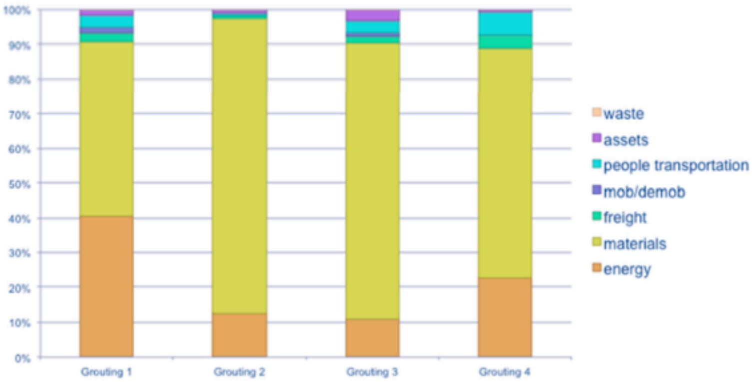
4 projects

- Canal Cavour Monformoso Vercelli
- Chapel Mill Reservoir
- HWS Lankowitz
- Exit channel ponte gardena dam

Emissions sources breakdown

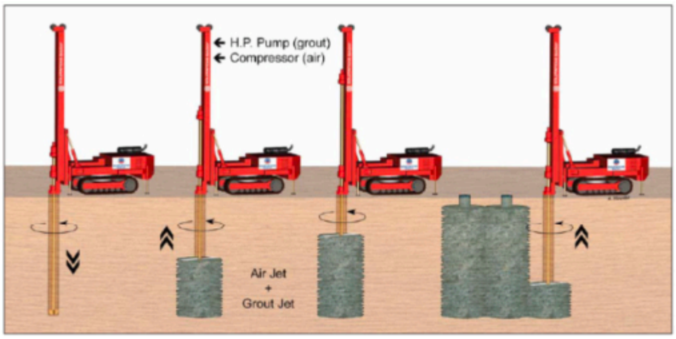


Primary Emission sources		**92%**
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	70%
Energy	Amount of energy	22%
Secondary Emission sources		**8%**
Source	**Estimation method**	**Relative importance**
People transportation	Standard activity data	3,6%
Freight	Standard activity data (details in the freight section)	2,3%
Assets	Additional rate : 1,7%	1,6%
Mob/demob	Additional rate : 0,8%	0,7%
Waste	Additional rate : 0,1%	0,0%

JET GROUTING

Contributors to samples

bam infra BAM Infraconsult bv, KELLER, Grupo Terratest, Soletanche Bachy, Servizi & Costruzioni

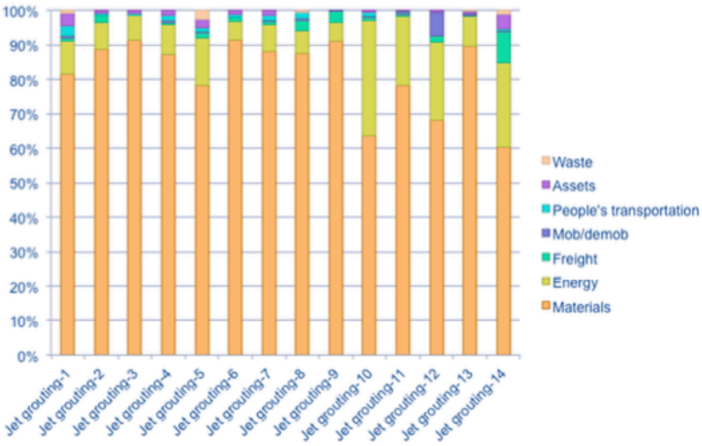


Copyright Soletanche Bachy

14 projects

- Fincantieri shipyard Sestri Ponente Genova
- landfill Eco-Libarna Serravalle Scrivia
- Jet grouting project
- Channel of Santa Brigida creek
- Industrial building in Genoa
- Airport runway
- Industrial building in Albenga
- Hofwirt Seckau
- Utrecht
- McDonald's
- Church of SS. Annunziata
- Oldenzaal
- bioethanol fuel tank
- Arnhem

Emissions sources breakdown



Primary Emission sources		95%
Source	**Activity data**	**Relative importance**
Materials	Quantity of materials	82%
Energy	Amount of energy	13%
Secondary Emission sources		**5%**
Source	**Estimation method**	**Relative importance**
Freight	Standard activity data (details in the freight section)	1,8%
Assets	Additional rate : 1,3%	1,3%
People transportation	Standard activity data	1,0%
Mob/demob	Additional rate : 0,8%	0,8%
Waste	Additional rate : 0,4%	0,4%

9 Acknowledgements

EFFC/DFI and Carbone 4 would like to thank their sponsors on this projects that enable the development of this platform:

Carbone 4 thanks the members of the EFFC/DFI working group set up for this project:

- Luca Bruni – Injectosond (Italy, EFFC)
- Christopher Nelsen – Delveunderground (USA, DFI)
- Ciaran Jennings – Forumcourt (UK, EFFC)
- Luke Deamer – Keller (UK, EFFC)
- Theresa Engler – DFI (USA, DFI)
- Matthew Glisson – DFI (USA, DFI)

Many thanks also to all the members of EFFC/DFI that help us testing the tool and the old members of EFFC/DFI and Carbone 4 that create the first version of the tool, in an excel form.

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