Toward a Low-Carbon Economy: The Clim'Foot Project Approach for the Organization's Carbon Footprint

Simona Scalbi, Patrizia Buttol, Arianna Dominici Loprieno, Gioia Garavini, Erika Mancuso, Francesca Reale, and Alessandra Zamagni

Abstract The EU Emission Trading System (ETS) represents an essential part of the European policies on Climate Change, targeting the most polluting organizations, which cover 45% of the GHG emissions. However, no common framework has been proposed yet for "non-ETS organizations." The reduction of direct emissions in most of the cases is not enough for significantly tackling climate change, but an approach that encompasses also indirect emissions should be adopted, as promoted in the Carbon Footprint of Organisations (CFO), for achieving the ambitious targets set in the European Green Deal. The application of the CFO supports organizations in defining and monitoring the effects of mitigation actions: thanks to CFO, organizations are encouraged to innovate their management system, improve the use of resources, strengthen relationships in the supply chain, beside obtaining a reduction of their costs. In this context, the LIFE Clim'Foot project has given a contribution to foster public policies for calculation and reduction of the CFO. The project has dealt with two key aspects: (i) the need for national policies addressing GHG emissions of non-ETS organizations and the strategic role of structured and robust tools, such as national databases of Emission Factors; (ii) the relevance of organizations'

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training in fostering their commitment to account for and mitigate GHG emissions. This chapter illustrates the development and application of Clim'Foot approach for promoting the calculation of the CFO and definition of mitigation actions and to highlight the results of the testing phase in Italy. The approach is described in terms of (i) the toolbox developed (national databases of emission factors, training materials and carbon footprint calculator), (ii) the voluntary program set up to engage public and private organizations and (iii) the role played by decision-makers. Strengths and weaknesses of the Clim'Foot approach are discussed, together with opportunities of replicability and transferability of the results to support the development of a dynamic European network for carbon accounting.

Keywords Climate change · Carbon footprint · CFO · Low carbon economy · Mitigation actions · Emission factors · Data quality · Carbon footprint calculator

1 Introduction

Human activities, especially combustion of fossil fuels, deforestation and farming livestock, have led to an increase of the global average temperature for about 0.85 °C in the last 20 years [1]. Scientists consider that an increase of 2 °C compared with preindustrial age is the threshold, beyond which we can expect dangerous and even catastrophic event occurring. For this reason, 195 countries reached an agreement at the Paris Climate Conference (COP21), held in December 2015, to limit global warming to well below 2 °C above preindustrial levels. Actually, the national climate action plans presented in Paris showed just the trend to be followed but are not enough to achieve the goal.

Also before 2015, the EU countries together with Iceland had endorsed the Kyoto protocol (1998) and were committed to cut by 20% compared to 1990 the greenhouse gas (GHG) emissions by 2020. Moreover, the EU has defined a road map of the transformation towards a low-carbon economy [2], which engages the EU to achieve 40% reduction of GHG emissions by 2030, compared to 1990, and 80% by 2050.

In this context, the EU emission trading system (ETS) represents an essential part of the European policies on climate change, as it targets the most polluting organizations, which cover 45% of the GHG emissions. The ETS sectors that mostly contribute to GHG emissions are the following[1]:

- power and heat generation, all energy-intensive industry sectors (oil refineries, steel works and production of metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and organic chemicals), commercial aviation, which are mainly sources of carbon dioxide (CO_2);
- production of nitric, adipic, glyoxal and glyoxylic acids as sources of Nitrous oxide (N_2O);
- aluminum production as a source of perfluorocarbons (PFCs).

[1] http://ec.europa.eu/clima/policies/ets/index_en.htm.

In 2014, the European Council confirmed that emission reductions should be reached not only by the ETS but also by non-ETS sectors, setting the reduction targets to 43% and 30%, respectively, by 2030 compared to 2005 [3].

To reach this commitment, the Effort Sharing Regulation[2] has established binding annual GHG emission targets for Member States for the periods 2013–2020 and 2021–2030. These targets concern emissions from most non-ETS sectors, such as transport, buildings, agriculture and waste, which can led to a reduction of the total EU emissions by 10% [4]. Currently, 13 Member States have reached reduction of GHG emissions, but only 4 have already fulfilled their 2020 goals. To reach their targets, the States need to implement additional measures (already in place in some countries), e.g. energy efficiency measures in the residential and services sectors, or to use the flexibility mechanisms that Effort Sharing Regulation makes available [5].

However, no common framework has been proposed yet for GHG reduction targets at country level for non-ETS organizations.[3] Consequently, the involvement of private and public organizations to reduce their carbon footprint (CF) should be supported by reliable data, tools and innovative approaches that allow also the calculation of their GHG emissions. Besides, the environmental advantages due to the mitigation actions identified are accompanied by innovation, optimization of the resources use, strengthening of relationships within the supply chain and reduction of management costs.

In this context, the LIFE project "Clim'Foot—Climate Governance: Implementing public policies to calculate and reduce organizations carbon footprint" (LIFE14 GIC/FR/000475, hereinafter Clim'Foot[4]) aimed to foster public policies for calculation and reduction of the CF of non-ETS organizations. The project has dealt with two key aspects:

(i) the need for national policies addressing GHG emissions of non-ETS organizations and the strategic role of standardized tools, such as national databases (DBs) of Emission Factors (EFs)[5]
(ii) the relevance of organizations training to foster their commitment targets to account and mitigate GHG emissions.

Clim'Foot has brought together seven partners from five EU Countries: ADEME (project coordinator) and IFC (France), ENEA and Ecoinnovazione (Italy), CRES (Greece), HOI (Hungary) and EIHP (Croatia).

After an overview of the Standards for CFO calculation, development and application of the Clim'Foot approach for calculating and reducing CFO are here presented and discussed, together with the results achieved from its implementation in public and private organizations in Italy.

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[2] https://ec.europa.eu/clima/policies/effort/regulation_en.

[3] http://ec.europa.eu/clima/policies/strategies/progress/kyoto_2/index_en.htm.

[4] https://www.climfoot-project.eu/.

[5] The Emission Factors are calculated ratios between the quantity of GHG emissions and the units of activity associated with their release [6].

2 Standards for Carbon Footprint Organization

In literature, standards and specifications exist to calculate the CFO, such as the GHG Protocol Corporate Accounting and Reporting Standard [6]; the GHG Protocol Corporate Value Chain [7] and the ISO 14064 [8], Part 1.

These documents provide organizations with directions about identifying, measuring and communicating the GHGs emitted, generally in 1 year, from all the activities (direct and indirect) across the organization, including the use of energy in buildings, industrial processes and company vehicles.

ISO and GHG Protocols present a similar approach to the calculation of the CFO. The former, like all the standards, provides the reference framework, while the latter goes into the detail of its implementation and contains also motivations for GHG reporting [9].

Both documents propose two types of approaches for setting organization's boundaries:

- Approach of control: all GHG emissions and/or removals are quantified concerning facilities that the organization controls financially or operationally. A company has financial control over the operation if it has the right to the majority of benefits of the operation or if it retains the majority risks and rewards of ownership of the operation's assets. A company has the operational control if it has the authority to introduce and implement its operating policies [6] [page 17].
- Equity share approach: the organization quantifies its portion of GHG emissions and removals from respective facilities [8]. The equity share reflects the extent of rights a company has to the risks and rewards coming from an operation and is normally the same as the ownership percentage [6] [page 17].

The GHG protocols and ISO recommend the classification of three types of emissions:

1. ***Direct GHG emissions***: emissions from greenhouse gas sources owned or controlled by the company, defined as ***Scope 1*** by GHG Protocol.
2. ***Energy indirect GHG emissions***: emissions from the production of purchased energy used by the company (electricity, heat or steam), defined as ***Scope 2*** by GHG Protocol.
3. ***Other indirect GHG emissions,*** e.g., emissions from business travel by employees, transport of products and materials, waste generated by the organization but managed by another organization, defined as ***Scope 3*** by GHG Protocol.

Under Scope 1 the following emissions are considered:

- Emissions from fuels and/or Wastes burning.
- Process and Fugitive emissions from:
  - Air conditioning and cooling
  - Agriculture

  - Industrial process
  - Wastes
- LULUCF[6] (Land use, Land Use Change and Forestry).

Scope 2, which includes emissions from the production of the purchased energy used by the Organization, does not include the transmission and distribution losses, which are accounted for in scope 3. By definition, scope 3 emissions are all indirect emissions (not included in scope 2) occurring in the value chain (e.g., materials suppliers, third-party logistics providers, waste management suppliers, travel suppliers, employees, and customers) [6]. The choice about the categories to be included in scope 3 is discretionary and this may impair comparison across companies.

Scope 3 accounts also GHG emissions of capital goods (i.e., plant, property and equipment, such as furniture, office equipment, and computers that the company uses for its activity). Since these GHG emissions are not depreciated or discounted over the life of the asset, which typically occurs in financial accounting, capital purchases, such as new building construction, occurring only once in a while, may significantly vary scope 3 emissions from year to year and companies should highlight the exceptionality of the capital investment in the public report [7].

Moreover, the scope 3 accounting is based on the life cycle approach and carbon footprint is one specific indicator accounted for in LCA, so the CFO method including the scope 3 is a starting point to become familiar with Life Cycle Assessment.

ln literature, there are several resources for carbon calculation and carbon disclosure options available for businesses, institutions and local authorities. For microorganizations and SMEs, many of these resources are free. Table 1 reports some examples of free calculators, all including national emission factors.

3 The Clim'Foot Approach to Carbon Footprint of Organizations

The Clim'Foot approach for CFO calculation and reduction is an original concept, developed and tested during the project, which is structured along three levels (Fig. 1):

(a) development of a toolbox including national DBs of EFs, a tool for the calculation of CFO, training materials and a dissemination platform;
(b) setting up of a voluntary program, involving a selected number of proactive public and private organizations, which are trained for using the toolbox to calculate their CFO, with the support of technical experts;
(c) involvement of policymakers since the early stage of the process, to foster the replicability and transferability of the approach and the implementation of regulations or public policies for the mitigation of GHG emissions.

[6]The LULUCF covers emissions of GHG and removal of carbon from the atmosphere due to human use of soils, trees, plants, biomass and timber.

Table 1 Examples of CFO free calculators

Source	Description	Web site
The Department for Business Energy & Industrial Strategy (BEIS) of UK	They provide a tool (Excel format) and a guide [10]	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018
The Environmental Protection Agency (EPA) of Ireland	They provide a list of carbon calculators and a tool for resource efficiency	http://www.BeGreen.ie and www.GreenBusiness.ie
Carbon Footprint Ltd	They propose an online carbon footprint calculator. They also offer other advanced tools for businesses for a fee	http://www.carbonfootprint.com/calculator1.html
GHG Protocol	They provide a suite of calculation tools to assist companies in calculating their GHG emissions and measuring the benefits of mitigation projects	https://ghgprotocol.org/calculation-tools

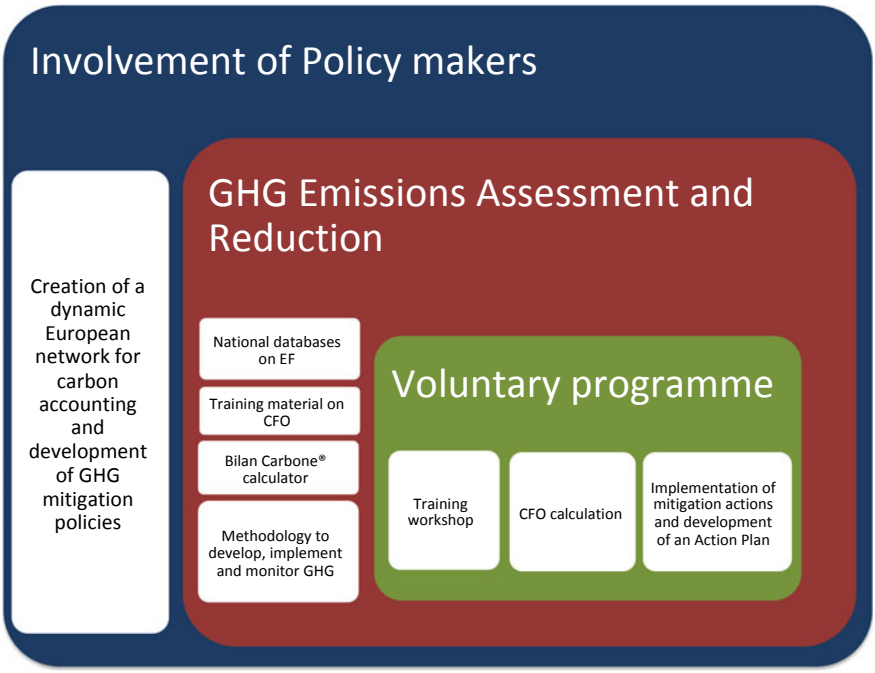


Fig. 1 Clim'Foot approach

3.1 The Toolbox

3.1.1 The National Databases

The national DBs (one per each of the countries involved in the project) include a set of European EFs, which are common to all countries, and a number of country-specific EFs. The databases are supplemented by technical documentation aiming to:

(i) share the data sources used and promote the replicability in other sectors and contexts;
(ii) enable validation and update of the EFs;
(iii) present the data to external users such as regulators, the public and stakeholder groups in a transparent way.

The documentation also serves the purpose of ensuring consistency among the different DBs in terms of completeness of data description, appropriateness of calculation and coherence of data quality assessment.

The development of national DBs on EFs requires a common methodology, which defines the content and classification structure of the DBs and the list of greenhouse gases with their characterization factors, gives recommendations on data collection and data quality requirements, overviews the main data sources available and ensures a consistent development of datasets starting from different data sources (e.g. Life Cycle Inventories (LCI) from LCA databases and National Inventory Reports). This is a major issue as some data sources deliver subsets of most relevant emissions, while others give the results in terms of CO_{2eq}, after aggregating the emissions according to the characterization factors.

The methodology adopted in Clim'Foot [11] is mainly based on the GHG protocol for Organizations [6, 7, 12], the ISO 14064 [8] and the IPCC guidelines [13], but takes also into account the European initiative on Organization Environmental Footprint (OEF) [14], in particular for the data quality definition.

The Clim'Foot DBs cover the sectors that most contribute to the GHG emissions following the recommendations of the GHG protocols, thus including Metals, Chemicals, Minerals, Pulp and paper, Semiconductor productions, Refrigerants, and the emissions related to land use, land use change and forestry (LULUCF).

In the DB, each emission factor is a record, and each record represents a unit process of human activity that exchanges resources (biogenic CO2 uptake) and GHG emissions with the environment. **Each activity represents a process/good/service** and is characterized by a specific **reference flow**, i.e., the measure of the **process/good/service** output. Each record includes:

- **metadata**, which qualitatively and quantitatively describe the emission factor to support the end user's choice of EF for the CF calculation;
- **elementary flows**, i.e. all the GHGs exchanged with the environment during the human activity;

- **characterized GHG** in CO_{2eq}, calculated by multiplying the amount of each GHG by its characterization factor
- **emission factor**, which is obtained by adding all characterized GHGs related to the human activity (mass unit of CO_{2eq}/amount of activity—e.g., $kgCO_{2eq}$/1 kg CH_4 production).

The elementary flows are the GHGs listed in the Kyoto Protocol and the characterization factors of IPCC 2013 are used (Table 2).

The robustness of each EF is evaluated by means of data quality criteria, which intend to answer two different questions: (i) how much does the EF represent the declared characteristics of the data sources from which it has been elaborated? (ii) how much suitable is the EF factor to assess the CFO of a specific company, i.e., how much does it fit for purpose? Building upon international and European initiatives on data quality in environmental footprint studies, the methodology provides instructions for the data quality evaluation by defining the following criteria:

- ***time-related representativeness (TiR)*** = "degree to which the dataset reflects the true population of interest regarding the time/age of the data, including for included background process datasets, if any" [15].
- ***technological representativeness (TeR)*** = "degree to which the dataset reflects the true population of interest regarding technology, including for included background process datasets, if any" [15].
- ***geographical representativeness (GeR)*** = "degree to which the dataset reflects the true population of interest regarding geography, including for included background process datasets, if any" [15].

A qualitative approach was chosen for its evaluation, taking into account the information available on the used data sources. Table 3 reports the description of the quality criteria used in the Clim'Foot DB.

Table 2 Characterization factors from IPCC 2013 [1]

Gases common name	Chemical formula	Characterization Factor in CO_{2eq}
Fossil Carbon dioxide (CO_2)	CO_2	1
Biogenic Carbon dioxide (CO_2)	CO_2	–
Methane	CH_4	30
Biogenic methane	CH_4	28
Nitrous oxide	N_2O	265
Hydrofluorocarbons[a]	HFCs	–
Perfluorocarbons[a]	PFCs	–
Sulfur hexafluoride	SF_6	23500
Nitrogen trifluoride[b]	NF_3	16100

[a]See Appendix 8.A of IPCC 2013 document for the complete list
[b]Nitrogen trifluoride (NF3) has been recently added to the requirements of Scope 3 Standard and Product Standard

Table 3 Quality level and rating for the quality criteria adopted in the Clim'Foot project

Quality level	TiR	TeR	GR
Very good	The TiR is not older than 4 years with respect to the reference year of the data source	The technologies used are exactly the same as the technologies covered by the data	The process takes place in the same country as the one the data is valid for
Good	The TiR is not older than 6 years with respect to the reference year of the data source	The technologies used are included in the mix of technologies covered by the data	The process takes place in the geographical region (e.g. Europe) for which the data is valid for
Fair	The TiR is not older than 8 years with respect to the reference year of the data source	The technologies used are similar to those covered by the data	The process takes place in one of the geographical regions for which the data are valid for
Poor	The TiR is not older than 10 years with respect to the reference year of the data source	The technologies used show several relevant differences compared with the technologies covered by the data	The process takes place in a country that is not included in the geographical region(s) the data are valid for, but sufficient similarities are estimated based on expert judgment
Very poor	The TiR is older than 10 years with respect to the reference year of the data source	The technologies used are not representative for the technologies covered by the data	The process takes place in a different country than the one for which the data are valid for

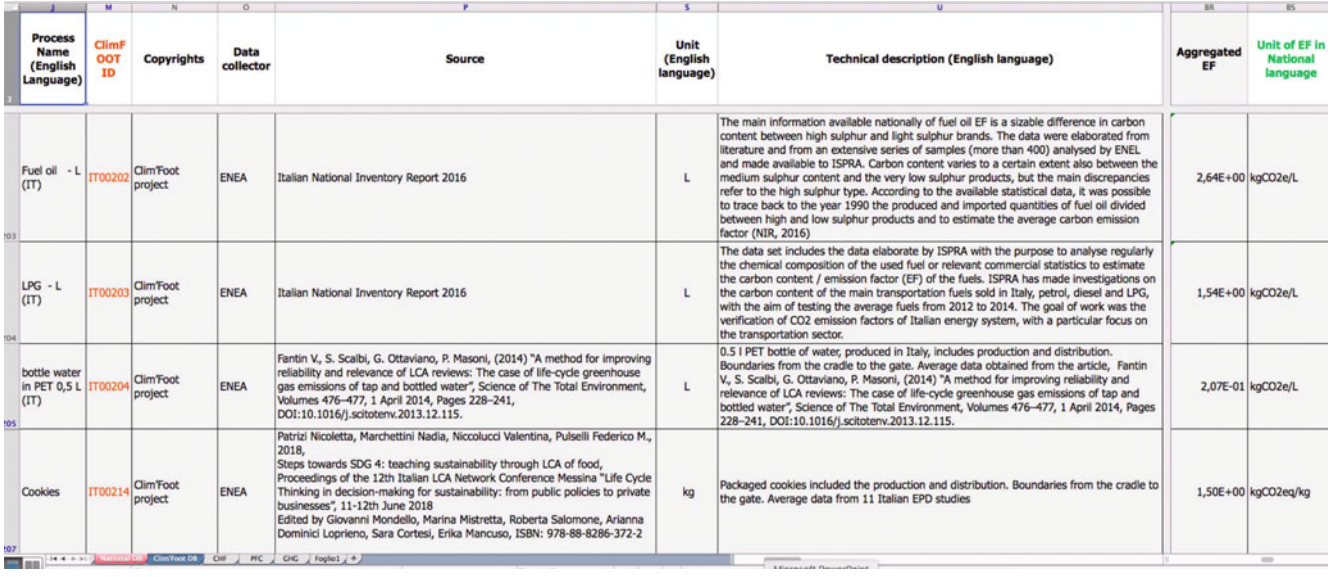
During the project, five national databases were developed in excel format (one file per country, Fig. 2). Each national DB file includes the following six sheets:

1. **Category**: it includes the categories for each language;
2. **National DB**: it includes the description of the metadata, the quantified emissions (by gas type) associated to each activity included in the DB, the associated EF and the EF breakdown per gas;
3. **Clim'Foot DB**: it includes all the National DBs developed in the project, including both country-specific and EU EFs;
4. **CHF** includes the Characterization Factors of HFCs;
5. **PFC** includes the Characterization Factors of PFCs;
6. **GHG** includes the Characterization Factors of CO_2, CH_4f, CH_4b, N_2O, SF_6.

Each national DBs has 150 European EFs, common to all databases, and at least 150 country-specific EFs. Table 4 shows the number of National and European EFs developed in the Clim'Foot project for each sector and country.

The extensive excel databases have been made available to the potential final users through a simplified web version, available on the Clim'Foot website.[7] Two types of search functions have been provided: within a specific category, i.e. the sectors

[7] http://www.climfoot-project.eu/.



Process Name (English Language)	ClimFOOT ID	Copyrights	Data collector	Source	Unit (English language)	Technical description (English language)	Aggregated EF	Unit of EF in National language
Fuel oil - L (IT)	IT00202	Clim'Foot project	ENEA	Italian National Inventory Report 2016	L	The main information available nationally of fuel oil EF is a sizable difference in carbon content between high sulphur and light sulphur brands. The data were elaborated from literature and from an extensive series of samples (more than 400) analysed by ENEL and made available to ISPRA. Carbon content varies to a certain extent also between the medium sulphur content and the very low sulphur products, but the main discrepancies refer to the high sulphur type. According to the available statistical data, it was possible to trace back to the year 1990 the produced and imported quantities of fuel oil divided between high and low sulphur products and to estimate the average carbon emission factor (NIR, 2016)	2,64E+00	kgCO2e/L
LPG - L (IT)	IT00203	Clim'Foot project	ENEA	Italian National Inventory Report 2016	L	The data set includes the data elaborate by ISPRA with the purpose to analyse regularly the chemical composition of the used fuel or relevant commercial statistics to estimate the carbon content / emission factor (EF) of the fuels. ISPRA has made investigations on the carbon content of the main transportation fuels sold in Italy, petrol, diesel and LPG, with the aim of testing the average fuels from 2012 to 2014. The goal of work was the verification of CO2 emission factors of Italian energy system, with a particular focus on the transportation sector.	1,54E+00	kgCO2e/L
bottle water in PET 0,5 L (IT)	IT00204	Clim'Foot project	ENEA	Fantin V., S. Scalbi, G. Ottaviano, P. Masoni, (2014) "A method for improving reliability and relevance of LCA reviews: The case of life-cycle greenhouse gas emissions of tap and bottled water", Science of The Total Environment, Volumes 476–477, 1 April 2014, Pages 228–241, DOI:10.1016/j.scitotenv.2013.12.115.	L	0.5 l PET bottle of water, produced in Italy, includes production and distribution. Boundaries from the cradle to the gate. Average data obtained from the article, Fantin V., S. Scalbi, G. Ottaviano, P. Masoni, (2014) "A method for improving reliability and relevance of LCA reviews: The case of life-cycle greenhouse gas emissions of tap and bottled water", Science of The Total Environment, Volumes 476–477, 1 April 2014, Pages 228–241, DOI:10.1016/j.scitotenv.2013.12.115.	2,07E-01	kgCO2e/L
Cookies	IT00214	Clim'Foot project	ENEA	Patrizi Nicoletta, Marchettini Nadia, Niccolucci Valentina, Pulselli Federico M., 2018, Steps towards SDG 4: teaching sustainability through LCA of food, Proceedings of the 12th Italian LCA Network Conference Messina "Life Cycle Thinking in decision-making for sustainability: from public policies to private businesses", 11-12th June 2018 Edited by Giovanni Mondello, Marina Mistretta, Roberta Salomone, Arianna Dominici Loprieno, Sara Cortesi, Erika Mancuso, ISBN: 978-88-8286-372-2	kg	Packaged cookies included the production and distribution. Boundaries from the cradle to the gate. Average data from 11 Italian EPD studies	1,50E+00	kgCO2eq/kg

Fig. 2 Database format, sheet on National DB

Table 4 National and European emission factors developed in the Clim'Foot project for each sector and country

Sector		European	Hungarian	Croatian	Greek	Italian	French
Energy	Fuels	23	19	18	25	43	67
	Electricity	6	4	1	26	4	
	Thermal energy	6	13	21	20		
Fugitive emissions				9 (refrigerant)		29 (agriculture)	
Transport (freight and passenger)	Road	3	250	91	22	73	89
	Rail	2	32	4	2		
	Air	5		4	8		
	Water	3		2	4		
Industrial Processes and Product use	Materials	59	34	5	9		
	Chemicals	21				9	
	Construction	12	13				
	Food and meals		1		27	16	
	Agriculture			5	10	14	
Waste Management		10	11	6	8	10	
LULUCF			6	6	9		
TOT		150	383	172	170	198	156

identify by the project, or among all the categories using three filters: keyword, localization or unit of emission factor (Fig. 3).

In the web version for each EF, a short description of metadata is given in two languages: the country-specific language of the DB and English (Fig. 4).

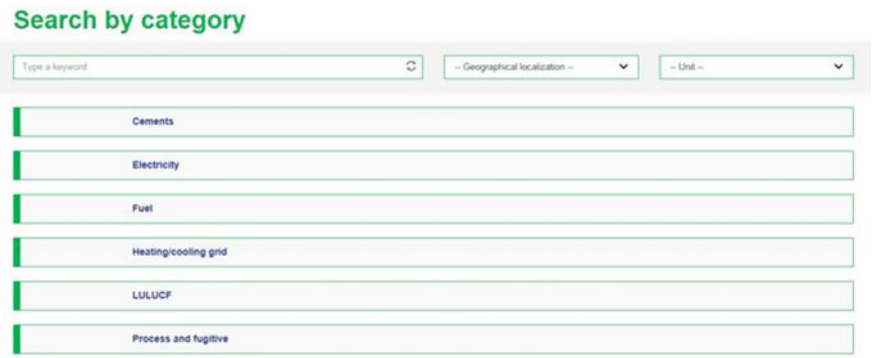


Fig. 3 Search format of the DB web version

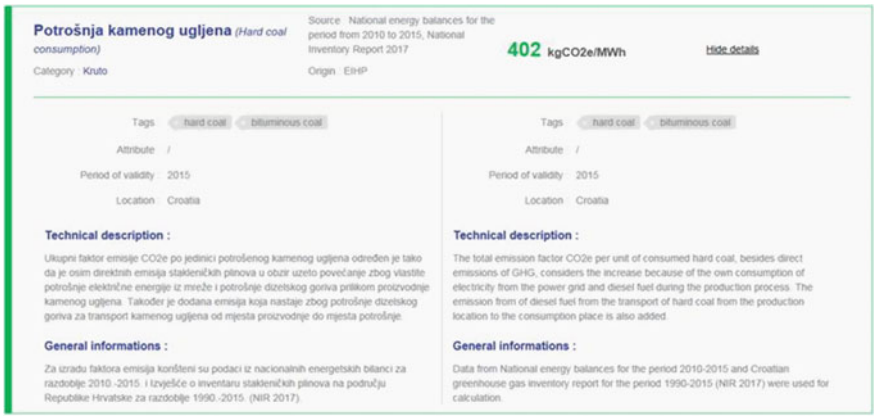


Fig. 4 Example of metadata in the DB

3.1.2 Carbon Footprint Organization Calculation Tool

In the context of the Clim'Foot project, the Bilan Carbone® Clim'Foot tool has been developed and used for the voluntary program. The tool has been developed starting from the French tool "Bilan Carbone®" by ADEME, in collaboration with the Association Bilan Carbone (ABC), and is currently managed by ABC. More in detail, the Bilan Carbone® has been adapted to the national contexts of the Clim'Foot partners through the integration of the national and European EF databases developed during the project.

The Bilan Carbone® Clim'Foot allows the GHG accounting in compliance with the GHG Protocol [6] and ISO standard 14064-1 [8] and provides formats for reporting accordingly. It consists of an Excel file including the following spreadsheets:

- A first spreadsheet, where to describe the organization performing the CFO and to select the approach to the CFO calculation (financial control, operational control, share of capital)
- Several spreadsheets to fill in the main activity categories described below
- A spreadsheet reporting all emission factors available for the calculation
- A supporting spreadsheet including references for conversion between several units of measure describing activity data
- Four spreadsheets reporting results in terms of graphs, CO2eq general overview, summary results tables compliant to ISO standard and to the GHG Protocol.

The Bilan Carbone® Clim'Foot tool allows GHG emissions calculation for all activities considered in the value chain of an organization, structured into 10 main categories:

- Energy sources, where it is possible to account for emissions from heat and electricity consumption

- Nonenergy related sources, where direct emissions can be calculated (e.g. from livestock or use of fertilizer) or directly reported. Such category addresses also gases not covered by the Kyoto protocol
- Inputs, where impacts of materials and products consumption in the organization operations are addressed (including water)
- Packaging, which accounts for emissions due to the production of packaging materials (e.g., used for the packaging of the finished products)
- Transport of people, where transport activities are commuting, business travels and external person travels (e.g. visitors)
- Transport of goods, which accounts for emissions due to upstream transport (purchasing), internal transport and downstream transport (selling, distribution)
- Waste, which accounts for emissions from the disposal/treatment of waste produced by the organization, during its production/service activity
- Capital goods, where emissions due to buildings and infrastructure (even IT) can be estimated, and the known or proper depreciation period is considered, if ISO standard 14064 is applied
- Use stages, which concerns emissions due to the use of products by consumers/final users
- End-of-life, which addresses emissions due to the disposal/final treatment of products, after their use.

The tool can be downloaded from the project website after registration and does not require high level of expertise even if, based on the experience of the voluntary program, the participation to the face to face training course has been judged to be very important. Several end users suggest developing a short guide with brief description of main methodology options and key features.

3.1.3 The Training Courses

The target groups of the training courses are trainers and end users. The training of the trainers has a twofold objective:

- to train trainers on the methodology for calculating and mitigating CFO;
- to learn coaching tips and strategies to be used for training the end users.

The objectives of the training of end users are: i) to increase awareness on the climate change impact; ii) to teach how to calculate the CFO and iii) to give an overview on how to plan and implement a carbon management plan.

Different training materials were made available:

- online training, providing a general overview on climate change, the methodology for the CFO assessment and the calculator use;
- material to prepare technical workshop on CF for organizations, in national languages;
- dissemination materials, to be used in meetings with stakeholders such as industrial trade associations or professional orders.

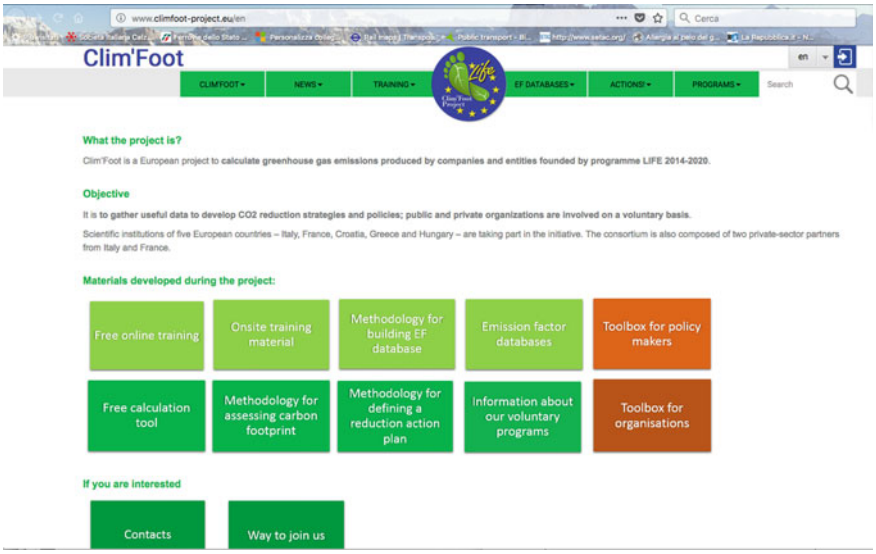


Fig. 5 Clim'Foot dissemination platform

The training course for organizations was implemented in the national languages of the Clim'Foot partners.

3.1.4 The Platform

The dissemination platform is a virtual place where users (policymakers and organizations) find information and training on climate change; have full access to the EFs national DBs and background reports; find information on the voluntary program already implemented, including the lessons learnt, and the description of how to implement a new voluntary program. The platform is available in six languages, namely English, French, Greek, Hungarian, Croatian, and Italian. The dissemination platform can be found at the Clim'Foot website (www.climfoot-project.eu/) (Fig. 5).

3.2 The Voluntary Program

The voluntary program includes three main phases: training, CFO calculation and reduction of the GHG emissions (i.e. implementation of mitigation actions). The program is based on a voluntary process to support public and private organizations in calculating and reducing their CF.

In the first phase, a large database of contacts was developed to identify end users interested in the project participation and a call for expression of interest was

launched. Organizations that declared their interest signed an agreement for participating to the Clim'Foot project, and committed themselves to attend both on-line and two-day on-site training.

In the second phase, the organizations collected data and calculated their CFO. The layout of the CFO report is standardized and includes: information about the organization, definition of the boundaries, description of the data collection, results of the CFO calculation and hotspot analysis, which allows the identification of the main sources of GHG emissions. Most of the end-users reached a good understanding of the different aspects that have to be faced to calculate CFO, in particular how to select EFs for activities under their direct control (e.g. the consumption of purchased electricity) or relevant products/materials used in the production activities.

The third phase—reduction of the GHG emissions—is an important milestone of the Clim'Foot approach. Based on the hotspot analysis, a plan of mitigation actions has been defined—supported also by an economic evaluation—together with the definition of targets and a timeline. Examples of hotspots identified by public organizations were the reorganization and control of employees' travels, business travels and purchase of new company cars. The mitigation actions identified by organizations involved an increased use of renewable energy in combined heating and electricity system, the improvement of energy efficiency, the updating of heating systems. The actions for the transition to low-carbon organizations were classified into quick-wins (short term), priority actions (mid-term) and strategic actions, and their prioritization and the assessment of the results due to the action implementation were supported by a technical committee. Moreover, the communication of the carbon footprint results to several departments of organizations and to suppliers increased their environmental awareness and offered the opportunity to identify new possible mitigation actions.

3.3 The Policymakers' Involvement

The approach proposed suggests an early involvement of policymakers in Technical National Committees, as they are in charge of implementing regulations and public policies for the reduction of GHG emissions. Such an involvement has a twofold advantage: on the one side, they can access training sessions from the beginning of the process related to the approach and its objectives; on the other side they can give feedbacks on the process and suggest future initiatives of replicability and transferability, taking into considerations needs and wishes at policy level.

The final goal is to create a dynamic European network for carbon accounting, able to answer the following expectations:

- raising awareness among policymakers at national, regional and local level;
- exchanging best practices;
- fostering replicability and transferability of the experiences.

Indeed, one of the main purposes of the LIFE Clim'Foot project was to disseminate in European countries outside the project consortium, a common approach for calculating the CFO with standardized and high-quality databases and the project partners are committed to support replicability initiatives beyond the end of the project (see also Sect. 4.4).

4 Application of the Approach in the Italian Context

4.1 The Italian National Database of EFs

Data currently available to perform a CFO study (such as the EF Database by IPCC) have been mostly developed to fulfill the accounting duties set by the EU legislation at Member State level and for those organizations that contribute most to GHG emissions (i.e. the most polluting industries), but they do not match the needs of the totality of EU organizations. Several EFs are provided only with reference to an international scale (in terms of geographical representativeness), an aspect that raises a two-fold issue. On the policy side, the lack of national EFs limits the implementation of policies fostering the CFO accounting and reduction. On the organizations' side, the use of international EFs lowers the accuracy of the results of the CF and discourages mitigation actions. As a consequence of the current data availability, the CFO is mostly applied by those organizations able to afford the cost of a deep investigation on EFs, with the support of consultants and/or with the use of commercial DBs (e.g. LCI DB developed for Life Cycle Assessment).

The Italian DB includes 150 European EFs and 198 country-specific EFs (Table 5). The DB structure, currently in excel format, is designed to allow the import of data in a relational DB to improve its replicability and transferability.

4.2 Toward a Growing Use of CFO by the Organizations: The Voluntary Program for a Bottom-Up Process

The Italian database of contacts included 150 public and private organizations. The call launched to officially involve the potential end users into the project has received 19 expressions of interest to join the voluntary program. The Italian partners prepared and sent a survey to identify the key drivers for the participation of the 19 organizations to the voluntary program and to map their expectations. Public organizations showed interest in the project due to the opportunity to participate in collaborative networks, to exchange ideas and experiences toward a more environmentally friendly organization. For the private sectors, the project was a good opportunity to share experiences, and to learn more on climate change and its management to establish new potential business relationships and to increase competitiveness.

Table 5 Italian emission factors

Category	Data source	Number of EFs
Fossil fuels consumption	Italian National Inventory Report 2017 [16]	43
Electricity consumption	National report on renewable energy [17] and Italian National Inventory Report 2017 [16]	4
Freight transport	National database on transport, elaborated [18]	16
Passenger transport	National database on transport, elaborated [18]	57
Chemicals	Italian National Inventory Report 2017 [16]	9
Waste	Italian National Inventory Report 2017 [16]	10
Agriculture	Leap Database the Global Database of GHG emissions related to feed crops for the agricultural product, developed by FAO [19]	14
Mineral water	Fantin et al. [20]	2
Fugitive emission from agriculture	Italian National Inventory Report 2017 [13]	29
Food and beverage	Patrizi et al. [21]	14

The end-users have been involved in the following activities:

- Training sessions (on-line and on-site) on climate change and CF assessment;
- Calculation of their CFO by using Bilan Carbone® Clim'Foot, translated into Italian.
- Implementation of the mitigation actions based on the CFO results.

Two workshops were held in Italy for the organizations involved in the national voluntary program. They were organized in sessions of teaching and exercising and included: (i) a general overview of the main challenges related to climate change and energy, and the international and national initiatives on carbon footprint; (ii) a presentation of the methodological and standard principles and the main phases of a CF project; (iii) a technical presentation of the Bilan Carbone® calculator and practical exercises; (iv) the definition of mitigation actions for carbon reduction and the presentation of some case studies. All the developed material was made publicly available at the project website.

During the calculation phase, the support of the national partners has been guaranteed thanks to monthly contacts and technical face-to-face and virtual meetings. In particular, the organizations needed to be supported in the following steps: i) choice of the approach (equity share or control); ii) definition of the boundaries, i.e. activities and processes to be included in the CFO study, in line with the organizations

strategic goals; iii) choice of the activity data to collect and EFs. The face-to-face meetings with the organizations, which were aimed at better involving the end-users and analyzing in detail the major difficulties encountered, were an important element of the experimentation phase.

All the 19 Italian organizations have calculated their CFO. Four organizations have analyzed only direct emissions and energy indirect emissions and focused on energy consumption. The others have investigated the indirect emissions too, such as materials in input, packaging, home-to-work transport, waste and capitals good, in order to get a more complete view of their carbon footprint and to select targets and strategies for a (potential) GHG reduction. A survey, which was aimed at monitoring the economic impacts of the project actions, has shown that most of the time (51%) for the CFO calculation was dedicated to the definition of the system boundary and the data collection, followed by the hours for data input in Bilan Carbone® Clim'Foot and analysis of the results (40%) and the hours for educational activity (9%).

During the voluntary program, strengths and weaknesses of Clim'Foot tools were also assessed. The organizations highlighted the need to have additional EFs to calculate their CFO, which were then built up and implemented in the DB (waste and water treatment, minerals water, renewable energies). Further development is in progress, which includes construction, chemicals and waste scenarios. All organizations highlighted that this experience increased their awareness on GHG problems. Some of them decided also to include the results of CFO in their quality management plan as an indicator to evaluate the efficacy of improvement actions related to energy.

After the calculation of their CFO, 13 organizations have defined mitigation actions, aimed at improving the mobility of the employees, increasing the share of renewable energy, improving the heating systems and overall reducing the emissions from purchased goods. Moreover, one organization developed a Sustainability Report that presents the policy and the actions to improve its social and environmental sustainability, including the environmental benefits obtained thanks to the implementation of the mitigation actions. As the monitoring of the total CO_2 emissions does not permit the assessment of the efficacy of the mitigation actions because emissions depend on the annual production, they defined the indicator "CO_2 emitted for unit of production," which catches the real environmental improvement better than the measurement of the total energy saving. At the end of the Clim'Foot project, 2 organizations have also developed an Action Plan where:

- a steering committee was set up to provide a governance of the action plan;
- the objective and targets of GHG reduction were defined;
- a set of mitigation actions was identified as well as strategies towards the defined objective and targets, in terms of finance and timeline;
- a list of environmental performance indicators was selected to check the outcomes of mitigation actions, such as CO_{2eq} per meter of tissue produced;

Furthermore, by the end of the project in August 2018, two organizations changed their electricity mix and chose a supplier who provides 100% renewable energy, implementing a mitigation action for CFO reduction, in agreement with their environmental policy.

4.3 The Involvement of Italian Policymakers

Policymakers from all country partners showed an interest toward the strategy adopted, i.e., the development of standard tools that can be either directly applied or used as a basis to create country specific tools. During the project, about 100 policymakers from countries different from those of the project partners have also been reached to present the project results and collecting information about the carbon policies of their countries. A survey and 2 webinars have been organized and 39 policymakers, coming from 9 countries, were trained on the Clim'Foot toolbox during a workshop organized at the end of the project final conference.

In Italy representatives of the Ministry of the Environment and the Ministry of Economic Development were involved in the national technical committee. During the periodic meetings, the toolbox and the voluntary program have been presented and have generated interest. In particular, the Italian Ministry of the Environment, signed a letter of commitment to endorse Clim'Foot tools, especially the Italian National Database and the Italian version of Bilan Carbone®. Indeed, the Clim'Foot initiative, with its tools and training courses, contributed to the project "CReIAMO PA" (Competences and Networks for Environmental Integration and Improvement of the Public Administration Bodies), carried out by the Italian Ministry of Environment and financed by the National Operational Programme on Governance and Institutional Capacity (Expertise and network for the environmental integration and for the improvement of organizations of the Public Administration 2018–2021). The project includes, among others, a Work Package—"Promotion of Environmental and Energy Management Models in Public Administrations," aimed at supporting local administrations that intend to plan and implement measures to reduce greenhouse gas emissions and improve the environmental performance of their organization.

The participation of the Città Metropolitana di Torino (Italy) is an example of involvement of a local public administration. After the training workshop, they contacted some schools of the territory and encouraged them to calculate and reduce their CFO. A group of students of five high schools were trained, calculated their schools CF and identified the main critical aspects. The participation to the voluntary program offered the public administration a twofold benefit: on one side, they could fulfill the demand for increasing environmental awareness of young people, in agreement with the objectives of the Green Education initiative of Piedmont Region; on the other side they could enrich the set of indicators monitored by the Energy manager of the Città Metropolitana, by adding the quantification of the schools CF.

4.4 The Post-life Phase

The update and the enlargement of the Italian national DB, which is time consuming and needs specific expertise, is another important aspect that is guaranteed after the

end of the project by the commitment of the Clim'Foot partners through the collaboration with other projects aimed at developing country-specific datasets for both national EF and Life Cycle Assessment database, and through the involvement of stakeholders such as trade associations, national agencies or networks. The dissemination activities about the Clim'Foot approach are continuing in order to involve other policymakers and foster synergies with other projects or policymakers' initiatives. A first synergy has already been set between Clim'Foot and the project "CReIAMO PA," which is on-going and will run until June2022, and includes training and support actions on CFO.

From 2018 and so far, several training events were organized for the Public Administrations:

- five workshops in Rome, Turin, Cagliari, Padua and Bari to provide general training on CFO and present Clim'Foot tools
- five laboratory sessions in Florence, Turin, Bari, Cagliari and Padua for the use of the Clim'Foot calculator and to present CFO case studies.

Furthermore, two courses were organized for training the consultants that will support local administrations in calculating the CFO and in developing GHG mitigation actions. This training action is built upon the Clim'Foot action "training the trainers." Other training sessions are planned for the next future.

After the dissemination phase, the "CReIAMO PA" project started to calculate the CFO with several different public administrations: one Region (Piedmont), five Municipalities (Mantova, Prato, Cagliari, Saluzzo, Serrenti), three Regional agencies for environmental protection (Piedmont, Friuli Venezia Giulia, Apulia), and IPLA,[8] society for forestry management of Piedmont.

5 Conclusions

The modular structure of the toolbox and the integration of informative materials and documents summarizing the lessons learnt, are the strengths of the project. All this increases the potential of replicability and sustainability of the approach both in the consortium's countries and in other European countries. The ultimate goal is to raise policymakers' awareness on climate change mitigation and give them instruments, methodologies and training materials to implement the necessary national policies.

National Databases of GHG Emission Factors, with reliable and country-specific data available for free, are a decisive asset for national policies and can promote the adoption of mitigation actions by the organizations. The development of a common methodology and format, the definition of procedures for data collection, highlighting the main sectors to be developed and favoring the exchange of EFs among partners, were key aspects for the transferability and replicability of the approach in other countries and contexts.

[8] Istituto per le Piante da Legno e l'Ambiente.

The voluntary program has highlighted that training and support actions are important for the CFO calculation and the definition and implementation of mitigation policies. This experience has given useful feedback on the main tools developed in the project, namely the database and the training. For the database, the organizations identified the need to update some existing EFs, such as the Italian electricity mix and transportation, and to develop new EFs in some sectors such as chemicals and waste. Moreover, during the voluntary program, many organizations have requested further explanations about the system boundary definition and the difference among approaches (operational, financial). Therefore, the training structure was improved to include a more detailed explanation of these features and integrate new and more practical examples. This new structure has already been implemented in the training developed during the "CReIAMO PA" workshops and laboratories.

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