ACTION C5.2: STUDY ON THE REPLICABILITY AND TRANSFERABILITY POTENTIAL OF THE CLIM'FOOT PROJECT

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Action C5.2 Replicability and transferability potential

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Contents

1. Introduction

Fostering the transferability and replicability of LIFE Clim'Foot activities and results targeting policymakers is one of the main goals of the project.

This document presents an overview of the LIFE Clim'Foot project, focusing on the lessons learnt during the implementation of national databases, the promotion of the Bilan Carbone® tool for calculation of the carbon footprint of organisations (CFO) with country specific emission factors and requirements, the development of voluntary programmes for CFO calculation and related mitigation actions, the training for end users, the implementation of CFO in practice and general project objectives.

The replicability and sustainability have been analysed in the Consortium countries (Italy, Hungary, Greece, Croatia and France) and beyond.

For transferability purposes, similarities and differences between organisation environmental footprint (OEF) and CFO approaches have been investigated along with the transferability potential of the national databases developed in the framework of the LIFE Clim'Foot project.

2. LIFE Clim'Foot project approach – lesson learnt

This chapter describes the Clim'Foot approach, in terms of developed tools (training, Bilan Carbone® tool and National database) and voluntary programme (experimentation) to calculate and reduce the carbon footprint of the organisations. The aim of chapter is to introduce the potential replicability and transferability of the project results.

2.1 National databases

Clim'Foot has developed five national databases (DBs) of country-specific EFs, with at least 150 EU common EFs and at least 150 country-specific EFs for each DB. A common methodology for the EFs definition and for the Database structure have been defined with the aim of 1) allowing the comparability of EFs among the different countries, 2) fostering as much as possible a harmonized application of CFO methodology, 3) allowing data exchange/sharing among the different national databases and in the context of future replication actions (future EFs database in countries outside the consortium).

The main references for the common methodology for Database development (i.e. for EF definition and for the database structure) are the GHG protocols for Organisations[1] (GHG, 2004; 2011a; 2011b), the ISO 14064 (2006) and the IPCC guidelines (2006; 2013).The European initiative on Product and Organisation Environmental Footprint (PEF/OEF) (EC, 2013) has also been considered, in particular for the data quality definition. The methodology defines content and classification structure of the DBs and identifies the reference greenhouse gases (GHG) and includes recommendations on data collection, including an overview of the main data sources (in a priority order) for the development of EFs. In addition, some examples of dataset's development starting from different data sources such as the Life Cycle Inventory (LCI) database and the National Inventory Reports (NIR) (Scalbi et al., 2016) are included.

Each national database developed in the context of Clim'Foot is accompanied by a methodology report which deeply explains how the common methodology is applied for the national context (Deliverable C2.2: National Database of Emission Factors, Italy, Greece, Hungary, Croatia).

These reports aim to: i) provide information/documentation on the data sources used, so as to ensure the transparency on one hand and to favour the replicability of the calculation in other sectors/contexts on the other hand; ii) ease the validation and update of the EFs; iii) present the data to external users such as regulators, general public or specific stakeholder groups, in order to raise the awareness, stimulate the involvement and participation, promote the replicability actions in other countries. In addition, this document has served in purpose to manage the consistency among the Clim'Foot National EFs DBs in terms of completeness of data description, appropriateness of calculation and coherence of data quality assessment. E.g. the consistency of the input data used for calculating the EFs has represented a major issue. In fact, not all the

[1] World resources institute and World Business Council for sustainable development

potential data sources report the relevant (selected) GHG flows in a disaggregated way: some data sources deliver a sub-set of emissions, reporting them as the most relevant ones, while others report the one result in terms of CO_{2eq}, without any information on the contribution of the single GHGs (Scalbi et al, 2017).

Concerning France, at the beginning of the project, the emission factors were already calculated Indeed, ADEME published the first version of its "Base Carbone®" which inspired this project, in 2014. A documentation is available on all the emission factors developed since its creation.

Each national DB file includes six sheets:

- **Category**: which includes the categories for each language;
- **National DB**: which includes the description of the metadata with the structure defined in the deliverable A2.2, the CF emission factors (European and country-specific), the characterized CF emission factors, the Emission factor and their unit;
- **Clim'Foot DB**: this is linked with the National database (selected metadata published on-line), and includes all the National Databases developed in the project, including both country-specific and EU EFs;
- **CHF** is the sheet with the Characterization Factors of CHF;
- **PCF** is the sheet with the Characterization Factors of PFC;
- **GHG** is the sheet with the Characterization Factors of CO_2, CH_4f, CH_4b, N_2O, SF_6.

In particular each data set is composed by four main parts:

- Metadata: they provide a description of the data set with the aim to guaranty clear information to support the end-user in the choice of dataset for the carbon footprint calculation, in English and national leagues:
    - Name
    - Technical description
    - Data quality
    - General info
- Elementary flows: all the GHG emitted in the environment by the human activity described in the data set with the quantity related to the amount of activity considered;
- Characterized GHG in CO_{2eq}.

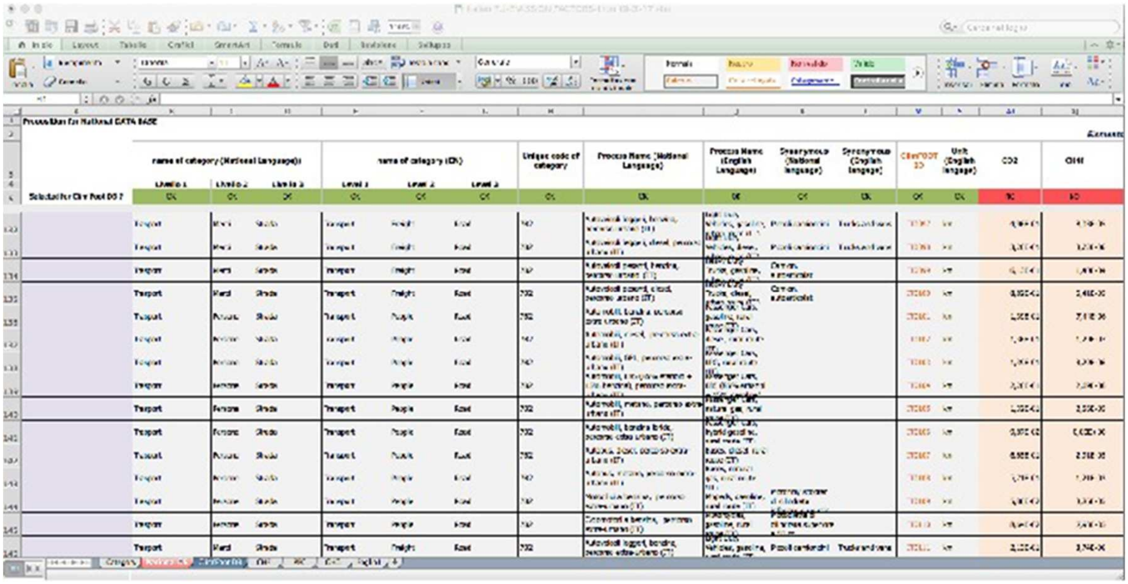

Figure 1 Database format, sheet on National DB

Moreover, a simplified web version of the DB is available on the Clim'Foot website [http://www.climfoot-project.eu/.](http://www.climfoot-project.eu/)[SS1] . This online version of the DB allows interested parties to have a look in two or three clicks on the main characteristics of each emission factor. Data are extracted from the Excel files provided by each country.

One can search directly from the name of categories or use one of the three filter proposed: keyword, localization or unit of emission factor.

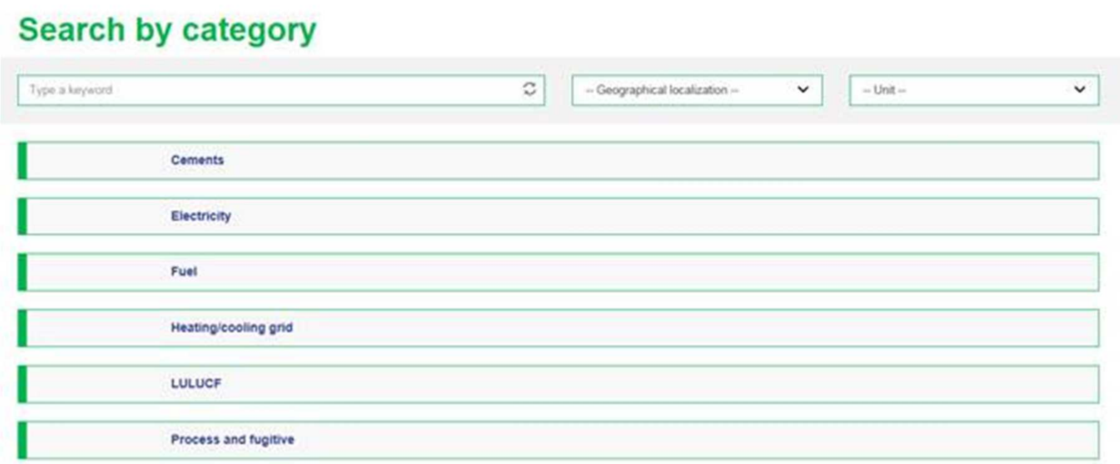

Figure 2 on-line DB, search format

For each EF, the information is available in two languages: the national one of the producer and in English. See beyond an example:

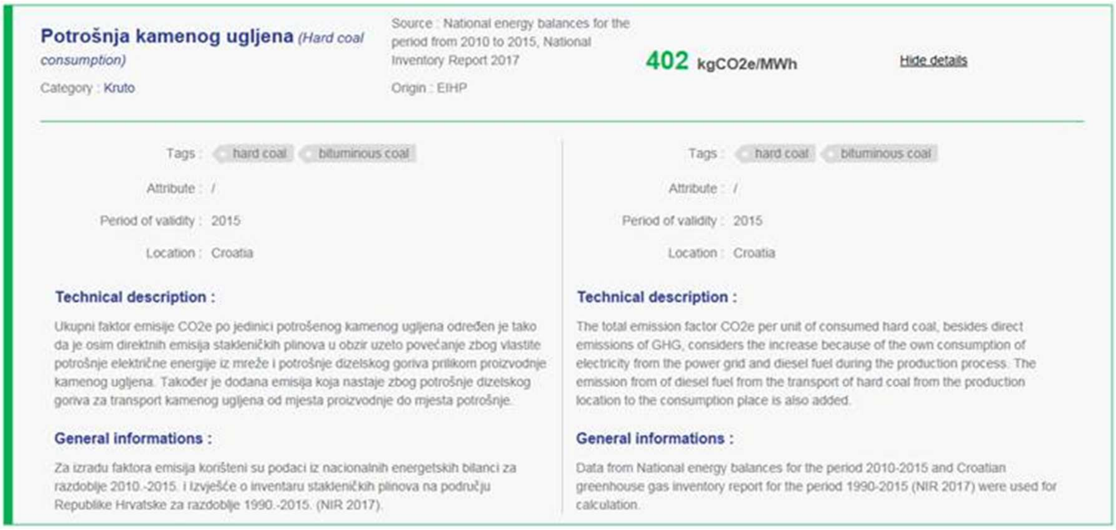

Figure 3 EFs information

2.1.1 For Hungary

The number of the Hungarian emission factors per category is shown in the Table 1. The main sources of the National database were the National Inventory Report and existing databases like Gabi, DEFRA, ELCD, EPA, COPERT, Ecoinvent, studies of associations of different inputs (e.g. steel), several other studies, scientific articles, e.g. The calculation methods, metadata are listed in "EF Database Report" (pdf file). The National Emission Factor Database harmonised at project level can be found in "Hungarian National DB Clim'Foot DB FINAL" (excel file).

Table 1 Hungarian emission factors

CATEGORY	NUMBER OF EFs
Fossil fuels	19
Heating, air conditioning	13
Electricity	4
Plastic	31
Metals	3
Water	1
Road freight	119
Rail freight	3
Passenger transport road	131
Passenger transport rail	29
Organic waste	4
Hazardous waste	3

Wastewater	4
Buildings	13
Land use	6
TOTAL	383

2.1.2 For Croatia

The main reference for the methodology to develop CF DB is the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) that define the methodology to calculate GHG EFs. Croatian National Inventory Report 2017, Greenhouse Gas Inventory 1990 - 2015 (Croatian NIR 2017) contains data and information on EFs for the following sectors: Energy, Industrial processes and product use, Agriculture, LULUCF and Waste. NIR contains data from the relevant National DBs, such as Energy Balances, Statistical Yearbooks, Environmental Pollution Register, Waste Management Information System as well national scientific research. Information about EFs have been also collected from other existing sources that are consistent with the Clim'Foot approach. For this purpose, data from European/International DBs have been considered whereby the issue of harmonization to national circumstances has been considered. The following DBs have been analysed: EFDB - Emission Factor Database (IPCC – International), Base Carbone (ADEME – France), ELCD - European Life Cycle Database (JRC – EU) and Bilan Carbone® tool - version 7.4 (2015).

EIHP has prepared 172 country-specific emission factors. The number of the Croatian emission factors per category is shown in Table 2.

Table 2 Croatian emission factors

CATEGORY	NUMBER OF EFs
Fossil fuels consumption	13
Organic fuels consumption	5
Electricity consumption	1
Heat energy consumption	21
Freight transport	32
Passenger transport	69
Land Use, Land Use Change and Forestry (LULUCF)	6
Waste	6
Agriculture	5
Purchasing of goods	5
Refrigerants	9
TOTAL	172

EIHP has prepared 35 European emission factors. The number of the European emission factors per category is shown in Table 3.

Table 3 European emission factors prepared by EIHP

CATEGORY	NUMBER OF EFs
Fossil fuels production	17
Organic fuels production	6
Electricity production	6
Heat energy production	6
TOTAL	35

EIHP incorporated in the Croatian Clim'Foot database 35 presented EU EFs and EU EFs prepared by other project partners.

The technical description, methodology, data sources, data quality and uncertainty analysis for Croatian emission factors are presented in the document "National Database of Emission Factors, Croatia" (pdf file). The National Emission Factor Database harmonised at project level can be found in the document "Croatian National DB Clim'Foot DB" (excel file). The Database includes abovementioned 35 European emission factors.

2.1.3 For Greece

The National Inventory Report was used as a reliable data source, wherever it was feasible and as a guide for key data sources and calculation methodologies. However, due to the level of disaggregation required for the definition of national emission factors and the lack of detailed data in the NIR, several other sources have been also used for the constitution of the national database, such as Life Cycle Inventory (LCI) databases and literature data. Moreover, emission factors have been calculated according to the methodologies provided by 2006 IPCC Guidelines for national greenhouse gas inventories, EMEP/EEA air pollutant emission inventory guidebook 2013, Base Carbone and DEFRA methodology paper for emission factors.

CRES has prepared 173 national emission factors. The number of the Greek emission factors per category is shown in Table 4.

Table 4 Greek emission factors

CATEGORY	NUMBER OF EFs
Fossil fuels consumption	26
Electricity consumption	26
Heat energy consumption	20
Road transport	22
Rail transport	2
Air transport	8

Sea transport	4
Agriculture	10
Products and process, food	29
Waste	8
Material	9
Land Use, Land Use Change and Forestry (LULUCF)	9
TOTAL	173

CRES has prepared 30 European emission factors. The number of the European emission factors per category is shown in Table 5.

Table 5 European emission factors prepared by CRES

CATEGORY	NUMBER OF EFs
Waste	10
Electricity production	2
Products and process	18
TOTAL	30

Additionally, CRES incorporated in their national Clim'Foot database 129 European emission factors developed by other project partners.

The technical description, methodology, data sources, data quality and uncertainty analysis for the Greek emission factors are presented in the document "National Database of Emission Factors, Greece" (pdf file). The National Emission Factor Database harmonised at project level can be found in the document "Greek National DB Clim'Foot DB" (excel file).

2.1.4 For Italy

The main sources for the national emission factors were the Italian National Inventory Report 2017, for fuel, waste, direct emissions from agriculture, products and processes; National database on transport 2016, elaborated by ISPRA; Leap Database, Global Database of GHG emissions related to feed crops (FAO) for the agricultural product. For the EU EFs data from ELCD - European Life Cycle Database (JRC – EU) were collected.

Italy has prepared 182 country-specific emission factors. The number of the Italian emission factors per category is shown in Table 6.

Table 6 Italian emission factors

CATEGORY	NUMBER OF EFs
Fossil fuels consumption	43
Electricity consumption	2

Freight transport	16
Passenger transport	57
Chemicals	9
Waste	10
Agriculture	16
Fugitive emission from agriculture	29
TOTAL	182

ENEA has prepared 27 European emission factors. The number of the European emission factors per category is shown in Table 7.

Table 7 Emission factors prepared by ENEA

CATEGORY	NUMBER OF EFs
Transport	8
Chemicals	3
Construction	7
Water, treatment and distribution	1
Plastic	8
TOTAL	27

Ecoinnovazione has developed national emission factors related to:

- enteric fermentation for Dairy Cattle, Non-Dairy Cattle, Buffalo, Sheep, Goats, Horses, Mules and Asses, Sows, Other Swine, Rabbits;
- manure management for Dairy Cattle, Non-dairy Cattle, Buffalo, Sows, Other Swine;
- vegetables differentiated per production system and production practice: barley, maize, wheat.

All other national emission factors were developed by ENEA.

The technical description, methodology, data sources, data quality and uncertainty analysis for Italian emission factors are presented in the document "National Database of Emission Factors, Italy". The document comprehends the sector of fuels, transport, chemicals, electricity. The Italian Database includes 182 National Emission factors: Fuels, Electricity, Road transport, Products, and process - food, chemical production, construction, Waste and 120 European emission factors developed by Italian, Greek, Hungarian and Croatian partners.

2.1.5 For France

Regarding the French database, it was already developed at the beginning of the Base Carbone® and currently contains 2147 emission factors with a full documentation.

ADEME have provided 156 country-specific emission factors from its Base Carbone® and adapted to the structure and requirements of the new European database. The number of the French emission factors given per category is shown in Table 8.

Table 8 Emission factors developed by ADEME

CATEGORY	NUMBER OF EFs
Fossil fuels	36
Organic fuels	12
Electricity production	8
Electricity consumption	11
Freight transport	58
Passenger transport	31
TOTAL	156

ADEME has extracted 29 European emission factors. The number of the European emission factors per category is shown in Table 9.

Table 9 European emission factors extracted by ADEME

CATEGORY	NUMBER OF EFs
Products and process: Plastic and chemical product	25
Products and process: Minerals and non-metals	4
TOTAL	29

2.1.6 Lessons learnt on the database

The creation of National Databases of GHG Emission Factors is a key activity to promote actions of mitigation of CF in the organization and support National policies. Indeed, making available reliable and free country specific data allows the implementation of more effective actions in line with the characteristics and the critical aspects of each country. The use of common methodology and format has favoured the exchange of EFs among partners and can advantage the countries that would implement their national database. Indeed, they can take information on the way to develop their own National database and use the existing EFs developed by other countries, if they no adequate information is available for its development.

Application of the general methodology

One of the main issues was the application of quality criteria. Indeed, the data quality criteria were set both for a qualitative and quantitative assessment, so as to match both the approach and put a step forward the OEF methodology. Each partner could decide whether to adopt the qualitative or quantitative approach (or both). All partners decided to apply in the end the qualitative approach, as it is easier and faster, especially when used data sources do not report sufficiently information on data quality. Thus, the lesson learnt is that the source documentation level should drive the selection of data sources for the EF development, in higher measure. In fact, the data quality assessment is the base for the aware use of the data itself and for the correct interpretation of the CFO results. In addition, an automatic way to speed up the switch from a qualitative assessment to a quantitative one should be put in place so as to obtain two evaluation types with a single effort. However, the criterion "uncertainty" still remains an issue, as most of the data sources for the EF definition often do not include any data quality assessment.

Priority for further development of the database

It was experienced that not all sectors are covered enough to allow a sound CFO by all organization types. This is the case of the chemical sector. In Italy, two of the organizations involved in the voluntary programme are from the pharmaceutical and cosmetic sector. Unfortunately, they were not able to fully represent the full basket of purchased substances, which in turn resulted in a not-full representation of emissions in scope 3. Thus, a higher effort is needed to cover this sector, even if this is partly due to a general lack of data concerning the environmental impact of chemical substances. The involvement of stakeholders such as categories associations, national agencies or networks could support the EFs implementation.

2.2 Comparative analysis of the EFs

A comparative analysis of the EFs developed in the national databases has been performed to understand which types of EFs vary most significantly from one country to another and which ones are more homogeneous at the European scale.

The compared national EFs have:

- Same process name
- Same perimeter/system boundary
- Same unit

The comparison was performed for the following sectors:

- Energy
- Road transport
- Waste

For the other sectors, making a comparison was extremely difficult, because the national DBs often include different products. Moreover, where the products are similar, EFs come from different data sources, with different boundaries and technologies.

In the comparison analysis for each group of EFs, the mean and the deviations standards were calculated. It is important to highlight that samples are not significant.

2.2.1 Energy

The EF sample in the energy sector with the highest deviation standards (0.2) is the electricity production. Variation among the EFs within the sample is due to the different mix (Table 10). In the countries in which renewable energy share is more prominent, the EF is lower compared to that of countries using more fossil fuels.

For the combustion of different fuels, the standards deviation changes from 0.01 for natural gas to 0.04 for lignite combustions.

Table 10 Electricity production EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Greek electricity mix 2008	EL00032	Greece	0.78	kg CO_{2e}/kWh	**0.64**	**0.2**
Greek electricity mix 2009	EL00035	Greece	0.79	kg CO_{2e}/kWh		
Greek electricity mix 2010	EL00038	Greece	0.79	kg CO_{2e}/kWh		
Greek electricity mix 2011	EL00041	Greece	0.81	kg CO_{2e}/kWh		
Greek electricity mix 2012	EL00044	Greece	0.82	kg CO_{2e}/kWh		
Greek electricity mix 2013	EL00047	Greece	0.72	kg CO_{2e}/kWh		
Greek electricity mix 2014	EL00050	Greece	0.74	kg CO_{2e}/kWh		
Electricity consumption	CRO0054	Croatia	0.38	kg CO_{2e}/kWh		
Hungarian electricity mix at net production	HU00048	Hungary	0.39	kg CO_{2e}/kWh		
Italian electricity mix at net production-2015	IT00127	Italy	0.32	kg CO_{2e}/kWh		
Hungarian electricity mix gross production	HU00050	Hungary	0.47	kg CO_{2e}/kWh		
Hungarian electricity mix gross production and import	HU00383	Hungary	0.47	kg CO_{2e}/kWh		
French electricity mix 2014	FR24370	France	0.82	kg CO_{2e}/kWh		

Table 11 Electricity losses EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Italian electricity grid losses	IT00128	Italy	0.02	kg CO_{2e}/kWh	**0.05**	**0.02**
Hungarian electricity grid losses	HU00049	Hungary	0.07	kg CO_{2e}/kWh		
Greek electricity grid losses 2008	EL00033	Greece	0.07	kg CO_{2e}/kWh		
Greek electricity grid losses 2009	EL00036	Greece	0.04	kg CO_{2e}/kWh		
Greek electricity grid losses 2010	EL00039	Greece	0.06	kg CO_{2e}/kWh		
Greek electricity grid losses 2011	EL00042	Greece	0.04	kg CO_{2e}/kWh		
Greek electricity grid losses 2012	EL00045	Greece	0.02	kg CO_{2e}/kWh		

Greek electricity grid losses 2013	EL00048	Greece	0.05	kg CO_{2e}/kWh		
Greek electricity grid losses 2014	EL00051	Greece	0.07	kg CO_{2e}/kWh		

Table 12 Lignite combustion EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Lignite consumption	CRO0036	Croatia	0.42	kg CO_{2e}/kWh	**0.37**	**0.04**
Lignite combustion	EL00054	Greece	0.36	kg CO_{2e}/kWh		
Lignite Hungarian combustion mix	HU00001	Hungary	0.33	kg CO_{2e}/kWh		
Lignite	FR12957	France	0.39	kg CO_{2e}/kWh		

Table 13 Liquefied Petroleum Gas (LPG) combustion EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
LPG combustion	EL00058	Greece	0.23	kg CO_{2e}/kWh	**0.25**	**0.03**
LPG consumption - stationary energy sources	CRO0045	Croatia	0.28	kg CO_{2e}/kWh		
LPG - kWh	IT00182	Italy	0.24	kg CO_{2e}/kWh		
LPG Hungarian combustion mix	HU00009	Hungary	0.22	kg CO_{2e}/kWh		
LPG for vehicles	FR14030	France	0.27	kg CO_{2e}/kWh		

Table 14 Gasoline combustion EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Gasoline - kWh	IT00176	Italy	0.26	kg CO_{2e}/kWh	**0.29**	**0.04**
Gasoline Hungarian combustion mix	HU00011	Hungary	0.34	kg CO_{2e}/kWh		
Gasoline consumption	CRO0040	Croatia	0.30	kg CO_{2e}/kWh		
Gasoline combustion	EL00067	Greece	0.25	kg CO_{2e}/kWh		

Table 15 Natural gas combustion EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Natural gas combustion	EL00074	Greece	0.20	kg CO_{2e}/kWh	**0.21**	**0.01**

Natural gas Italian combustion mix - kWh	IT00174	Italy	0.21	kg CO_{2e}/kWh		
Natural gas Hungarian combustion mix	HU00008	Hungary	0.20	kg CO_{2e}/kWh		
Natural gas consumption - stationary energy sources	CRO0047	Croatia	0.22	kg CO_{2e}/kWh		
Natural gas	FR13516	France	0.24	kg CO_{2e}/kWh		

2.2.2 Road transport

In the road transport, the EF sample that has the highest deviation standards is the bus average with 0.16. The variation among EFs in the sample is due to different fuel mixes used in each country.

For other transport road considered, standards deviation changes from 0.07 for light truck -petrol and passenger cars, gasoline till 0.09 for the light truck diesel.

Table 16 Light truck petrol EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Light Commercial Vehicle Petrol Average	HU00142	Hungary	0.28	kg CO_{2e}/km	**0.3**	**0.07**
Light-duty vehicles, gasoline, conventional, <3,5t	CRO0145	Croatia	0.40	kg CO_{2e}/km		
Light Duty Vehicles, gasoline, any route	IT00083	Italy	0.29	kg CO_{2e}/km		
Light duty trucks petrol average	EL00118	Greece	0.23	kg CO_{2e}/km		

Table 17 Light truck diesel EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Light Commercial Vehicle Diesel Average	HU00149	Hungary	0.25	kg CO_{2e}/km	**0.29**	**0.09**
Light duty trucks diesel average	EL00119	Greece	0.26	kg CO_{2e}/km		
Light-duty vehicles, diesel, conventional, <3,5t	CRO0148	Croatia	0.42	kg CO_{2e}/km		
Light Duty Vehicles, diesel, any route	IT00084	Italy	0.24	kg CO_{2e}/km		

Table 18 Passenger car, gasoline EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Passenger Car Petrol Average	HU00132	Hungary	0.18	kg CO_{2e}/km	**0.24**	**0.07**
Passenger car petrol average	EL00103	Greece	0.18	kg CO_{2e}/km		
Passenger Cars, gasoline, any route	IT00075	Italy	0.18	kg CO_{2e}/km		
Passenger car, gasoline, volume >2.0l, Euro 3	CRO0093	Croatia	0.33	kg CO_{2e}/km		
Passenger car, gasoline, volume 1.4-2.0l, Euro 3	CRO0086	Croatia	0.28	kg CO_{2e}/km		
Personal car, gasoline, average power	FR21610	France	0.26	kg CO_{2e}/km		

Table 19 Passenger car, diesel EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Passenger car, diesel, volume >2.0l, Conventional	CRO0104	Croatia	0.27	kg CO_{2e}/km	**0.21**	**0.05**
Passenger car, diesel, volume 0-2.0l, conventional	CRO0097	Croatia	0.26	kg CO_{2e}/km		
Passenger car diesel average	EL00102	Greece	0.16	kg CO_{2e}/km		
Passenger Cars, diesel, any route	IT00076	Italy	0.15	kg CO_{2e}/km		
Passenger Car Diesel Average	HU00133	Hungary	0.18	kg CO_{2e}/km		
Personal car, diesel, average power	FR21611	France	0.25	kg CO_{2e}/km		

Table 20 Bus average EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Buses, fuel mix, any route	IT00053	Italy	0.71	kg CO_{2e}/km	**0.85**	**0.16**
Bus Average	HU00289	Hungary	0.82	kg CO_{2e}/km		
Bus average	EL00114	Greece	1.03	kg CO_{2e}/km		

2.2.3 Waste

In the waste sector, the EF sample that has the highest deviation standards is the solid waste disposal with 0.29. Variation among the EFs in the sample is due to different frameworks of landfill management in each country, for example the recovery of biogas and sludge.

The standards deviation for the remaining two process changes from 0.04 for incineration of municipal solid waste till 0.16 for composting process.

Table 21 Solid waste disposal EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Solid waste to landfill	IT00022	Italy	1.08	$kgCO_{2e}/kg$	**0.89**	**0.29**
Municipal solid waste disposal at managed landfills	CRO0183	Croatia	1.18	$kgCO_{2e}/kg$		
Solid waste disposal on land, managed	EL00312	Greece	0.56	$kgCO_{2e}/kg$		
Solid Waste Disposal in Hungary	HU00020	Hungary	0.74	$kgCO_{2e}/kg$		

Table 22 Incineration of municipal solid waste (MSW) EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Waste incineration of municipal solid waste (MSW)	EL00004	EU-27	0.33	$kgCO_{2e}/kg$	**0.3**	**0.04**
Waste incineration of MSW without energy recovery	IT00023	Italy	0.32	$kgCO_{2e}/kg$		
Waste incineration mixed MSW	HU00344	Hungary	0.26	$kgCO_{2e}/kg$		

Table 23 Composting of municipal solid waste EFs

Process Name	ClimFOOT ID	Location	EFs in CO_{2eq}	Unit	Mean	Standard deviation +/-
Composting of organic waste	CRO0185	Croatia	0.22	$kgCO_{2e}/kg$	**0.26**	**0.17**
Composting process	IT00020	Italy	0.01	$kgCO_{2e}/kg$		
Composting of municipal solid waste	EL00311	Greece	0.20	$kgCO_{2e}/kg$		
Composting of Municipal Solid Waste in Hungary (dry basis)	HU00032	Hungary	0.46	$kgCO_{2e}/kg$		
Composting of Municipal Solid Waste in Hungary (wet basis)	HU00033	Hungary	0.18	$kgCO_{2e}/kg$		
Composting of Municipal Sludge in Hungary	HU00034	Hungary	0.46	$kgCO_{2e}/kg$		

2.2.4 Lessons learnt on EF

In the energy sector, the compared EFs for the fuel combustion (solid, liquid and gas) are quite similar with deviation standards ranging from 0.01 to 0.04. The difference is the content of C in the different fuels. In this case, there is the possibility to use the fuels combustion of other countries in the national DB. This possibility is true for the EFs in the transport sector, in particular for the average trucks and cars that have deviation standard between 0.05 and 0.09.

Moreover, in the comparative analysis developed in the Clim'Foot national DB, the highest deviation standards were for the National electricity mix and in the waste sectors. The suggestion is that the national electricity mix should be developed in each new national DB, as well as the EFs on waste treatment. Indeed, the energy mix in each country changes significantly depending on the percentage of renewables, nuclear or fuels used in the national mix. Furthermore, the EFs of wastes are also country-specific, because each country has different policy and technologies on the waste treatments, so it is relevant to implement country specific EFs.

As mentioned before, it is difficult to give a general comment about the possibility to use EFs of other countries in the National DB for other sectors/products. Indeed, some sectors, such as agriculture, are really country specific. Moreover, the EFs of products depend on boundaries and technologies considered in the calculation. Indeed, the EFs are related to a specific country situation but also to used technologies and considered boundaries.

2.3 Bilan Carbone® tool for CFO calculation

The chapter presents a brief description of the main modifications performed by each country to develop the national version, highlighting the main changes and integrations. The LIFE Clim'Foot project approach for calculation of carbon footprint of an organisation uses the Bilan Carbone® tool, adapted on the national conditions with implementation of the National EFs and EU EFs, developed in the National DBs. The Bilan Carbone® Clim'Foot tool enables GHG emissions calculation from all activities relevant to the operation of an organisation, separated in ten categories: Energy sources, Non-energy sources, Inputs, Packaging, Transport of persons, Transport of goods, Direct waste, Capital goods, Use stages and End-of-life. The Bilan Carbone® Clim'Foot tool follows GHG Protocol and ISO standards (14064-1 & ISO/TR 14069) and provides extraction for reporting in accordance with GHG Protocol and ISO standards.

The Bilan Carbone® Clim'Foot tool is the calculator used for the CFO. It gives a picture of the organisation's operation and is a tool to estimate its GHG emissions at a given moment. It is an Excel file with several spread sheets containing fixed data and cases to fill in:

- there are some spread sheets to fill in according to the sectors and the organisation's activities (energy, transport, etc)
- one spread sheet with the emission factors used for the calculation

- the final spread sheets which display the results (one in CO2eq, one according to GHG Protocol standard and the last one according to ISO 14069 international standard) and some graphs.

The Bilan Carbone® Clim'Foot tool has been adapted to the project. It is easier to use than the previous Bilan Carbone® tool and adjusted for a complete reporting of the organization's emissions. It considers all physical emissions, direct and indirect (scope 1/2/3). All emissions are calculated using the Global Warming Potentials (GWP) and results are presented in CO_2 equivalent (CO_2eq).

The tool was proposed by ADEME at the beginning of the project and is a common tool used in France for CFO. This one is free and available on the cooperation platform (to registered users).

Moreover, each country has translated and adapted the French Bilan Carbone® tool to the National conditions, implementing EFs of National DB in the tool. These country specific tools are available on the Clim'Foot web site.

Other CFO calculators are available. The Department for Business Energy & Industrial Strategy (BEIS) of UK has developed a tool for GHG reporting in the organizations. It is an excel file and a guide is available, "2018 GOVERNMENT GHG CONVERSION FACTORS FOR COMPANY REPORTING Methodology paper for emission factors: final report (Hill et al., 2018) (https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018). Furthermore, the Environmental Protection Agency (EPA) of US through its Resource Efficiency Programme offers a range of services, advice and guidance to businesses and institutions on reducing energy and other resources use while maintaining productivity (See www.BeGreen.ie and External linkwww.GreenBusiness.ie). Moreover, there are a range of carbon calculator resources and carbon disclosure options available for businesses, institutions and local authorities. For micro SMEs and SMEs many of the resources are free (http://www.carbonfootprint.com/calculator1.html; http://www.epa.ie/climate/calculators/#.VYqGVxtVhHw). GHG Protocol too developed a suite of calculation tools to assist companies in calculating their greenhouse gas emissions and measure the benefits of climate change mitigation projects.

All these tools are implemented with National emission factors to calculation.

2.3.1 Lessons learnt on the tool

Disregarding the selected tool for the CFO calculation, a short guide to key features should be developed, including a reminder on main methodology options (e.g. operational approach vs financial). Moreover, in Italy the organizations suggest a simplification of the Italian calculator, deleting the elements strictly related to the French context.

The decision of the Consortium to implement a CFO calculator with National emission factors was very useful for helping the organizations in their CFO calculation. The end users appreciate the possibility to have Bilan Carbone® Clim'Foot tool with country-specific and reliable data.

2.4 Voluntary programme for CFO calculation and mitigation actions

A brief description of the voluntary programmes (experimentation) is presented, highlighting the main issues in the experimentation and the possible solution implemented.

2.4.1 Objectives

The general aim of the C4.1. voluntary program: "Calculation of organisation's carbon footprint by end users" was to support end-users in the carbon footprint calculation.

According to the grant agreement, at least 50 organisations (10 from Hungary, 10 from Croatia, 10 from Greece, 20 from Italy) would calculate their carbon footprints using the Bilan Carbone® tool and the emission factors calculated according to the methodology defined in Deliverable A2.1.

Two main steps of the calculation were the following: training session for end users (C4.1.1.) and implementation by end-users (C4.1.2.).

2.4.2 Training sessions for end users (C.4.1.1.)

Commitments for Training session for end users

Organisations selected among contacts collected in action A3.1., in order to participate in the demonstration phase had to fulfil a web-based survey to assess their skills regarding carbon footprint. The survey was designed by IFC to evaluate the knowledge evolution of these employees during the demonstration phase, as analysed in actions D2.1. and C5.1. The results of the survey provided information on end-users' knowledge and determined the pace of providing training, as well as raised attention to less known parts.

In order to perform the national training, all project partners attended the "train the trainers" course in Paris, organised by IFC. End users in every country were trained by respective project partner during National workshops. An online training presenting the main steps in the calculation of the carbon footprint by using the platform was available online in Hungarian, Croatian, Greek and Italian or in English with national subtitles. End users from each country got access before the workshop by sending names and e-mail addresses to IFC.

Technical details of the trainings

9 trainings were organized by the project partners for end-users, 3 courses were held in Hungary, while 2 courses were organized in the other partner countries. The first one was organized by the Italian project partners between the 24th and 25th of October and the last two trainings were between the 5th and 6th of December 2016. Generally, it took 2 days, while Italian partners organized a one-day long training. There were several trainers in each country who attended the train the trainer course in Paris in April 2016. The end-users were selected based on the type of the organisation, private and public, except for Italy where it was mixed. The total number of

participants was 137, from 69 different organisations, 40 from private and 29 from public sector. The technical details are summarized in Table 24.

Table 24 Technical details of the trainings for end users

Country	Organizer	Date	Duration	Type of organisations	Nr. of participants
Hungary	HOI	23-24th November 2016	2 days	public sector	7
Hungary	HOI	1-2th December 2016	2 days	public sector	11
Hungary	HOI	5-6th December 2016	2 days	private sector	17
Croatia	EIHP	23-24th November 2016	2 days	public sector	17
Croatia	EIHP	29-30th November 2016	2 days	private sector	21
Greece	CRES	1-2th December 2016	2 days	public sector	14
Greece	CRES	5-6th December 2016	2 days	private sector	7
Italy	ENEA + ECOI	24-25th October 2016	2 days	private + public	33
Italy	ENEA + ECOI	5th December 2016	1 day	private + public	10

Training program

The content and schedule of the training were designed by IFC. The educational plan for calculating the carbon footprint of an organisation with the Bilan Carbone® tool was available for all project partners. The document was open to modifications in each country and all partners had possibility to translate and elaborate new training materials too.

The program was divided into four major sequences. The objective of the first part was to introduce the participating organisations, to get information about the hosting institution and the Clim'Foot project, and to get the acquired knowledge about climate and energy challenges and the methodological principles. The second major session was aiming at identifying the perimeters and starting the usage of the Bilan Carbone® tool. During the third sequence of the training the presentation of the calculator was continued and there was also a part dealing with defining actions based on the result of the calculation. At the end of the training, there was an overview about the methodology and steps of a carbon footprint and end-users got information about the upcoming activities, the implementation phase and had possibility to evaluate the effectiveness of the training. Table 25 contains the proposed schedule. All project partners had a very similar schedule for the trainings.

Table 25 Educational plan for end-users' training

Time	Sequence	Duration
9h00 – 9h30	1 – Introduction and individual presentations	30 min
9h30 – 10h45	2 – Synthesis of main energy – climate challenges	75 min
10h45 – 11h00	Break	15 min
11h00 – 12h15	3 – Methodological principles	75 min

	Lunch	
13h45 – 14h30	4 – Defining perimeter	45 min
14h30 – 14h50	5 – Overview of the Bilan Carbone® tool	20 min
14h50 – 17h30	6 – Presentation of the calculator with exercise – Part 1	160 min
	End of day 1	
9h00 – 9h15	Feedback from day 1 + Q&A	15 min
9h15 – 11h15	7 – Presentation of the calculator with exercise – Part 2	120 min
11h15 – 12h15	8 – Defining actions	60 min
	Lunch	
13h45 – 14h45	9 – The main steps of a carbon footprint project	60 min
14h45 – 15h45	10 – Overview of international and national regulations	60 min
15h45 – 16h00	Break	15 min
16h00 – 16h45	11 – Organisation of the implementation phase	45 min
16h45 – 17h15	12 – Evaluations	30 min

After the registration of all the participants, each national project coordinator would welcome all participants to the seminar and introduced the trainers in each country. After it, everyone had the possibility to introduce themselves and reasons for participation in the project. After the introductions, the agenda of the training seminar was presented. Every project partner gave a short presentation about their organisation and the fields of work, especially related to environment protection and gave an overview about the Project and the main Project activities. It was followed by an interactive presentation about the main energy and climate challenges and the methodological principles as well.

After the theoretical principles, all participants were involved in groups for defining parameters for carbon footprint calculation. Each group presented their definition of the perimeter for their case and intense discussions took place according to each organisation's questions regarding their real-life perimeter.

All participants were introduced into the Bilan Carbone® tool, starting with the sheet "Description" and passing through all sheets. The tool was presented sheet by sheet (according to IFC instructions) through an imaginary local authority case study for the end users from the public sector. For the end users from the private sector it was presented through different types of imaginary company case studies.

The 2nd day started with feedbacks from the first day and with questions and answers session. There were also a lot of discussion. It was followed by presenting the Bilan Carbone® tool remaining sheets and about defining actions based on the calculation. In the final presentations, main future steps and implementation phase were analysed.

Each country gave feedback about the quiz aiming at identifying the maturity of end-users.

At the end of the trainings' participants completed evaluation forms enabling to express their opinion on the seminar content, expertise of the trainers and the organisation.

All the participants were very actively involved in the seminars. They actively participated in discussions, questioning, and giving ideas about the input data for the carbon footprint. They showed high interest and according to the evaluation quiz, the aim of the training seminars was fulfilled. Overall, all questions that came up during the training were answered by trainers.

2.4.3 Implementation by end-users (C4.1.2.)

Support of end users in calculation

Project partners supported the participants during the experimentation and provided technical supports to assist end-users in the different steps of the calculation or for using the platform. If a participant noticed an inconsistency in the platform, s/ reported it. Project partners were in touch regularly with each end-user, either visiting the organisation and/or planning teleconferences and web meetings. The aim of those meetings was to regularly support end-users and maintain the dynamics of the demonstration. The bilateral meetings – physical or web meetings – provided an opportunity to refresh the knowledge of the methodology, answer the questions in connection with calculating or data collecting. Among the aims were to provide useful advises for organisations and to give a complete picture of the calculating process and the data collecting. All the project partners took visits for supporting the end-users. During the supporting period Croatia, Greece, Italy and Hungary undertook 38 physical end-user visits. Italy, because of the geographical distances undertook also web-meetings and teleconferences. Project partners identified and listed all the inconsistencies and problems during the demonstration.

Reporting

Each project partner filled an "activity report" of the demonstration, defined by CRES. It was sent to HOI every 3 months. This document presented the actions undertaken by the partners to support the end-users, as well as the activities realized by the end-users. Moreover, potential inconsistencies and problems were also listed in this report.

In addition, each end-user provided a complete report on its carbon footprint that was analysed by its National project partner. This end-user final report was defined by HOI. The document presented main information about the organisation, and the organisations' experiences during the voluntary program, like definition of the perimeters, data collection process and main problems during the collection or the calculation. The report also contains the results of the CFO calculating and a reduction approach, so the end-users could provide a broad picture about the voluntary program through this final report. The target was to involve 50 end-users carbon footprint calculation, 20 In Italy and 10 in Greece, Croatia and Hungary respectively.

Each country (partner) authored a National report, collected and analysed by HOI and CRES in a global report, presenting the results of the action and the problems encountered during the demonstration. The documents present main results of the voluntary program from trainings to national reports of CFO calculation.

2.4.4 Lessons learnt on the voluntary programme, including training

In order to set allow a quality CFO calculation in the context of a voluntary programme, the selection of organizations should take into account to some extent the availability of EFs in the national database (so as to not limit/affect – too much - the CFO exercise). As an alternative, as experience in Hungary, the choice of EFs in the national database (in the first development) should be done on the base of organizations involved in the voluntary programme.

About the typical planning of a voluntary programme, it is important that the timeframe between the training sessions and the starting of the CFO exercise (which depends on the availability of EFs database and calculator) is not too long. The risk (as happened in many countries) is that some selected organizations lose the interest or the condition to perform the activity.

Based on the experience, a recommendation for the training structure is to give higher relevance to the system boundary definition and to the difference among the different approach (operational, financial). In fact, these points were among the most relevant in terms of support provided to the involved organizations, which often did not have a clear picture of their value chain (upstream, core, downstream) and on the type of approach to use.

Moreover, the voluntary programme experience has highlighted that the organisations were not able to calculate their CF by themselves: also, when the end users already had a good expertise on the topics and clear ideas about their participation in the voluntary programme, the initial training was not sufficient and they needed to be advised during the experimentation phase.

The voluntary program developed by the project was well documented and can be replicate in other European countries.

2.5 Voluntary program for the assessment of carbon strategy

2.5.1 Objectives

The general aim of the C4.2. Voluntary program: "Implementation of the voluntary programme related to mitigation actions" was to support the end-users definition of reduction action plans and the assessment of their carbon strategies.

2.5.2 Replicability potential of the voluntary programme

The voluntary programme for the definition and implementation of reduction plans is replicable. Indeed, all the methodologies defined during the project can be used in other countries or by other companies.

The voluntary program based on the assessment of the carbon strategies of companies by ACT – Assessing low Carbon Transition) can be replicate in other European countries, provided that the companies are in the following sectors: electric utilities, automotive manufacturers, retail, buildings, transport and food and beverage.

As shown by the French voluntary program, ACT can be applied to SMEs and mid cap companies, as well as large companies.

Nevertheless:

- The French low carbon transition pathways need to be adapted to the national context of the country of the program for buildings, transport and auto. It is also true for retail, auto and electric utilities but for those sectors, international or regional pathways already exist in ACT and can directly be used.

- Even if it is not necessary to have a high level of climate maturity, it is more useful to have from company's knowledge about climate and to perform a carbon footprint before activating ACT.

- Methodological material (complete methodologies or first drafts) exist but calculation tools have to be developed. This action is currently under process until end of 2018 for electricity, auto, retail and buildings.

- Trainings have to be translated and adapted.

2.5.3 Lesson learnt on the voluntary programme for carbon strategy assessment

The methodological content made available for the project and beyond integrating three new sectors and an adaptation to the SME/Mid-cap target with French pathways provided based on the SNBC (rounded out by the foresight activities of ADEME where relevant) presents points of improvement, but proved to be fully operational, resulting in pertinent ACT assessments with respect to the initial principles of the method.

The inclusion of the already existing ACT method sectors as well as new sectors is a favourable characteristic that should be repeated. Indeed, this provided both a sufficiently robust basis (the existing sectors) to continue to improve the method in general, while broadening its scope of application via the new sectors, as would require a future large-scale deployment of the ACT project.

29 out of the 30 initially planned ACT assessments were completed, allowing for rich and precious feedback for the next stages of the ACT project. This success rate is higher than the initial goal. In light of the diverse feedbacks collected, it appears that the format and implementation of the support provided to companies were behind this good result – in addition to the relevance of ACT for the companies.

The ACT method was shown to be as pertinent for SMEs and Mid-cap companies as for large companies, although from a different point of view: the added value is higher in terms of a progress benchmark than an assessment benchmark in this context. We can measure this aspect partially through the fact that almost all of the companies plan to make use of it internally following the road-test.

The operational application of the ACT method to SMEs and Mid-cap companies, which clearly do not have the same means as large companies, did not present any major difficulties under the conditions of the road-test (which notably included the initial training session and support provided by a competent consultant on the subject) despite the apparent complexity of its theoretical foundations, and the richness and diversity of its sector benchmarks.

The satisfaction expressed by several types of participants in the project, starting from the companies, as well as the smooth execution of the assessment exercises (the time allocated to them was less than initially expected), are positive factors that contribute to conveying a positive image with respect to the future dissemination of ACT, notably on a national scale.

The initial training session on the ACT method enabled the companies and assessors to gain sufficient skills for the needs of the assessments; it also provided an opportunity for development, testing, and improvement for this very first ACT training tool.

Conversely, the main factors that may have limited the achievement of the initial objectives of the road-test are the following:

The extremely tight schedule given the diversity of the objectives restricted the possibility for further development – notably for providing robust benchmark pathways. It also resulted in the methodological adaptation and development work interfering with the ACT assessments themselves, in that part of these two tasks had to be carried out at the same time.

Regarding the training, the lack of useable feedback limited the possibility of producing satisfactory case studies, and notably hampered the appropriation of the existing content by the consultants in charge of the adaptation and development.

The limited volume of the panel of companies, and for some sectors the lack of diversity within the sample, restricted sectoral learnings. The Building and Food sectors had only four representatives in the panel, and the Auto sector just one. The view on these sectors thus must be considered as very specific. The Electric utilities sector only included players that are very well-positioned on the subject of climate transition compared to the average, and the representatives of the Transport sector were almost all committed to the national "Objectif CO_2" programme.

3. Replicability potential of the Clim'Foot project

3.1 Replicability and sustainability inside the Consortium

The necessity to disseminate the project in our countries is a real necessity. The project team needs to involve policy makers from their countries of origin, through National Technical Committees or other activities, in order to have a sustainable project at the end of the LIFE funding.

The idea was to raise awareness of policy makers on CFO calculation and reduction at the beginning of the project. The project team also involved them in the National Technical Committee in order to promote the project, giving them a role of advisor in this project. Each country has organised at least 4 National Technical Committee during the project life, that were very useful to identify relevant policy makers, and get them involved in the project.

After that, the objective was to train national policy maker to the tool and to the replicability of the project results to continue after the end of the project. The Consortium organised a workshop dedicated to policy makers in June 2018, in Paris during which we had 9 policy makers from the Consortium participated: 3 from Hungary, 2 from Croatia, 1 from Greece and 3 from Italy.

The objective now is to support them for the launching of national policy regarding CFO, according to their needs, i.e. bilateral meeting, or customer service by e-mail, or phone call; depending on their demands.

Croatia

Main efforts were put on the animation of the National Technical Committee representatives at four meetings during the LIFE Clim'Foot project implementation. Four representatives of the Ministry of Environment and Energy, as well as policy makers from other institutions (e.g. Croatian Agency for Environment and Nature), were members of the Committee. During this Committee meetings, EIHP has tackled the political willingness for the replication and sustainability of the project. The Energy Institute is also disseminating the Clim'Foot approach by presenting the CFO calculation of the EIHP and its mitigation plan. The EIHP's experience was presented during the project implementation and will be presented as an example to be followed and a way to motivate and involve other policy makers and organisations in carbon footprint calculation and reduction in Croatia. The dedicated meeting with the policymakers in Croatia was held in June 2018 with participation of 8 representatives from the Ministry of Environment and Energy and the Croatian Agency for Environment and Nature. The objective of the meeting was to present the project to the policy makers and lead a discussion on how to implement the ideas and results of LIFE Clim'Foot project in the legal framework. Sustainability of the project and dissemination of results was also discussed.

The Clim'Foot project has given EIHP the opportunity to become a leading institution for spreading Clim'Foot Bilan Carbone approach in Croatia and in the region (Western Balkan countries), in cooperation with ABC, ADEME and other project partners. The main risk is the lack of political will of climate policy makers. Following that, EIHP will further work on awareness raising, especially of national climate policy makers and key representatives of organizations (decision makers), in order to create the preconditions for establishment of a sustainable carbon footprint calculation and reduction process in Croatia. EIHP will also work on the replicability of the Clim'Foot Bilan Carbone approach in the Western Balkan region.

In Croatia, three organisations directly expressed the willingness to participate in future voluntary programs. Due to existing bilateral collaboration, EIHP is assuming that majority of the organisation involved in the LIFE Clim'Foot voluntary programs are interested in participating in further activities on carbon footprint calculation and reduction, if the financial resources will be provided for the implementation of the voluntary programs' activities. EIHP has already received interests from other organisations to join the voluntary programs' activities, but the main issue is providing enough financial resources for further carbon footprint calculation and reduction.

In the past three years, there have been initiative to calculate the carbon footprint for all faculties of the University of Zagreb, as well as the inclusion of education on the calculation and reduction of carbon footprint in a few faculties (e.g. Faculty of Mechanical Engineering and Naval Architecture), as an additional lecture within the existing related courses, but for now without success. EIHP expects that some similar initiatives will be realized in future.

EIHP plans to present the Croatian voluntary programme on carbon footprint calculation, established in the framework of the LIFE Clim'Foot project, as well as the results of carbon footprint calculation for EIHP and other organisations at 2 or more different national or international events (conferences, workshops, seminars…) within the next 3 years. EIHP plans to prepare and publish scientific or professional articles on carbon footprint calculation and reduction, in order to promote sustainable carbon footprint calculation and reduction process in Croatia. In the same period, at least 2 scientific or professional articles on carbon footprint calculation and reduction should be prepared and published. Additionally, EIHP also plans to update the Croatian database of emission factors. At least 10 updated or new emission factors will be provided by EIHP during the next 3 years.

Italy

In Italy National policy makers were involved in the Advisory Board (AB) of the project and in the national technical committee (NTC). In the AB was involved the Ministry for the Environment and in the NTC the Ministry for the Environment (MATTM) and the Ministry of Economic Development (MISE). During the periodic meeting we have presented the Clim'Foot project tools (DB, Calculator and web site) and the voluntary programme. Both ministries were interested in the project. In particular MATTM were interested to use the Clim'Foot Italian National Database in their projects, with the aims to provide a sustainable management model to Public Administrations of the Italian regions, staff training, technical assistance, involvement of stakeholders, dissemination and communication of the methodology and results. In this context the Environmental Ministry (MATTM) signed the letter of commitment for the Clim'Foot project. The letter is intended to state the commitment of MATTM to take into account Clim'Foot results to support implementation of national public policies for calculating and reducing the carbon footprint of organizations. In particular, with the project "CreiamoPA", WP2 - Promotion of Environmental and Energy Management Models in Public Administrations, MATTM intends to support local administrations in planning and implementing measures to reduce greenhouse gas emissions and improve the environmental performance of its body / organization. The letters of commitment represent an important goal in the Replicability and sustainability of the Clim'Foot project inside of the Consortium.

Moreover, ENEA have involved a local decision maker, the Città Metropolitana di Torino (CMTo) in the voluntary programme, collaboration that was very useful to disseminate the Clim'Foot project. Indeed, after the training workshop they decided to apply the Clim'Foot approach by involving some schools of the territory in calculating and reducing their CFO. The following step was to train a group of students of five high schools, who have calculated their schools CF and have identified the main critical aspects. As a final result, with the participation to the voluntary programme, the public administration could fulfil the demand for increasing environmental awareness of young people, in agreement with the objectives of the Green Education initiative of Piemonte Region and is now able to implement the CF results of the schools in the set of indicators monitored by the Energy manager of the Città Metropolitana.

Moreover 10 organization on 12 that have participated to the voluntary programme with ENEA have decided to use the Italian Bilan Carbon tools instrument to monitor the environmental improvement of implemented mitigation actions and are interested to the implementation of the new EF in the national DB

Hungary

In Hungary, HOI will put efforts both in terms of the involvement of further Hungarian end-users and in terms of Hungarian policy makers**.**

HOI regularly organises events and workshops regarding environmental protection, nature conservation and agriculture. Each event where the project results can be delivered it will be presented in different ways: within a presentation, organising a side event, distribution of leaflets and placement of the roll-up.

A national conference is also planned in 2018 or in 2019 regarding the environmentally friendly way of operation of the organisations. The event will cover the topic of CFO, mobility plans and industrial symbiosis as well.

HOI has already calculated its carbon footprint that will be revised in each year and communicated as well. It will also contribute to deliver the project results to the public.

HOI is also planning to involve agricultural vocational schools: students will calculate the carbon footprint of their school acquiring the necessary knowledge on CFO and supporting the institution in GHG emission reduction.

At the end of the project, HOI made a guide on CFO for organisations that will also help us to involve additional organisations. HOI has already received many interests from other organisations to join the initiative so HOI plans to train and support further organisation in the calculation.

Regarding policy makers, HOI has established the National Technical Committee where all relevant policy makers were presented. During the four meetings, HOI trained the policy makers on CFO and Clim'Foot results achieving to gain the necessary knowledge for further steps. During the third and fourth National Technical Committee Meetings, HOI worked with policy makers on what can be influenced in the legislation and how. The last NTC was dedicated to a brainstorming with policy makers to identify the exact way to define a real National carbon policy and to have a list of policies the project dissemination may influence.

HOI officially asked the Ministry for Innovation and Technology responsible for climate affairs in Hungary to define concrete measures on CFO during the preparation of the Integrated National Climate and Energy Plan in August 2018. It could also enable the further usage of the Clim'Foot project results.

Greece

CRES attaches a lot of importance to the further exploitation of the LIFE Clim'foot project experience, as the accumulated knowledge and deliverables developed, and lessons learnt can enhance our national climate objectives. The Ministry of Environment and Energy was involved in the National technical Committee and 3 officers who are also involved in the climate change long-term energy planning were familiarized with the project processes and results. Furthermore, the Greek Minister's for Environment and Energy special consultant on Climate Change, Mr Vasileios Liogkas expressed high interest on the LIFE Clim'Foot activities and precisely on the implementation, outcomes and results of the voluntary programme. Following that, a bilateral meeting between the Project Team and the Special Consultant, was organized in order to further present in detail the voluntary programme. Based on this presentation the Special Consultant acting as Coordinator of the Inter-ministerial Committee for Circular Economy in Greece, will organize an event in which the LIFE Clim'Foot Voluntary Programme (methodology and Tools) will be introduced aiming to be replicated in the Central Public Administration in Greece. This event is expected to be realized in autumn 2018.

Moreover, the special consultant asked the team to present the project in the 9th Partnership Meeting of the EU Urban Agenda/ Circular economy with a view to showcase the project and export concept in other EU Urban Agenda partner countries (Athens 09/2018).

A few organisations have also demonstrated their will to participate in a potential continuation of the project. CRES has launched a call for replication in Greece. Some companies have expressed their willingness to participate in such an initiative, if the voluntary programme is repeated. For example, the Attica region would like to participate in the replication. There is also interest from the Covenant of Mayors, which will be interested in the use of the cooperation platform.

However, these organizations will need to be supported. One pending question is the way to finance and support such replication after the end of the LIFE project.

A presentation (poster or physical) can also take place in the 2nd Climate Change Conference that will take place in Athens in November 2018 and can further promote the project to interested public and private parties. Further potential dissemination activities will be designed and implemented at very possible opportunity.

France

France has the willingness to pursue high commitment of organisation regarding the management of their carbon footprint. The objective is to go further and to involve many other organisations in the assessment of their carbon strategy, through the launching of a new voluntary programme next year.

3.2 Replicability outside the Consortium

The replicability is intended as the dissemination and implementation of Clim’Foot tools and actions for calculating the CFO in European countries outside the project consortium. One of the main purposes of the LIFE Clim'Foot project is to disseminate all over Europe a common approach for calculating the carbon footprint of an organisation with standardized databases. Therefore, the significance of carbon footprint calculation and replication of project results in countries outside the consortium are emphasised.

Moreover, based on the replicability potential web questionnaire results, the willingness to adopt the LIFE Clim’Foot approach for carbon footprint calculation in European countries outside the consortium was analysed. The special workshop, together with the final conference (June 2018), was developed in order to train policymakers outside the consortium to replicate the project results. Based on the results obtained within this activity, the commitment for implementing the Clim’Foot approach outside the consortium is analysed.

The LIFE Clim'Foot consortium has recognized and gathered contacts of 97 policymakers outside the consortium. Figure 4 shows an illustrative representation of countries of recognized policymakers outside the consortium.

Figure 4 Countries of recognized policymakers outside the LIFE Clim'Foot consortium

As shown in a graph Figure 5, the majority of policymakers are from Austria (8), Germany (6), Montenegro (6), Finland (5), Belgium (4), Denmark (4), Poland (4), Serbia (4), while other countries are represented by less than 3 individuals.

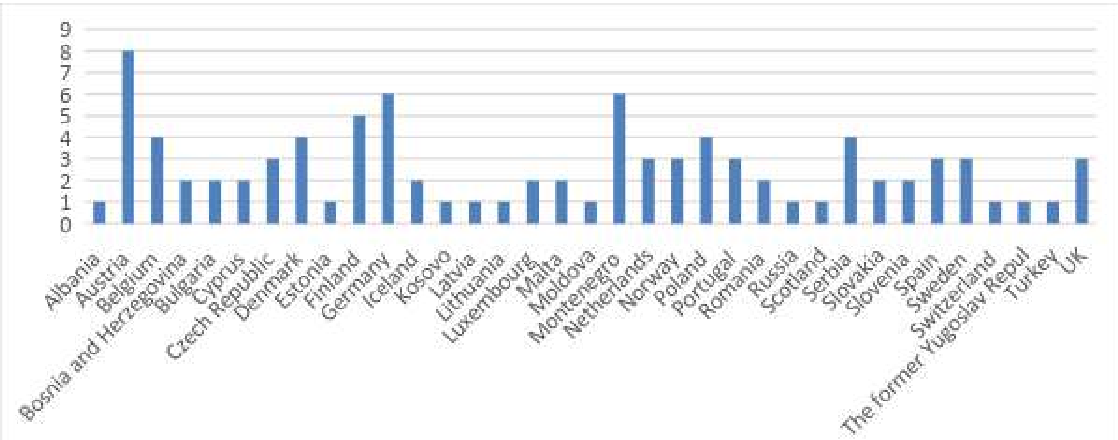

Figure 5 Graph of countries of recognized policymakers outside the LIFE Clim'Foot consortium

EIHP, in collaboration with other partners, has contacted 97 recognized policymakers over the period from October 2017 till June 2018, and has received 27 feedbacks, coming mostly from Montenegro, Serbia and Belgium. The distribution of answers is shown in Figure 6. The questionnaire about replicability potential was circulating from October 2017 and was available online at the LIFE Clim'Foot website (http://www.climfoot-project.eu/en/content/are-you-interested-joining-us).

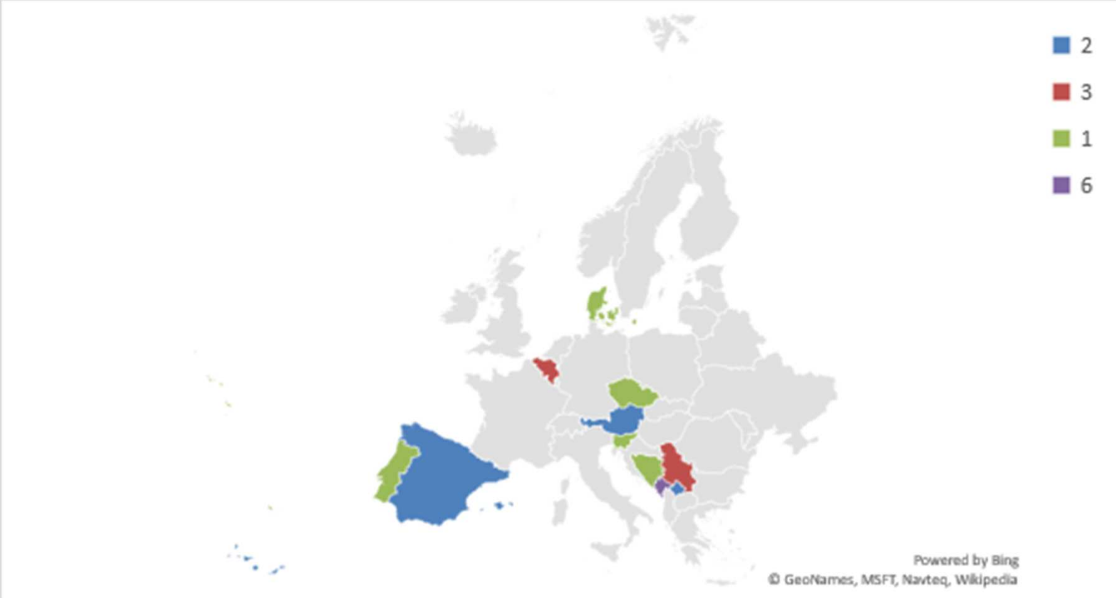

Figure 6 Distribution of questionnaires feedback among countries outside the LIFE Clim'Foot consortium

According to the sample from the questionnaire, voluntary programmes for carbon footprint calculation exist in Austria, Belgium, Bosnia and Herzegovina, Czech Republic, Denmark, Montenegro, Portugal and Spain, while they are missing in Kosovo, Serbia and Slovenia.

The covered sectors differ widely, from public and private organisations in Belgium, Czech Republic and Portugal, mainly large companies in Austria, tourism sector in Montenegro, government authorities in Bosnia and Herzegovina and local governments in Denmark. The methodology used are GHG and ISO standards, while Bilan Carbone® is used in Belgium. The covered scopes are 1, 2 while in Belgium, Bosnia and Herzegovina, Czech Republic and Spain scope 3 is also covered. Nevertheless, based on survey results, national database of emission factors exists only in Austria, Kosovo and Montenegro. The lack of databases of emission factors in countries with voluntary programmes are indicating that CFO is assessed with a significant uncertainty of carbon footprint calculations.

Stand on the survey analysis, 19 policymakers from 9 different countries have expressed their interest for participating at the final conference and special workshop for policymakers. Based on their interest, 5 policymakers were selected as representatives of their countries for replicability and transferability purposes of the Clim'Foot project.

For replicability and transferability purpose 2 webinar and a workshop dedicated to policymakers. The 2 Webinar "Supporting the calculation of carbon footprint of organisations" were organized the 15th and 18th of May, by ADEME and Ecoinnovazionne and involved about 22 and 30 policy maker each. Moreover, a workshop "Implementing a carbon footprint program in your country" was organized on the 15th of June 2018 in Paris. During the morning of the 15th June, 39 onsite participants from 9 different countries were registered:

- Belgium
- Croatia
- Czech Republic
- France
- Greece
- Hungary
- Italy
- Montenegro
- Poland

14 policymakers from the previously mentioned countries participated at the workshop, among which 5 policy makers from 4 countries outside the Consortium: 2 participants from Montenegro, 1 from Czech Republic, 1 from Poland and 1 from Belgium. The workshop was also broadcasted, thus additional policymakers were participating online. The broadcasting platform hosted 7 participants among which 3 participants were policymakers. Overall, 17 policy makers took part in the dedicated workshop.

The training programme was made up in different steps:

- The main ingredients of national carbon footprint programme
    - Set up a programme team
    - Communication
        - Set-up a website dedicated to the programme
        - Develop communication support and messages to primarily explain why people and their organisation should spend time on defining their carbon footprint
    - Training: programme team members and of organisations' representatives
    - Tools:
        - For the carbon footprint calculation phase: Calculator/EF database/data collection templates
        - For the action plan and low carbon strategy definition: methodology and calculation tool
    - Experimentation phase
- For each step of the programme: what LIFE Clim'Foot project offers
    - Methodology guides and calculation tool
    - EF database
    - Training materials for end-users and programme members
    - Communication materials
- Overall typical planning for the implementation of the programme
- Finance
    - Estimated cost of a typical programme

The overall idea was to show up the Clim'Foot results through each part of the program with continuous interventions from partners giving feedback. Participants were fostered to ask question anytime.

The dynamic of the workshop was well-heeled, because the public was already interested in the project and motivated for its replication; policy makers asked many questions on the use of the tools, on the demonstration phase, the French voluntary programme.

The conclusion of this event is that it was prosperous in exchanges between the LIFE beneficiaries and the policy makers. It was a good a good opportunity to provide tips and information to policy makers, in order to continue or replicate the project. At the end of the workshop they were able to ask many questions.

After the workshop, the possibility to sign a letter of commitment for taking into account the LIFE Clim'Foot approach and results, was offered to the interested policymakers. The legal representative from Agence wallonne de l'air et du climat – AWAC (Belgium) and the Assistant Minister of Energy Sector from the Ministry of Foreign Trade and Economic Relations from Bosnia and Herzegovina commit themselves to consider the results of the Clim'Foot project to support the implementation of national public policies for calculating and reducing the carbon footprint of organisations that are outside the scope of the EU ETS. The letters of commitment represent an important goal in the process of developing a common approach for calculating the carbon footprint of an organisation with standardized databases in the EU and beyond.

The planned next actions inside and outside the Consortium countries are reported in the deliverable F3.1 (After LIFE plan).

4. Transferability potential of the Clim'Foot project

In agreement with the Officer the Consortium for the transferability potential of the project considered the main methodological differences between CFO and OEF with focus on the national databases.

4.1 Similarities and differences between the OEF and CFO approaches

In this chapter, a general analysis of the similarity and differences between CFO approach (the GHG Protocol and ISO 14064) and the OEF methodology is presented.

The Organisation Environmental Footprint (OEF) is a Life Cycle Assessment (LCA) based method to quantify the relevant environmental impacts of an organisation. The OEF methodology has been defined in the "Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations (2013/179/EU)" (OEFs) and from 2014 the EU Commission are working on the document "Organisation Environmental Footprint - Sector Rules Guidance" (OEFSR), now at the version 6.3 (May 2018) with the primary objective to fix a consistent set of rules to calculate the potential environmental impacts of an organisation in a given sector. Sector specific rules analogous to OEFSRs exist in standards for calculating GHG emissions, such as the GHG Protocol. The OEFSR is a document in evolution. Indeed, there are several differences among the OEF guide (EC, 2013) and the OEFSR (EC, 2018) in topics such as the impact categories considered, data quality requirements, end-of-life formula. In the publication of the Resource Efficiency Roadmap the commission defined the future role of the environmental footprint methodology:

1. Establish a common methodological approach to enable Member States and the private sector to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life-cycle ('environmental footprint');

2. Ensure better understanding of consumer behaviour and provide better information on the environmental footprints of products, including preventing the use of misleading claims, and refining eco-labelling schemes.

The GHG Protocol establishes comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains and mitigation actions. Building on a 20-year partnership between World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), GHG Protocol works with governments, industry associations, NGOs, businesses and other organizations. GHG Protocol is developing standards, tools and online training that helps countries and cities track progress towards their climate goals.

The ISO 14064 standards have the aim to guarantee (trust) the processes of reporting and monitoring of GHG, in relation to the emission declarations by the organizations and projects for their reduction.

Authors, for the purpose of this document, have made a comparison analysis with the OEFSR (2018) last available version. The comparison is based on the approach used in document "Analysis of Existing Environmental Footprint Methodologies for Products and Organisations: Recommendations, Rationale, and Alignment", (EC-IES-JRC, 2011), the description of the considered methodological aspects is reported in the Annex. In Table 26 provides list of methodological issues considered in the analysis.

Table 26 Comparison of ISO14064, GHG Protocol and OEFSR (EC, 2018)

Methodological Consideration	OEFSR (EC, 2018)	ISO 14064	GHG Protocol all documents
Life Cycle Thinking (LCT) (Life Cycle Approach)	Yes	Scope 1, 2 (not LCT) and 3 optional (LCT)	Scope 1, 2 (not LCT) and 3 optional (LCT)
Communication Target Audiences	B2B and B2C	B2B and B2C	B2B and B2C

Methodological Consideration	OEFSR (EC, 2018)	ISO 14064	GHG Protocol all documents
Functional Unit	Concept of functional unit (organisation as goods/service provider) and reference flow (Product Portfolio = the sum of goods/services provided by the organisation over the reporting interval)	Does not use FU and reference flow concept	Does not use FU and reference flow concept
System Boundary	Default cradle-to- grave, control approach (financial and/or operational).	Scope 1, 2 mandatory and 3 optional, choice of equity share, financial control, or operational control approach	Scope 1, 2 mandatory and 3 optional. Boundaries defined based on equity share or control criteria.
Cut Off	Not allowed	Based on considerations of materiality, feasibility and cost effectiveness.	Discouraged
Covered Emissions / Impact Categories	A default set of 16 mid-point impact categories (mandatory) and Out of these 16 impact categories the sector OEFSR shall list those that are most relevant for the specific sector. Optional the normalization and weighting	GHG emissions	GHG emissions
Data Quality	Data quality of each dataset and the total EF study shall be calculated and reported. Data quality is assessed against four criteria: - Technological (TeR), - Geographical (GR), - Time (TiR), - Precision/uncertainty (P). DQR=(TeR+GR+TiR+P)/4 The DQR of the newly developed dataset shall be calculated for all process that account at least 80% of the total environmental impact	Requires data management plan + uncertainty assessment. Refers to ISO 14064-3 for validation / verification requirements.	Recommends qualitative data quality scoring for scope 3 calculations. Specifies criteria for a data management plan. Guidelines on the GHG website for uncertainty assessments.

Methodological Consideration	OEFSR (EC, 2018)	ISO 14064	GHG Protocol all documents
Allocation	OEF multi- functionality hierarchy: (1) subdivision or system expansion; (2) allocation based on a relevant underlying physical relationship (here substitution may apply); (3) allocation based on some other relationship	No guidance	Companies should avoid or minimize allocation if possible. Guide propose such allocation methods: Physical, economic, other (Allocating the emissions of an activity based on industry-specific or company- specific allocation methods)
Biogenic (Carbon) Emissions and Removals	Defines two options for modelling the biogenic carbon: Option 1: modelling all biogenic carbon uptakes and releases. This allows carbon tracking and assures that all flows are included. It may require complex modelling for a zero impact in the end. Option 2: simplified modelling of only those flows that influence the climate change impact results (namely biogenic methane emissions). Moreover, with a lifetime beyond 100 years, a carbon credit shall be modelled as an emission uptake as 'resource from air' using the elementary flow 'carbon dioxide (biogenic-100yr).	Carbon storage shall be reported separately.	Biogenic emissions and removals to be included in the assessment. It includes biogenic carbon in the inventory for all products and requires separate reporting for additional transparency.
Climate Change Factors	Consider the emission factor IPCC (2013) that include the climate–carbon feedback for different substances and some other correction EF factors. For the carbon monoxide (fossil) the EF is 1.57, for CH_4 (fossil) 36.75 and CH_4 (biogenic) 34. Moreover, for time horizon beyond 100 years, EF of Carbon dioxide (biogenic-100yr) from air is -1 CO_{2eq}	The use of the latest IPCC Fifth Assessment Report, 2013 (AR5) values is recommended. CH_4 (fossil) 30 and CH_4 biogenic 28. The GWP values provided here from the AR5 for non-CO_2 gases do not include climate-carbon feedbacks.	The use of the latest IPCC Fifth Assessment Report, 2013 (AR5) values is recommended. CH_4 30 and CH_4 biogenic 28. The GWP values provided here from the AR5 for non-CO_2 gases do not include climate-carbon feedbacks.

Methodological Consideration	OEFSR (EC, 2018)	ISO 14064	GHG Protocol all documents
Emission Off-setting	Shall not be included in the assessment.	Reductions from purchased credit or other external projects must be documented and reported separately.	Inventory method reported separately
Review	During the transition phase or until a European policy regulating EF based information is adopted by the Commission, it is not recommended to carry out any communication of the environmental profile of a product or organisation in absence of a valid OEFSR. In any case, if and when such a study is carried out, it shall be subject to an independent third-party review carried out in accordance to ISO 14044, ISO 14071 and all complementary requirements included in this Guidance with reference to review of OEFSRs.	Review report or 3rd party verification statement should be available for public assertions. Required level of validation and verification depends on several criteria.	Provides detailed guidance, but not a requirement.

4.2 Transferability potential of Clim'Foot national databases

In this chapter, an analysis on the transferability and usability potential of the National DBs for the Climate change impact category within the organisation environmental footprint methodology has been performed. The result is the definition of criteria useful to implement specific actions that can make the National DBs or, at least, a few datasets compliant with life cycle inventory (LCI) datasets to be used in organisation environmental footprint calculation for climate change.

Context

To develop the methodology for definition of Clim'Foot National Databases, the following references have been considered:

- GHG Protocol Corporate Accounting and Reporting Standard - The Corporate Standard provides instruction on how a company should perform a GHG inventory; it covers scopes 1 and 2 (see also the Scope 2 Guidance)

- GHG Protocol Corporate Value Chain (Scope 3) Standard - This standard provides instruction on how a company should perform a scope 3 GHG inventory, which includes emissions from throughout a company's value chain.
- GHG Protocol Product Life Cycle Standard the Product Life Cycle Standard instructs users on accounting for the emissions of a product's full life cycle; users can learn to focus efforts on the greatest GHG reduction opportunities in order to develop more sustainable products.
- ISO 14064:2006 Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals
- ISO/TR 14069:2013 Greenhouse gases Quantification and reporting of greenhouse gas emissions for organisations -- Guidance for the application of ISO 14064-1.
- ISO/TS 14067:2013 Carbon footprint of products - Requirements and guidelines for quantification and communication
- ISO/TS 14072_2014 Environmental management – Life cycle assessment – Requirements and guidelines for organisational life cycle assessment.
- PAS 2050:2011 assessment of the life cycle greenhouse gas emissions of goods and services Standards for LCA at product level
- ISO 14040:2006 - Environmental management -- Life cycle assessment -- Principles and framework
- ISO 14044:2006 -Environmental management -- Life cycle assessment -- Requirements and guidelines
- EU Commission Recommendation (2013/179/EU) on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations
    - Product Environmental Footprint (PEF) Guide, Annex II,
    - Organization Environmental Footprint (OEF) Guide, Annex III
    - Guidance for the implementation of the EU PEF during the EF pilot phase - Version 5.0 and Ecoinvent Data Quality Guidelines, May 2015
- IPCC
    - 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES
    - Climate Change 2013, The Physical Science Basis Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change 2013

In the project the main reference for the methodology to develop the national databases is the IPCCs, (2006, 2013) which defines the methodology to calculate GHG emission factors for the sector of energy, waste, agriculture, industrial process and product use.

The methodology to develop the National EFs DB (Scalbi et al., 2016) was completed in June 2016.

As mentioned previously, the OEFSR available in 2015 (1st public consultation) has several differences if compared to the OEFSR (EC, 2018) in topics such as the impact categories, data quality requirements, end of life formula. Likewise, the OEFSR is yet in transition phase. Therefore, all the actions that are discussed in the next paragraphs to make some EF datasets in compliant with OEF for calculation of the Climate change emissions are not definitive actions, because the final OEFSR is not available at this time.

Difference between EFs calculated in Clim'Foot project and OEF compliant dataset

The main issues in EFs complaint with OEFSR data set for the Climate change calculation are:

1. Database format,
2. Gases covered and nomenclature,
3. The characterization factors,
4. Data sources used for calculating the EFs,
5. Data quality requirements

Database Format

The Consortium chose to use the Excel format for the national database. This choice was motivated by the necessity for most of the partners to have a format easy to implement and, as previously mentioned, it is designed to be imported in a relational DB in order to improve its replicability and transferability. On the contrary the ILCD format (XML format) shall be used for the data sets compliant with OEFSR. More information is available in http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml

Gases covered

The Clim'Foot DB includes the greenhouse gases, as suggested by GHG Protocol and ISO 14064, covered by the Kyoto Protocol:

- Fossil carbon dioxide (CO_2)
- Biogenic carbon dioxide (CO_2)
- Methane (CH_4)
- Biogenic methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Nitrogen trifluoride (NF_3)

The impact category of Climate Change in the OEFS includes all the gases covered **by the Kyoto Protocol and by the Montreal Protocol,** such as the CFCs, Halons, carbon monoxide (fossil) etc. Furthermore, information can be found in the document, "Supporting information to the characterisation factors of recommended EF Life Cycle Impact Assessment methods (Fazio et al., 2018)" and in EF Method Excel file: http://eplca.jrc.ec.europa.eu/permalink/EF-LCIAMethod_CF(EF-v2.0).xls. In this Excel file the gases covered in the climate change categories for OEFSR are reported.

Nomenclature

The elementary flows in a dataset are defined by a reference nomenclature, a set of rules to name and classify the flows in a consistent and unique way. In Clim'Foot national DBs and in OEFSR compliant LCI datasets a different nomenclature is used. Indeed, Clim'Foot nomenclature reports the Chemical formula for the gases as reported in Table 27.

Table 27 Nomenclature for GHG and characterization Factor in Clim'Foot DB

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	0
Methane	CH_4	30
Biogenic methane	CH_4	28
Nitrous oxide	N_2O	265
Sulphur hexafluoride	SF_6	23500
Nitrogen trifluoride	NF_3	16100

For the HFCs and PCFs gases common name is used as you can see in the D2.2 deliverable (Scalbi et al., 2018).

On the contrary, the nomenclature of OEFSR shall be compliant with "ILCD Handbook – Nomenclature and other conventions", that uses mainly the common gases names, not chemical formula.

Further information on flow nomenclature can be found at following links:

- for Elementary Flow list available at: http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml
- http://eplca.jrc.ec.europa.eu/uploads/MANPROJ-PR-ILCD-Handbook-Nomenclature-and-other-conventions-first-edition-ISBN-fin-v1.0-E.pdf
- Change Log ILCD-EF: http://eplca.jrc.ec.europa.eu/permalink/ChangeLog_COMPLETE_ILCDtoEF2.0.xlsx

Characterization Factor (CF)

Within the current OEF method, the global warming potentials of the "Third assessment report of IPCC" (2007) are applied. The GWPs shall be updated using the Fifth assessment report of IPCC (2013), including climate-change carbon feedbacks for both CO_2 and non-CO_2 substances (following the UNEP/SETAC recommendations of the Pellston Workshop, January 2016[2]).

[2] https://www.setac.org/page/PTWorkshops

In Table 28 the CFs for climate change modelling, with carbon feedbacks (in CO_2-equivalents) are reported.

Table 28 Table CFs for climate change modelling, with carbon feedbacks (in CO_2 equivalents)

Substance	Compartment	CF-GWP100
Carbon dioxide (fossil)	Air emission	1
Methane (fossil)	Air emission	36,75
Carbon monoxide (fossil)	Air emission	1,57
Carbon dioxide (biogenic)	Resources from air	0
Carbon dioxide (biogenic-100yr)	Resources from air	-1
Methane (biogenic)	Air emission	34
Carbon monoxide (biogenic)	Air emission	0

These emission factors are quite different from the Emission factors used in the Clim'Foot national DBs (Table 27 The main differences are for the Methane fossil and biogenic).

Data source

About the data source the main issues are:

a) Aggregation level - in Clim'Foot data are sometime aggregated at CO_2eq level, not elementary flows are available;
b) Modelling approach - Circular Footprint Formula in OEF, not applied when developing EFs from products to be used under scope 3 of the assessment.

The data, that have emission factor directly in CO_{2eq} without the breakdown emissions, do not allow to see which elementary flows are considered and which Characterization Factors are used in the calculation. Hence, it is not possible to understand if the dataset is compliant or not with the OEFSR). As a matter of fact, all data before 2013 are not compliant with OEFSR, because of the methane (fossil and biogenic) the CF was 25 CO_{2eq}.

Circular Footprint Formula in OEF

Moreover, in the OEFSR (EC, 2018) the waste of products used during manufacturing, distribution, retail, use stage or after use shall be included in the overall modelling of the life cycle of the product. Overall, this should be modelled and reported at the life cycle stage where the waste occurs. To model product waste, OEFSR (2018) Guide requires the use of a formula named to "Circular Footprint Formula" (CFF) to deal with multi-functionality in recycling, re-use and energy recovery situations. The formula is quite complex and the specific rules to be followed are provided in section 7.18 of OEFSR (EC, 2018). This formula has been modified in respect to the end-of-life (EoL) formula used in the OEF Guide (EC, 2013). Indeed, initial feedbacks received by some pilots participating to the EF pilot phase and from further experience gathered during three years of pilot phase, led the Commission to re-consider the EoL formula available. Data sets including waste, which are used for scope 3, are not compliant with OEFSR (EC, 2018) because CFF formula to calculate waste is not considered.

Data quality

About data quality, further specification is needed to understand the difference.

Firstly, to develop the data quality criteria in methodology for EF National DB (Scalbi et al., 2016), several different approaches have been considered, in particular:

- requirements available in the GHG standards and guidelines
    - ISO 14064-1:2006 quality limited to the criterion "uncertainty" (of emissions factors)
    - GHG Protocol: data quality indicators (Pedigree matrix, non-updated release), namely representativeness (technological, temporal, geographical, completeness, reliability). Qualitative approach (no scoring system)
    - PAS 2050: relevance, completeness, consistency, accuracy and transparency
- developments occurring in the LCA field:
    - ISO 14044 requirements (qualitative)
    - PEF/OEF requirements (scoring system)
    - LCI databases own systems
    - UNEP/SETAC Life Cycle Initiative (to be further detailed)

In order to favour the transition towards EF databases a DQ assessment was developed suitable a scoring system, taking in account the initiatives on data quality at European and international level.

The following criteria have been defined:

- time representativeness (TiR) = degree to which the dataset reflects the specific conditions of the system being considered regarding the time/age of the data and including background process datasets, if any.
- technological representativeness (TeR) = degree to which the dataset reflects the true population of interest regarding technology, including for included background process datasets, if any.
- geographical representativeness (GeR) = degree to which the dataset reflects the true population of interest regarding geography, including for included background process datasets, if any.
- Uncertainty (it can be expressed as standard deviation, percentage or according to expert judgment, for more clarification see "Deliverable A2.2: Methodology for constituting the National Databases", section 8.3).

A semi-quantitative assessment of the overall emission factors shall be calculated summing up the achieved quality rating for each of the quality criteria, divided by the total number of criteria. The Data Quality Rating (DQR) result is used to identify the corresponding quality level. This evaluation shall be done according to the following formula:

$$DQR=(TiR+TeR+GR+U)/4 \quad (1)$$

The (1) formula is quite similar to the formula (2) developed in the OFRS (2018)

$$DQR=(TiR+TeR+GR+P)/4 \quad (2)$$

where TeR is the Technological-Representativeness, GR is the Geographical-Representativeness, TiR is the Time-Representativeness, and P is the Precision/uncertainty.

Nevertheless, the value to qualitative information (Very good, Good, Fair, Poor, Very poor) used for the evaluation of Clim'Foot Data quality parameters was different respect the value considered in OEFSR Data quality parameters, see Table 29 and Table 30.

Table 29 Clim'Foot table on quality level and rating for the quality criteria (Adapted from: Guidance for the implementation of the EU PEF during the EF pilot phase - Version 5.0 and Ecoinvent Data Quality Guidelines, May 2015)

Quality level	Quality rating	TiR	TeR	GR	U
Very good	1	The TiR is not older than 4 years with respect to the reference year of the data source	The technologies used are 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.	≤ 10%
Good	2	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.	10% to 20%
Fair	3	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 is valid for.	20% to 30%
Poor	4	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 to the technologies covered by the data	The process takes place in a country that is not included in the geographical region(s) the data is valid for, but enough similarities are estimated based on expert judgement.	30% to 50%
Very poor	5	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 is valid for.	> 50%

Table 30 OEFSR (2018) table on quality level and rating for the quality criteria

Quality level	Quality rating	TiR	TeR	GR	P
Very good	1	The data refers to the most recent annual administration period with respect to the EF report publication date	The elementary flows and the secondary dataset reflect exactly the technology of the newly developed dataset	The data(set) reflects the exact geography where the process modelled in the newly created dataset takes place	Measured/calculated and externally verified
Good	2	The data refers to maximum 2 annual administration periods with respect to the EF report publication date	The elementary flows and the secondary dataset are a proxy of the technology of the newly developed dataset	The data(set) partly reflects the geography where the process modelled in the newly created dataset takes place	Measured/calculated and internally verified, plausibility checked by reviewer
Fair	3	The data refers to maximum three annual administration periods with respect to the EF report publication	Not applicable	Not applicable	Measured/calculated/literature and plausibility not checked by reviewer OR Qualified estimate based on calculations plausibility checked by review
Poor/ Very poor	4	Not applicable	Not applicable	Not applicable	Not applicable

Actions that can make the National DBs or, at least, several OEFSR datasets compliant

The actions suggested to adapt the data sets for use in the OEF Climate Change Calculation, are developed considering the OEFSR 2018 (EC, 2018) and all information available at the moment.

Data format

The first action to be in compliant with the OEFSR dataset for climate change calculation is to change the data format of the EF national Databases from Excel file to xml file.

To create the database in xml format it is possible to use the software Soda4LCA (https://bitbucket.org/okusche/soda4lca), as suggested by the JRC to be in compliance with PEF and LCND (Life Cycle Data network). At this moment the release Soda4LCA 4.4.3 is available.

Soda4LCA is a web-based user interface that can be accessed with any web browser. It includes functionalities for import and export and search and retrieval of dataset. Soda4LCA can store ILCD-formatted process (unit and aggregated processes, results), LCIA method, flow, flow property, unit group, contact and source datasets and referenced documents in the database.

An access right management system allows administrators to define which users have what kind of access (read, read only metadata, import, overwrite) to datasets. It supports the storage of different versions of a logical dataset and each version can be given a status that may be either RELEASED (when published) or UNRELEASED.

Figure 7 Logo Soda4LCA

To install Soda4 LCA the steps reported in Table 31 can be considered where the time and kind of experience are included:

Table 31 5step to implement Soda4LCA

Steps	Action	Work time	experience
1	Configuration of physical or virtual machine	1 hour	Expert of web management and CED machine
2	Installation of O.S: update, before the configuration of web access and server shh	5 hours	IT expert
3	Installation of Java, Apache, TOMCAT and eventually environment variable	2 hours	IT expert
4	Installation of DB MySql first configuration and preparation of DB scheme	2 hours	IT expert
5	Installation of Soda 4 LCA, configuration of TOMCAT, MySql, JDB driver, test	3 hours	IT expert
6	First configuration for installation test for Soda	3 hours	IT expert
7	Administration of Soda, user, registry and source of data	1 hour	Manager of the DB

Figure 8 and Figure 9 are showing the database structure and the type of software that shall be used to implement the DB.

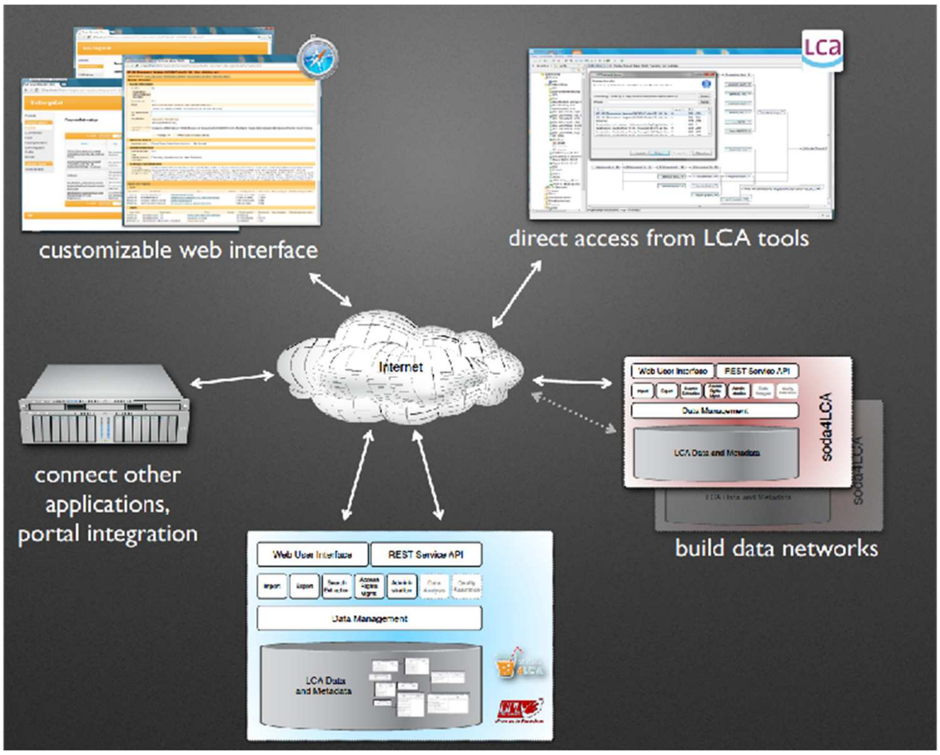

Figure 8 EF Database structure of Soda4LCA

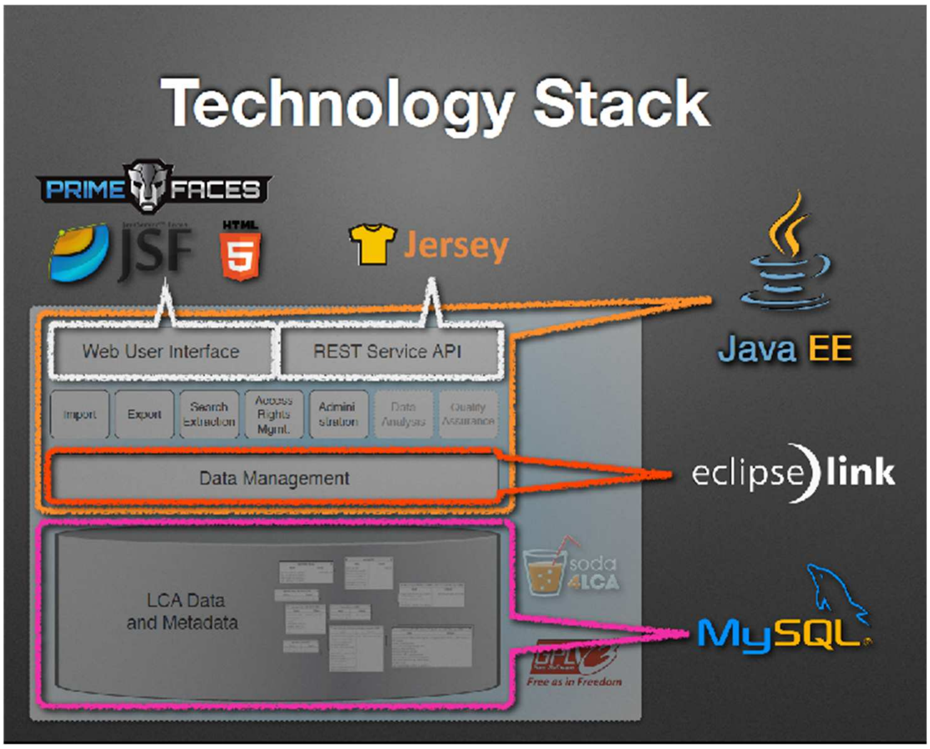

Figure 9 EF Database technology stock of Soda4LCA

In soda4LCA it is possible to import these formats:

- XML documents containing ILCD datasets
- ILCD ZIP archives containing ILCD datasets

These functionalities are useful to import EF from other DBs. Indeed, this kind of file is supported from several LCA software as OpeneLCA, SimaPro, Gabi.

To create the dataset in ILCD format you can use **ILCD editor (beta 11)**. It is a Java application, that can be used to develop and edit the dataset in ILCD format.

The editor for datasets can be downloaded to: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml. In the same page other tools and documents for the creation, editing and compliance validation of datasets are also available. Furthermore, is possible to export the single dataset and entire database as ILCD ZIP.

The developer kit is available at: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml. Additionally, the requirements available at: http://eplca.jrc.ec.europa.eu/uploads/QMS_H08_ENSURE_ILCD_GuidanceDocumentationLCADataSets_Version1-1Beta_2011_ISBN_clean.pdf shall be fulfilled.

A Gases covered, nomenclature and Characterization factors

Using the ILCD editor (beta 11) to implement the national EFs, the nomenclature will be in compliance with the OEFSR (EC, 2018). Moreover, using Soda4LCA as a database all emission factors are available only in elementary flows and they aren't characterized. These datasets can be imported in LCA software as OpenLCA, SimaPro, Gabi where it is possible to calculate the Climate Change using the CFs recommended by OEFRS.

In conclusion, each Clim'Foot EFs should be re-built with the ILCD editor, and then inserted in the Soda4LCA a database, to have a National EFs compliant with OEFSR.

It is important to highlight that using these actions to make the EF national DBs compliant with the OEFSR the datasets are reported only in elementary Flows. In order to have the results in CO_2eq, it is necessary to use the datasets developed in National DB to be compliant with GHG, too.

Data source

Regarding data source, actions to make the existing EF compliant with OEFSR for Climate Change calculation cannot be implemented when the data sets:

- do not have elementary flows and are expressed as a total CO_2eq
- consider the waste in product phase and end-of-life phases, such as some products (aluminium production, chemicals production, and so on).

However, the actions above suggested can be applied for the EF datasets that consider only the direct emissions, including the Elementary flows, which have a clear technical description and clearly define the system boundary (no infrastructures, no materials, no end of life). These datasets could be:

- National waste treatments,
- National fuels,
- National transports.

For these dataset's data quality should be implemented in agreement with the OEFSR (2018) data quality requirement. In this case, each dataset should be updated with TeR, GR, TiR and P/U values, considering Table 2 OEFSR (2018) and DQI should be recalculated. For further detail on OEFSR data quality requirement see Chapter 7.19 in OEFSR (EC, 2018)

Moreover, if new EFs, in scope 3, will be implemented in the EF national DBs in compliance with OEFRS, the suggestion is to use as data source an LCI inventory OEF compliant

The OEFSR (2018) proposes as compliant the datasets available on the following links:

- http://eplca.jrc.ec.europa.eu/EF
- http://lcdn.blonkconsultants.nl
- http://ecoinvent.lca-data.com
- http://lcdn-cepe.org
- https://lcdn.quantis-software.com/PEF/
- http://lcdn.thinkstep.com/Node

5. Conclusion

The establishment of a harmonised approach for calculation and reduction of the carbon footprint of organisation in non-ETS sectors is an important objective of the LIFE Clim'Foot project. Significant efforts have been done in order to establish a common methodology and standard databases with transferability and replicability potential requirements.

In the framework of the LIFE Clim'Foot project four national databases for Hungary, Croatia, Greece and Italy were created, while 156 EFs from the French database were adapted for purpose of harmonisation based on the developed methodology. For carbon footprint calculation of organisations, the Bilan Carbone® Clim'Foot tool, containing national EFs, was adapted to national needs and demands. In order to support the end-users in carbon footprint calculation 9 trainings were organized by the project partners. During the voluntary programmes, project partners provided technical supports to assist end-users in the different steps of the calculation or in using the platform.

In order to reach policy makers from partner countries, national technical committees have been established in partner countries. Furthermore, 17 policy makers took part in the dedicated workshop organized in the framework of the final conference. Policymakers from Belgium and Bosnia and Herzegovina commit themselves to consider the results of the Clim'Foot project to support the implementation of national public policies for calculating and reducing the carbon footprint of organisations that are outside the scope of the EU ETS. The letters of commitment represent an important goal in the process of developing a common approach for calculating the carbon footprint of an organisation with standardized databases in the EU and beyond.

The analysis on the transferability and usability potential of the National DBs for the Climate change impact category within the organisation environmental footprint methodology has been performed. The analysis show that the implementation of some National Clim'Foot dataset in OEFSR dataset compliant for Climate Change is possible, but time consuming. Indeed, the differences between the OEFSR and CFO approaches are significant, in term of aim, impact categories, GHG gases, characterization factors, data format and nomenclature. Nevertheless, several aspects were considered in the preparatory action such as the data quality requirement, that was performed analysing the OEF, but the further implementation of OEF have modified these aspects, so now if the compliance is requested, the data quality assessment of the datasets should be reviewed.

The modular structure of the toolbox and the accompanying informative materials, including the documents that summarise the lessons learnt, are the strengths of the project, as factors that increase the potential of replicability and transferability of the approach inside the consortium and in other European countries. The policy makers, indeed, after considering the strategy that better fits the national and local context, can select the tool most suitable to develop specific services for the organizations or to implement national legislation and/or reward measures for the reduction of CO_2 emissions.

Moreover, the involvement of stakeholders such as categories associations, national agencies or networks supported the dissemination of the project and helped in some EFs implementation. Finally, the integration with other projects or policy makers' initiatives has created synergies and promoted the use of Clim'Foot tools.

6. Literature

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7. Table of tables

8. Table of Figures

9. Abbreviations

ADEME	French Environment & Energy Management Agency
CF	Carbon Footprint
CFO	Carbon Footprint of Organisation
CRES	Centre for Renewable Energy Sources
DBs	Databases
EC	European Commission
EC	European Commission
EEA	European Environmental Agency
EFDB	Emission Factor Database
EFs	Emission Factors
EIHP	Energy Institute Hrvoje Požar
ELCD	European Life Cycle Database
EMEP	European Monitoring and Evaluation Programme
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
ETS	European Trading System
EU	European Union
FAO	Food and Agriculture Organisation
FU	Functional Unit
GeR	Geographical Representativeness
GHG	Greenhouse Gases
GWP	Global Warming Potentials
HOI	Herman Ottó Intitut
IES	Institute for European Studies
IFC	Institut de Formation Carbone
ILCD	International Reference Life Cycle Data System
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardization
ISPRA	Italian Institute for Environmental Protection and Research
JRC	Joint Research Centre
LCI	Life Cycle Inventory
LCT	Life Cycle Thinking
LULUCF	Land use, land-use change, and forestry
NIR	National Inventory Reports
OEF	Organisation Environmental Footprint
OEFSR	Organisation Environmental Footprint Sectorial Rule
PEF	Product Environmental Footprint
TeR	Technological Representativeness
TiR	Time Representativeness

10. Annex – Methodological aspects considered in the comparison

Methodological Consideration	Description and/or definition
Life Cycle Thinking? (Life Cycle Approach)	Life Cycle Thinking refers to taking into consideration the spectrum of resource flows and environmental interventions associated with a product, service, or organization from a supply chain perspective, including all phases from raw material acquisition through processing, distribution, use, and end-of-life processes. The life cycle thinking contributes to improved environmental management of business activities, including planning, procurement, and design, marketing & sales.
Communication Target Audiences	Intended users as individuals or organizations identified by those reporting as being reliant rely on that information to make decisions. [modified from ISO 14064]. NOTE: The intended user can be the client, the responsible party, programme administrators, regulators, the financial community or other affected stakeholders (such as local communities, government departments or non-governmental organizations) [modified from ISO 14064-1].
Functional Unit	The functional unit is the qualitative and quantitative aspects of the function(s) as related to the questions "what", "how much", "how well", and "for how long". The functional unit allows for making valid comparisons between products. Definition: Quantified performance of a product system for use as a reference unit [ISO 14044].
System Boundary	The system boundary determines which unit processes shall be included or excluded from the study. Normally, the system boundary of an LCA can include all activities from extraction of raw materials through processing, manufacturing, use, repair and maintenance processes as well as transport, waste treatment and other purchased services such as e.g. cleaning and legal services, marketing, production and decommissioning of capital goods, operation of premises such as retail, storage, administration offices, staff commuting, business travel, and end-of-life processes.
Cut Off	A cut off criterion is the specification of the amount of material or energy flow or the level of environmental significance associated

	with unit processes or product system to be excluded from a study. Cut-off criterion thus provides a clear basis for deciding on the inclusion or exclusion of processes in an analysis. It is generally a threshold on emissions or activity data which ensures that a sufficient part of these data has been included, as far as practical, for providing users with a picture of the environmental dimensions of the product considered. Cut-off rules are important to define an appropriate balance between result representativeness and data collection effort by users. Definition: Specification of the amount of material or energy flow or the level of environmental significance associated with unit processes or product systems to be excluded from a study [ISO 14044].
Covered Emissions / Impact Categories	Potential impacts to the natural environment, human health or the depletion of natural resources, caused by the interventions between the technosphere and the ecosphere that are considered in a given methodological standard. [ILCD] Definition: Class representing environmental issues of concern to which life cycle inventory analysis results may be assigned [ISO 14044]. output flows of all processes of a system as they occur. Modelling process along an existing supply-chain is of this type [ILCD]. Consequential modelling: modelling principle that identifies and models all processes in the background system of a system that may change in consequence of decisions made in the foreground system [ILCD]. Definition: the technical system is constructed using data on inputs and outputs. The flow model is typically illustrated with a flow chart that includes the activities that are going to be assessed in the relevant supply chain and gives a clear picture of the technical system boundaries. The input and output data needed for the construction of the model are collected for all activities within the system boundary, including from the supply chain (referred to as inputs from the technosphere).
Data Quality	Data quality is important to ensure the reliability of results. Definition: characteristics of data that relate to their ability to satisfy stated requirements [ISO 14044].

Allocation	The analysed system can produce more than analysed product therefore the analysis needs to partition this environmental load for each product. Definition: Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems [ISO 14044].
Fossil and Biogenic Carbon Emissions and Removals	There are two sources of carbon (dioxide) emissions: fossil and biogenic. Specific methods exist for accounting for both emissions and removals for each source. Fossil carbon is the carbon emission from non-renewable sources e.g. petroleum. Biogenic carbon is the carbon emission from renewable sources e.g.
Climate Change Factors	Climate change is a long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events with respect to an average, for example, greater or fewer extreme weather events. Climate change may be limited to a specific region or may occur across the whole Earth. In recent usage, especially in the context of environmental policy, climate change usually refers to changes in modern climate. It may be qualified as anthropogenic climate change, more generally known as global warming Definition: Global Warming Potential (GWP): A metric used to calculate the cumulative radiative forcing impact of multiple GHGs in a comparable way [WRI].
Emission Off-setting	The term “offset” is frequently used with reference to third-party greenhouse gas mitigation activities. Offsets are discrete GHG reductions used to compensate for (i.e. offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets. To avoid double counting, the reduction giving rise to the offset must occur at sources or sinks not included in the target or cap for which it is used. [WRI]
Review	An independent assessment of the reliability (considering completeness and accuracy) of an inventory and an impact

	assessment result [Adapted from WRI].
Elementary flows	All the gases emitted in the environment by the human activity described in the data set with the quantity related to the amount of activity considered.
Characterisation Factors	It is applied to convert an assigned elementary flow result to the common unit CO_{2eq}.
Nomenclature	Set of rules to name and classify data in a consistent and unique way.