CARBON FOOTPRINT DISCLOSURE REPORT OF FILMON® BX AND FILMON® CS

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For:

cfp flexible packaging | domo

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Quantis offers cutting-edge services in environmental footprinting (multiple indicators including carbon and water), eco design, sustainable supply chains and environmental communication. Quantis also provides innovative and customized IT tools, which enable organizations to evaluate, analyze and manage their environmental footprint with ease. Fueled by its close ties with the scientific community and its strategic research collaborations, Quantis has a strong track record in applying its knowledge and expertise to accompany clients in transforming LCA results into decisions and action plans. More information can be found at www.quantis-intl.com.

PROJECT INFORMATION	
Project title	Carbon Footprint disclosure report
Contracting organization	CFP Flexible packaging
Liability statement	Information contained in this report has been compiled from and/or computed from sources believed to be credible. Application of the data is strictly at the discretion and the responsibility of the reader. Quantis is not liable for any loss or damage arising from the use of the information in this document.
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ABBREVIATIONS AND ACRONYMS

CFP	Carbon Footprint
CO_2 eq	Carbon Dioxide equivalent
EOL	End of Life
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
kg	Kilogram = 1,000 grams (g) = 2.2 pounds (lbs)
km	Kilometer = 1000 meters (m)
kWh	Kilowatt-hour = 3,600,000 joules (j)
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
m^2	Square meter
m^3	Cubic meter
MJ	Megajoule = 1,000,000 joules, (948 Btu)
PA6	Nylon 6

1. Introduction

Cfp Flexible Packaging is a leading European PA6 film producer, part of DOMO Chemicals from 2014. Cfp Flexible Packaging is constantly monitoring its performances when it comes to safety, quality and environmental impact of its production. All these important aspects are managed with an Integrated Management System (QEHS) certified in conformity with standard norms. Cfp flexible packaging S.p.A., has engaged in an effort to understand the environmental impacts of their polyamide films FILMON® BX and FILMON CS®. To begin collecting this foundational knowledge, Cfp flexible packaging S.p.A. has commissioned Quantis to perform a Carbon footprint (CFP) of their FILMON® polyamide films. It is the intention that this CFP conforms to the International Organization for Standardization (ISO) 14067 (ISO, 2013), for public disclosure. This CFP disclosure report aims to have a CFP communication intended to be publicly available, for a non-comparative CFP external communication or CFP performance tracking report (ISO, 2013).

2. Goal of the study

This section describes the goal and scope of the study, along with the methodological framework of the carbon footprint. It includes the objectives of the study, a description of the product function and product system, the system boundaries, data sources, and methodological framework.

2.1. Objectives

This study evaluates the carbon footprint of two Cfp FILMON®polyamide film:

1. FILMON® BX
2. FILMON® CS

The specific goals of this study are as follows:

I. Characterize the overall GHG emissions of FILMON® BX and FILMON CS® produced by Cfp flexible packaging S.p.A. in Cesano Maderno (Italy).
II. Identity the GHG emissions and removals linked to the main life cycle stages of FILMON® BX and FILMON CS® and identify potential improvement opportunities.
III. Use those results to support communication and claims of sustainability information on FILMON® BX and FILMON CS® to a wide range of audiences, including consumers, retailers, governments, NGOs and others.

2.2. Intended audiences

The project report is intended to provide results in a clear and useful manner to inform Cfp flexible packaging S.p.A.'s communication of environmental performance to internal and external audiences such as partners, suppliers, customers, and the public. This CFP disclosure report aims to have a CFP communication intended to be publicly available, for a non-comparative CFP external communication or CFP performance tracking report (ISO, 2013).

2.3. Disclosures and declarations

Cfp flexible packaging S.p.A. seeks to evaluate and compare the GHG emissions associated to the life cycle of their polyamide films FILMON® BX and FILMON CS®. The report conforms to the ISO 14067 standard for a non-comparative CFP external communication or CFP performance tracking report as illustrated in Figure 1. Because the results of this study apply only to two particular product by Cfp flexible packaging, it is not expected to negatively affect any external interested parties. As stated in the ISO 14067 norm, CFP study shall not be used for a communication on overall environmental superiority of one product vs. another one. Comparison based on the CFPs of different products is only permitted if the calculation of CFPs of the products to be compared follows identical CFP quantification and communication requirements.The present study do not follow a specific CFP-PCR.

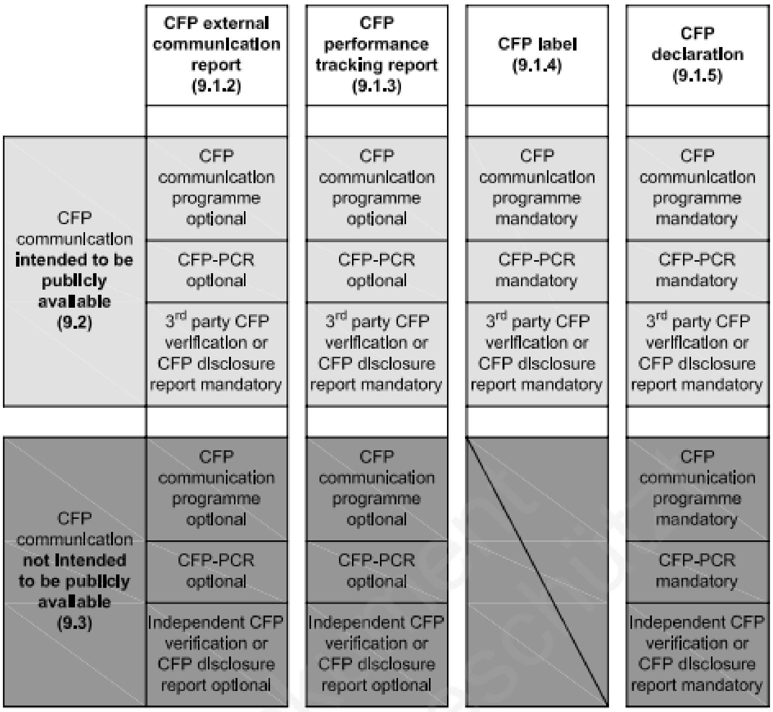

Figure 1 General requirements and guidelines for CFP communication options (ISO, 2013)

3. Scope of the study

This section describes the scope of the assessment. It includes a description of the products functions and products systems, the system boundaries, data sources, and methodological framework. Additional, specific data pertaining to each system can be found in Appendix A.

3.1. General description of the products studied

The products assessed in the studies are two Cfp FILMON® polyamide films produced by Cfp in Cesano Maderno (Italy):

1) FILMON® BX (biaxially oriented - BOPA)

FILMON® BX is a Biaxially Oriented polyamide films including one side corona treated materials. This product is commonly used in multi-layer structures for those applications requiring high puncture and flex-crack resistance and good aroma barrier. FILMON® BX is produced with an exclusive double bubble simultaneous stretching technology. This technology guarantees excellent balance in mechanical & physical properties resulting in high quality films (DOMO, 2018a).

2) FILMON® CS (CAST-PA)

FILMON® CS (PA-CAST) is a cast film product including one side corona treated materials. It offers an excellent thermoformabilty with a combination of mechanical, aroma/gas barrier and excellent brilliancy and transparency properties (DOMO, 2018b).

3.2. Functions and functional unit

The Carbon footprint method relies on a "functional unit" (FU) for comparison of alternative products that may substitute each other in fulfilling a certain function for the user or consumer. The FU describes this function in quantitative terms and serves as an anchor point of the comparison ensuring that the compared alternatives do indeed fulfil the same function. It is therefore critical that this parameter is clearly defined and measurable. The functional unit used for the assessment of both FILMON® BX and FILMON CS® is:

1kg of FILMON® *polyamide film.*

Other functions, such as barrier, transparency properties are not addressed in this study.

3.3. System boundaries

The system boundaries identify the life cycle stages, processes, and flows considered in the LCA and should include all activities relevant to attaining the above-mentioned study objectives. The following paragraphs present a general description of the system as well as temporal and geographical boundaries of this study.

3.3.1. General system description

This study assesses the life cycle of FILMON® BX and FILMON CS® from the extraction and processing of all raw materials through the end-of-life of all components, including primary and secondary packaging, as depicted in

.

Figure 2 Lifecycle of the FILMON® products evaluated in this study

The assessment considers all identifiable "upstream" activities to provide as comprehensive a view as possible of the product's cradle-to-grave life cycle. For example, when considering the environmental impact of transportation, not only are the emissions of the truck or ship considered, but also included are the impacts of additional processes and inputs needed to produce the fuel and the vehicle. In this way, the production chains of all inputs are traced back to the original extraction of raw materials. Capital goods are included wherever data was available. Capital goods are not included for distribution and retail. For the purposes of this analysis, the system was grouped into the following principal life cycle stages.

1) Raw materials production
2) Film Production
3) Packaging
4) Distribution
5) End-of-life

3.3.2. Temporal and geographic boundaries

This CFP is representative of FILMON® BX and FILMON CS® produced in Cesano Maderno (MB), Italy. The reference year of the study is 2017. Data and assumptions are intended to reflect current equipment, processes, and market conditions. It should be noted, however, that some processes within the system boundaries might take place anywhere or anytime. For example, the processes associated with the supply chain and with waste management can take place in Asia, North America or elsewhere in the world. In addition, certain processes may generate emissions over a longer period than the reference year. This applies to landfilling, which causes emissions (biogas and leachate) over a period of time whose length (several decades to over a century/millennium) depends on the design and operation parameters of the burial cells and how the emissions are modelled in the environment.

3.3.3. Cut-off criteria and exclusions

Processes may be excluded if their contributions to the total system's environmental impact are less than 1%. All product components and production processes are included when the necessary information is readily available or a reasonable estimate can be made. It should be noted that the capital equipment and infrastructure available in the Ecoinvent database (v3.3)(Weidema B P, Bauer C, Hischier R, Mutel C, Nemecek T, Reinhard J, Vadenbo C O, 2012) is included in the background data for this study in order to be as comprehensive as possible.

The use stage is excluded from the study due to the uncertainty related to the multiple possible applications of the products assessed.

Moreover, the following processes were left out of the system boundaries, in conformity to usual practices in carbon footprinting: labor, commuting of workers and administrative work.

4. Approach

4.1. Life cycle inventory

The quality of LCA results are dependent on the quality of data used in the evaluation. Every effort has been made for this investigation to implement the most credible and representative information available.

4.1.1. Primary and secondary data

Life cycle inventory (LCI) data collection mainly concerns the materials used, the energy consumed and the wastes and emissions generated by each process included in the system boundaries. Primary data have been collected directly from Cfp flexible packaging for the film production process, PA6 production, primary and secondary packaging materials as well as data related to transportation distances, modes, and waste generated at the plant. Additional information describing the remaining aspects of the life cycle was collected from the *Ecoinvent* database v3.3 in the cut-off by classification allocation model (Weidema et al. 2013). Ecoinvent is recognized as one of the most complete background LCI databases available, from a quantitative (number of included processes) and a qualitative (quality of the validation processes, data completeness, etc.) perspective. A full list of data sources is available in Appendix A.

4.1.2. Raw material production

Carbon footprint on PA6 granulate production was provided by Cfp flexible packaging and is taken from a study realized by Domo on DOMAMID® H27S, a polymer used for textile. The use of primary data for the production of the main raw material allows a higher accuracy on the environmental impact arising by the use of the raw material. A limitation is that the study realized by Domo using *GaBi* database, which is based on a methodological approach slightly different from that of the *Ecoinvent*, the database used in the rest of the study. A comparison of the GHG emission from PA6 production using different datasets is presented in the sensitivity analysis.

4.1.3. Film production

Primary data for film production were provided by CFP flexible packaging detailing:

- Material consumption
- Energy and water consumption
- Refrigerant gases

- Packaging material consumption
- Other material consumption
- Waste production

Full details on the data regarding the film production state are available in the Appendix A.

4.1.4. Packaging

Primary data regarding packaging material consumption and type of packaging were provided by CFP flexible packaging. Packaging was assumed similar for the two products under assessment. Table 1 summarizes the type and quantity of packaging material per FU.

Table 1 Packaging material and quantities used in this study.

Packaging type	Quantity [g/kg_{FU}]
Wood	71.63
Corrugated board	17.55
Plastic	5.96
Paper	0.04
Plastic pellet	1.08
Iron	0.04

4.1.5. Distribution

Data on distribution were derived from the turnover (in kg) per country of the two products were provided by Cfp flexible packaging. The average distribution distances are presented in Table 2. Detailed data regarding transportation distances are provided in Appendix A.

Table 2: Average transport distances used in this study

Product	Average transportation distance by truck [km]	Average transport distance by ship [km]
FILMON® BX	862	754
FILMON CS®	827	893

4.1.6. End-of-life

The so-called circular footprint formula (CFF), developed by the European Commission(Manfredi et al., 2012), is used in this study to account of the GHG emissions arising from the end-of-life stage.

The circular footprint formula takes into account the state of the market for recovered material and balances accordingly the credit in part to the user of the recycled material and in part to the provider of the recyclable material.

Error! Reference source not found. Figure 3 presents the circular footprint formula with its three distinct components: material (production and recycling), energy (recovery) and disposal, which add-up to the total impacts of a given material. **Error! Reference source not found.** details the notation used in the formula.

The two parameters in the formula are:

- A: Allocation factor of burdens and credits between supplier and user of recycled materials. This is a key parameter that enables a refined tuning between 100/0 and 0/100.If A is large (e.g., 0.8), the credits are mostly given to the system that uses recycled (secondary) material. Conversely, a small A (e.g., 0.2) will mostly give credits to the system providing recyclable material for use in the next system.
- B: Allocation factor of burdens and credits between supplier and user of energy recovery processes. Currently set to 0 by default, so full impacts and credits are allocated to the system generating the waste. This implies that the use of electricity and heat from MSWI plants is "free of charge". This could be changed if it was decided for policy reasons.

These factors are material- and application-specific.

Material

$$(1-R_1)E_V + R_1 \times \left(AE_{recycled} + (1-A)E_V \times \frac{Q_{Sin}}{Qp}\right) + (1-A)R_2 \times \left(E_{recyclingEoL} - E_V^* \times \frac{Q_{Sout}}{Q_P}\right)$$

Energy +

$$(1-B)R_3 \times (E_{ER} - LHV \times X_{ER,heat} \times E_{SE,heat} - LHV \times X_{ER,elec} \times E_{SE,elec})$$

Disposal +

$$(1-R_2-R_3) \times E_D$$

Figure 3: Circular Footprint Formula

Table 3: Notation used in the Circular footprint formula

Parameter	
A	Allocation factor of burdens and credits between supplier and user of recycled materials.
B	Allocation factor of energy recovery processes: it applies both to burdens and credits.
Q_{Sin}	Quality of the secondary material used as input
Q_{Sout}	Quality of the recycled material outgoing the system at the point of substitution.
Q_P	Quality of the primary material, i.e. quality of the virgin material.
R_1	Proportion of secondary material in the input
R_2	Proportion of the material in the product that will be recycled (or reused) in a subsequent system. R2 shall therefore take into account the inefficiencies in the collection and recycling (or reuse) processes. R2 shall be measured at the output of the recycling plant.
R_3	Proportion of the material in the product that is used for energy recovery at EoL.
$E_{recycled}$	Specific emissions and resources consumed arising from the recycling process of the recycled (reused) material, including collection, sorting and transportation process.

$E_{recyclingEoL}$	Specific emissions and resources consumed arising from the recycling process at EoL, including collection, sorting and transportation process.
E_v	Specific emissions and resources consumed arising from the acquisition and pre-processing of virgin material.
E_v^*	Specific emissions and resources consumed arising from the acquisition and pre-processing of virgin material assumed to be substituted by recyclable materials.
E_{ER}	Specific emissions and resources consumed arising from the energy recovery process (e.g., incineration with energy recovery, landfill with energy recovery, ...).
$E_{SE,heat}$ $E_{SE,elec}$	Specific emissions and resources consumed that would have arisen from the specific substituted energy source, heat[1] and electricity[2] respectively.
ED	Specific emissions and resources consumed arising from disposal of waste material at the EoL of the analysed product, without energy recovery.
$X_{ER, elec}$ $X_{ER,heat}$	Efficiency of the energy recovery process for heat and electricity respectively.
LHV	Lower Heating Value of the material in the product that is used for energy recovery.

Average parameters disposal provided by the European Commission for PA6 in UE28 in the context of the Product Environmental Footprint (PEF) initiative was used in this study and are presented in Table 4.

Table 4: Parameters used for the CFF formula. Default values taken from (European Commission, 2014)

Parameter	Value
A	50%
R1	0%
R2	0%
R3	45%

4.1.7. Treatment of electricity

Specific primary data were supplied by Cfp regarding electricity consumption at the film production stage detailing electricity consumptions and the grid mix used. Table 5, presents the grid mix electricity used in the study for the film production stage. For the other process included in the system boundaries, secondary data taken from Ecoinvent (Weidema B P, Bauer C, Hischier R, Mutel C, Nemecek T, Reinhard J, Vadenbo C O, 2012) were used.

Table 5 Electricity mix used by CFP in their site in Cesano Maderno

Electricity source	Percentage of the electricity mix used at the production plant [%]
Natural gas	48%
Renewables	25%
Coal	18%
Nuclear	4%

[1] By default for screenings, the substituted heat is «heat, light fuel oil, at boiler 10kW, non-modulating, CH, [MJ]». For more detailed LCAs, please refer to the heating mix in the General Assumptions Guidelines.
[2] By default for screenings, the substituted electricity mix is the European one, medium voltage.

Other	5%

4.1.8. Key assumptions

The following key assumptions are made in the model for the studied products:

- Data on PA6 granulate production are from the study realized by Domo on DOMAMID® H27S, a polymer used for textile. FILMON® BX and FILMON® CS are actually made of *H33F* and *H36F*, characterized by a different grade of viscosity compared to *H27S* but with similar consumptions in terms of energy and raw material.

Other assumptions are based on the professional judgment of the modelers and have been held constant for all products under study where a clear basis does not exist to differentiate among systems. All data sources and assumptions are documented in Appendix A.

4.1.9. Allocation methodology

A common methodological decision point occurs when the system being studied is directly connected to a past or future system, or produces co-products. When systems are linked in this manner, the boundaries of the system of interest must be widened to include the adjoining system, or the impacts of the linking items must be distributed—or allocated—across the systems. While there is no clear scientific consensus regarding an optimal method for handling this in all cases (Reap et al. 2008), many possible approaches have been developed, and each may have a greater level of appropriateness in certain circumstances.

ISO 14067 prioritizes the methodologies related to applying allocation. It is best to avoid allocation through system subdivision or expansion. If that is not possible, then one should perform allocation using an underlying physical relationship. If using a physical relationship is not possible or does not makes sense, then one can use another relationship. In film production stage a co-product is produced together with the main film product. Allocation has been performed using a mass-based relationship. In the sensitivity analysis the adopted allocation key is compared with an economic-based allocation key.

4.2. Impact assessment method

In the LCIA phase of a CFP study, the potential climate change impact of each GHG emitted and removed by the product system were calculated by multiplying the mass of GHG released or removed by the 100-year GWP given by the IPCC in units of "kg CO_{2e} per kg emission". Therefore, the CFP of the product under assessment is the sum of these calculated impacts. In compliance of the ISO 14067 norm, the latest GWP values provided by IPCC are used (IPCC, 2015).

4.3. Calculation tool

SimaPro software, developed by PRé Consultants (www.pre.nl) was used to assist the LCA modelling and link the reference flows with the LCI database and link the LCI flows to the relevant GWP factors. The final LCI result was calculated combining foreground data (intermediate products and elementary flows) with generic datasets providing cradle-to-gate background elementary flows to create a complete inventory of the studied system.

4.4. Contribution analysis

In compliance of the ISO 14067 norm, a contribution analysis is performed to determine the extent to which each process modelled contributes to the overall impact of the systems under study. Lower quality data may be suitable in the case of a process whose contribution is minimal. Similarly, processes with a great influence on the study results should be characterized by high-quality information. In this study, the contribution analysis is a simple observation of the relative importance of the different processes to the overall potential impact.

4.5. Scenarios for sensitivity analyses

The parameters, methodological choices and assumptions used when modelling the systems present a certain degree of uncertainty and variability. It is important to evaluate whether the choice of parameters, methods, and assumptions significantly influences the study's conclusions and to what extent the findings are dependent upon certain sets of conditions. Following the ISO 14067 standard, a series of sensitivity analyses are used to study the influence of the uncertainty and variability of modelling assumptions and data on the results and conclusions, thereby evaluating their robustness and reliability. Sensitivity analyses help in the interpretation phase to understand the uncertainty of results and identify limitations. The following parameters and choices are varied to test the sensitivity of the results and conclusions:

- Electricity mix for the film production stage
- Dataset for PA6 production
- Co product allocation in the film production stage

These are explained in more detail in section 5.3.

5. Results

5.1. Carbon footprint of FILMON® BX

The total carbon footprint of the FILMON® BX is estimated to be **11.2 kg $CO_{2\text{-eq}}$/kg.**

5.1.1. Contribution analysis of FILMON® BX

In the contribution analysis, the total CFP of the FILMON® BX is divided into the main product's life cycle stages to understand the contribution of each life cycle stage. The results are presented in Figure 4. The life cycle stage with the highest burden is the production of the raw material, specifically the PA6 production. It accounts for approximately 77% of the total impacts. Film production and end-of-life accounts for approximately 15% and 7% of the total footprint respectively. Packaging and distribution have negligible contribution on the overall CFP.

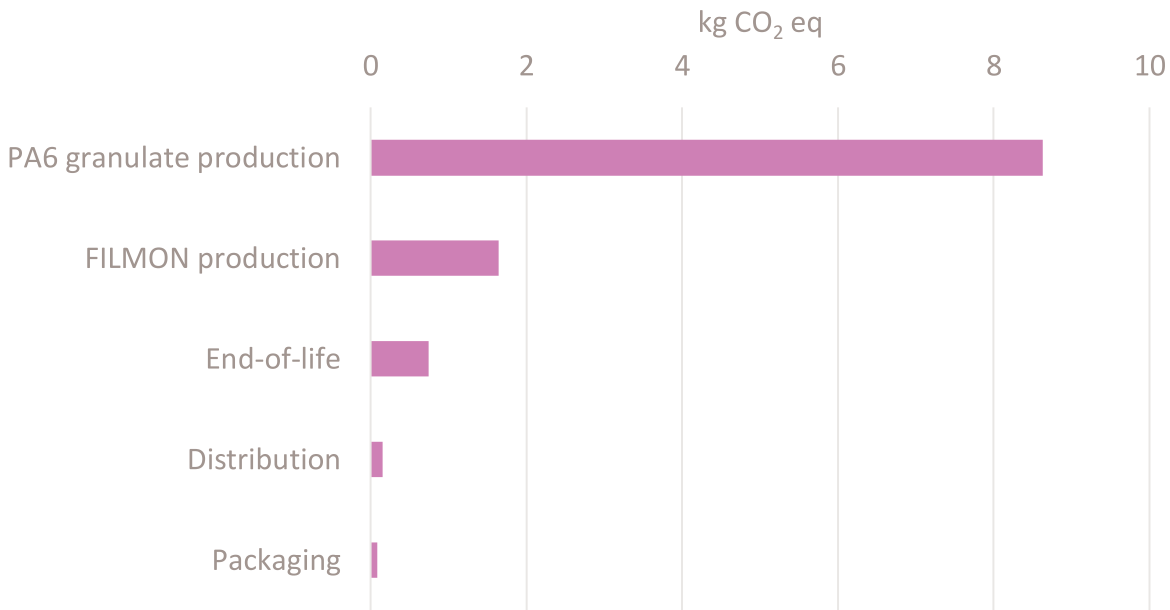

Figure 4 Contribution analysis for FILMON BX.

5.2. Carbon footprint of FILMON CS®

The total carbon footprint of the FILMON® BX is estimated to be **10.4 kg $CO_{2\text{-eq}}$/kg.**

5.2.1. Contribution analysis of FILMON® CS

In the contribution analysis, the total CFP of the FILMON® CS is divided into the main product's life cycle stages to understand the contribution of each life cycle stage. The results are presented in Figure 5. The life cycle stage with the highest burden is the production of the raw material, specifically the PA6 production. It accounts for approximately 83% of the total impacts. Film production and end-of-life accounts for approximately 8% and 7% of the total footprint respectively. Packaging and distribution have negligible contribution on the overall CFP.

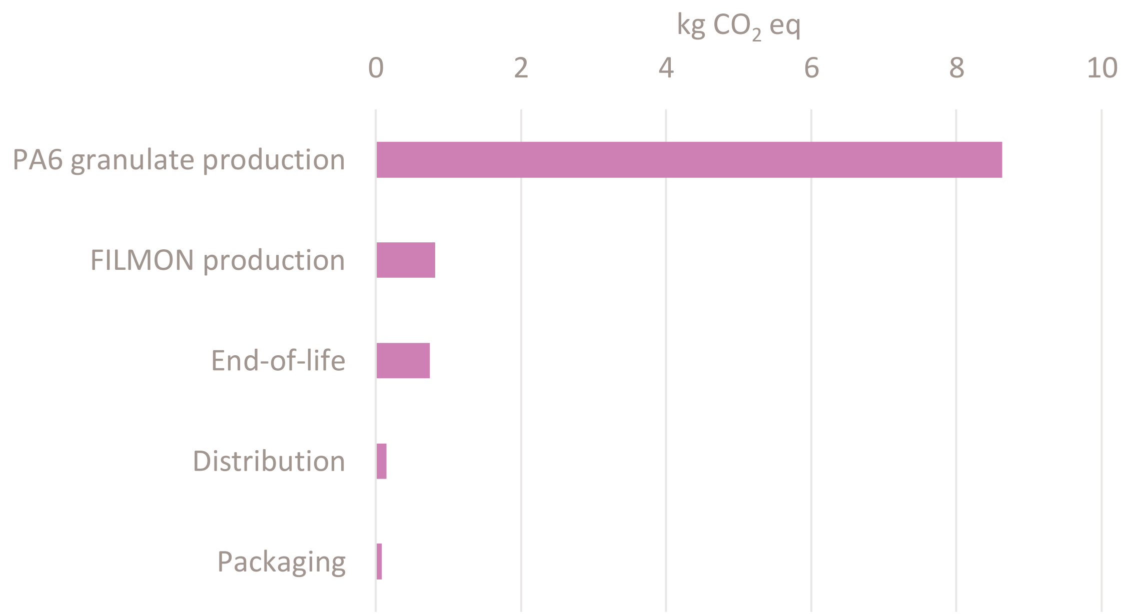

Figure 5 Contribution analysis of FILMON CS

5.3. Sensitivity analysis

Following the ISO 14067 standard, a series of sensitivity analyses is used to study the influence of the uncertainty and variability of modelling assumptions and data on the results and conclusions, thereby evaluating their robustness and reliability. Sensitivity analyses help in the interpretation phase to understand the uncertainty of results and identify limitations. The following parameters and choices are varied to test the sensitivity of the results:

- Electricity mix for the film production stage
- Dataset for PA6 production
- Co product allocation in the film production stage

5.3.1. Electricity mix for the film production stage

In this section, the results of the sensitivity analysis connected to the electricity utilization at the factory level are presented. The alternative scenarios tested are:

- The current electricity mix used at the Cfp flexible products factory
- The average Italian electricity mix
- Use of photovoltaic energy (e.g. installation of solar panel on the factory roof)

The results are presented in Figure 6. The electricity mix currently used by CFP has a higher footprint of 6% and 86% compared to the average Italian electricity mix and renewable energy sources respectively.

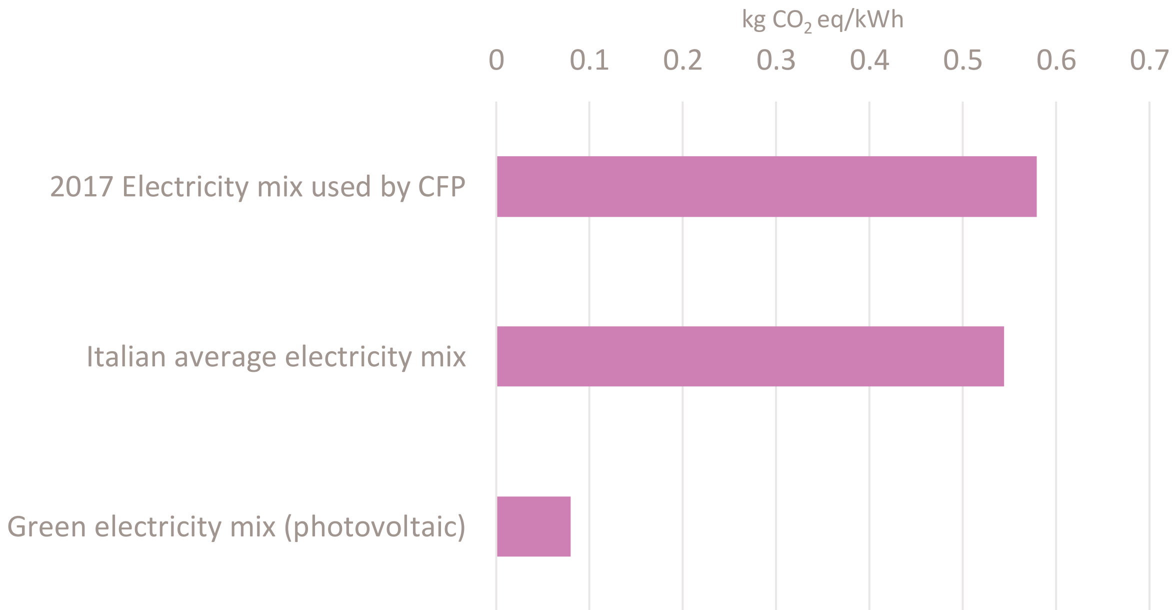

Figure 6 Sensitivity analysis of the electricity mix used in the film production stage.

5.3.2. Dataset for PA6 production

In this section the results of the sensitivity analysis connected to the dataset used to calculate the GHG emission of the PA6 are presented. The alternative scenario tested:

- The PA6 dataset provided by DOMO
- The EcoInvent process from PA6 production

The results are presented in Figure 7. The use of the Ecoinvent dataset leads to a higher estimation of the GHG emission for PA6 production of 16%.

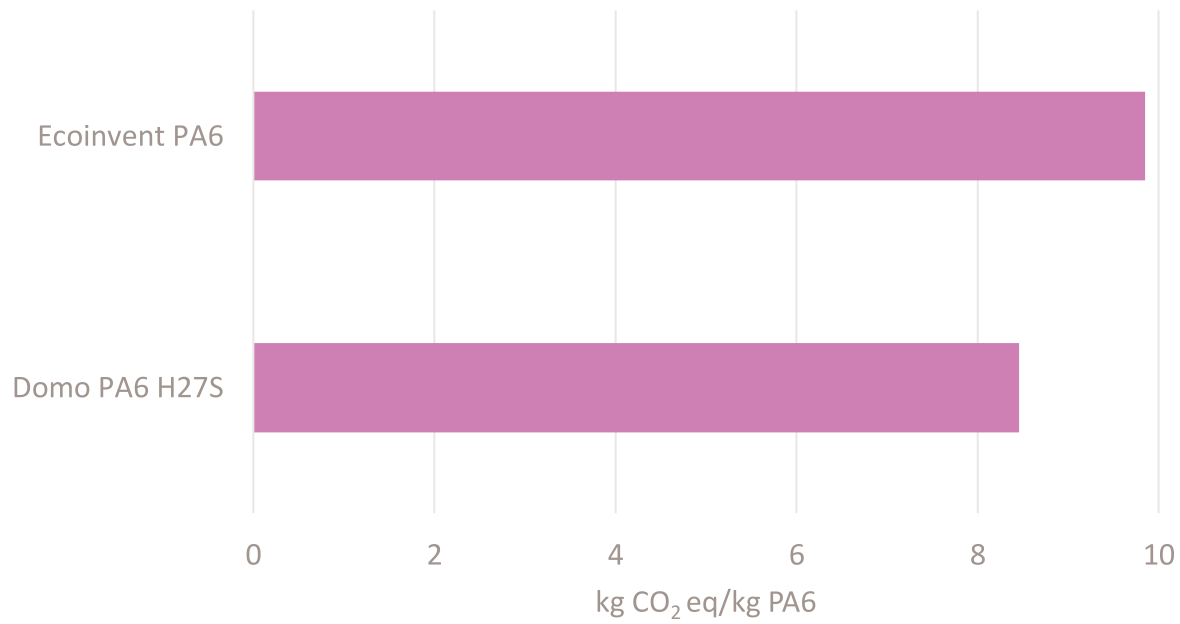

Figure 7 Sensitivity analysis of the LCI dataset for the raw materials.

5.3.3. Co product allocation in the film production stage

In this section the results of the sensitivity analysis connected to the co-product allocation in the film production stage. The alternative scenario tested for the production of 1kg of FILMON:

- Mass-based allocation
- Economic based allocation

The results are presented in Figure 8. The use of economic allocation leads to a higher estimation of the GHG emission of approximately 11% for both scenarios.

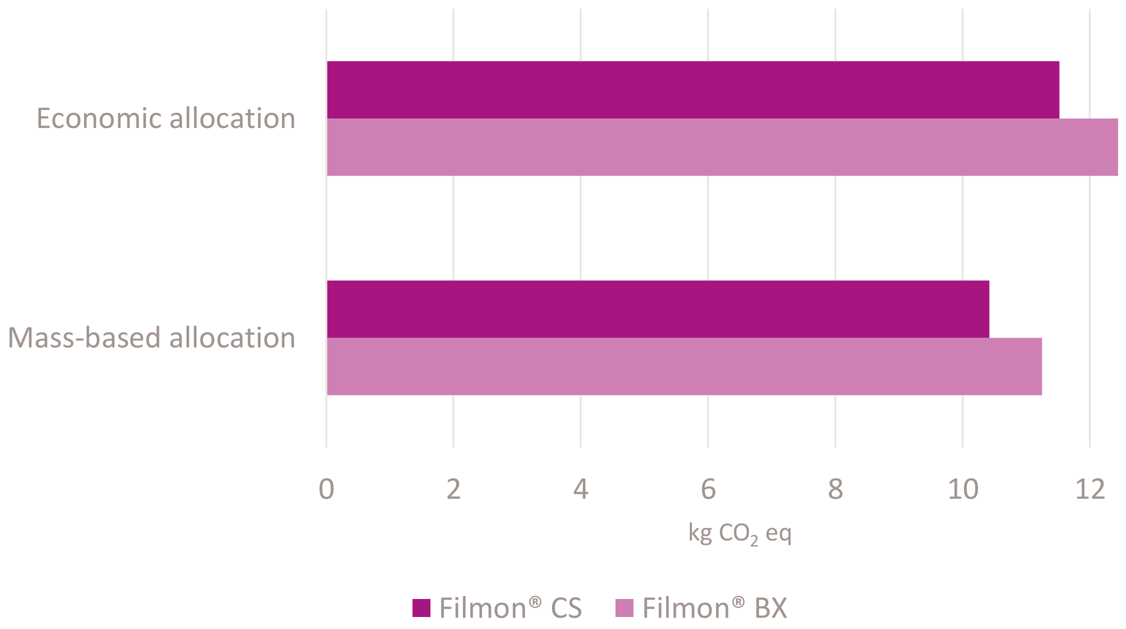

Figure 8 Sensitivity analysis co-products allocation method.

6. Conclusion and limitations

6.1. Conclusions

The carbon footprint study of the FILMON® BX and FILMON® CS has identified the PA6 granulate production as the largest contributor to GHG emission representing about 77% of the total FILMON® BX emissions and 82% FILMON® CS emissions.

The manufacturing stage at Cesano Maderno plant accounts for 16% in the case of FILMON® BX and 8% in the case of FILMON® CS. The difference is mainly connected to the low processing needs of FILMON® CS compared to FILMON® BX.

The electricity consumption has been identified as the main source of impacts of the manufacturing stage.

6.2. Limitation

- The study should not be used for comparative assessment with other product
- The study should not be used to compare the two products studied since the function is different

7. References

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8. Appendices

Appendix A – List of emission factors

Substance	GHG Factor [kg CO_2 eq/kg]
(E)-1-Chloro-3,3,3-trifluoroprop-1-ene	2
(E)-1,2,3,3,3-Pentafluoroprop-1-ene	0.0961
(Perfluorobutyl)ethylene	1
(Perfluoroctyl)ethylene	0.398
(Perfluorohexyl)ethylene	0.131
(Z)-1,1,1,4,4,4-Hexafluorobut-2-ene	2
(Z)-1,2,3,3,3-Pentafluoroprop-1-ene	0.284
(Z)-1,3,3,3-Tetrafluoroprop-1-ene	0.347
1-Propanol, 3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, HFE-7100	509
1-Propanol, i-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, i-HFE-7100	492
1-Propanol, n-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, n-HFE-7100	587
1-Undecanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-nonadecafluoro-	0.113
1,1,1,3,3,3-Hexafluoropropan-2-ol	221
1,2,2-Trichloro-1,1-difluoroethane	72
2,3,3,3-Tetrafluoropropene	0.429
Acetate, 1,1-difluoroethyl 2,2,2-trifluoro-	38
Acetate, 2,2,2-trifluoroethyl 2,2,2-trifluoro-	8
Acetate, difluoromethyl 2,2,2-trifluoro-	33
Acetate, methyl 2,2-difluoro-	4
Acetate, methyl 2,2,2-trifluoro-	64
Acetate, perfluorobutyl-	2
Acetate, perfluoroethyl-	3
Acetate, perfluoropropyl-	2
Butane, 1,1,1,2,2,3,3,4,4-nonafluoro-, HFC-329p	2740
Butane, 1,1,1,3,3-pentafluoro-, HFC-365mfc	966
Butane, perfluoro-	10200
Butane, perfluorocyclo-, PFC-318	10600
Butanol, 2,2,3,3,4,4,4-heptafluoro-	41
Butanol, 2,2,3,3,4,4,4-heptafluoro-1-	20
Butanol, 2,2,3,4,4,4-hexafluoro-1-	21
Carbon dioxide	1
Carbon dioxide, biogenic	0
Carbon dioxide, fossil	1
Carbon dioxide, land transformation	1

Carbon monoxide	1.57
Carbon monoxide, biogenic	0
Carbon monoxide, fossil	1.57
Carbon monoxide, land transformation	1.57
Chloroform	20
Cis-perfluorodecalin	8030
Decane, 1,1,...,15,15-eicosafluoro-2,5,8,11,14-Pentaoxapenta-	4240
Decane, 1,1,3,3,4,4,6,6,7,7,9,9,10,10,12,12-hexadecafluoro-2,5,8,11-tetraoxado-	5250
Decane, 1,1,3,3,5,5,7,7,8,8,10,10-dodecafluoro-2,4,6,9-tetraoxa-	4630
Decane, 1,1,3,3,5,5,7,7,9,9-decafluoro-2,4,6,8-tetraoxanonane-	8580
Dinitrogen monoxide	298
EPTE-furan	68
Ethane, 1-(difluoromethoxy)-1,1,2,2-tetrafluoro-	4990
Ethane, 1-chloro-1,1-difluoro-, HCFC-142b	2350
Ethane, 1-chloro-2,2,2-trifluoro-(difluoromethoxy)-, HCFE-235da2	595
Ethane, 1-ethoxy-1,1,2,2,2-pentafluoro-	71
Ethane, 1,1'-oxybis[2-(difluoromethoxy)-1,1,2,2-tetrafluoro-	5740
Ethane, 1,1-dichloro-1-fluoro-, HCFC-141b	938
Ethane, 1,1-dichloro-1,2-difluoro-, HCFC-132c	409
Ethane, 1,1-difluoro-, HFC-152a	167
Ethane, 1,1,1-trichloro-, HCFC-140	193
Ethane, 1,1,1-trifluoro-, HFC-143a	5510
Ethane, 1,1,1-trifluoro-2-bromo-	210
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	1550
Ethane, 1,1,1,2-tetrafluoro-2-bromo-, Halon 2401	223
Ethane, 1,1,2-trichloro-1,2-difluoro-, HCFC-122a	312
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	6590
Ethane, 1,1,2-trifluoro-, HFC-143	397
Ethane, 1,1,2,2-tetrafluoro-, HFC-134	1340
Ethane, 1,1,2,2-tetrafluoro-1-(fluoromethoxy)-	1050
Ethane, 1,1,2,2-tetrafluoro-1,2-dimethoxy-	269
Ethane, 1,2-dibromotetrafluoro-, Halon 2402	1730
Ethane, 1,2-dichloro-	1
Ethane, 1,2-dichloro-1,1,2-trifluoro-, HCFC-123a	447
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	9620
Ethane, 1,2-difluoro-, HFC-152	20
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	635
Ethane, 2-chloro-1,1,2-trifluoro-1-methoxy-	149
Ethane, 2,2-dichloro-1,1,1-trifluoro-, HCFC-123	96
Ethane, chloropentafluoro-, CFC-115	8520
Ethane, fluoro-, HFC-161	4

Ethane, hexafluoro-, HFC-116	12300
Ethane, pentafluoro-, HFC-125	3690
Ethanol, 2-fluoro-	1
Ethanol, 2,2-difluoro-	4
Ethanol, 2,2,2-trifluoro-	24
Ethene, 1,1-difluoro-, HFC-1132a	0.0516
Ethene, 1,1,2-trifluoro-2-(trifluoromethoxy)-	0.255
Ether, 1,1,1-trifluoromethyl methyl-, HFE-143a	632
Ether, 1,1,2,2-Tetrafluoroethyl 2,2,2-trifluoroethyl-, HFE-347mcc3	641
Ether, 1,1,2,2-Tetrafluoroethyl 2,2,2-trifluoroethyl-, HFE-347mcf2	1030
Ether, 1,1,2,2-Tetrafluoroethyl 2,2,2-trifluoroethyl-, HFE-347pcf2	1070
Ether, 1,1,2,2-Tetrafluoroethyl methyl-, HFE-254cb2	365
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356mec3	468
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356pcc3	500
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356pcf2	867
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356pcf3	540
Ether, 1,2,2-trifluoroethyl trifluoromethyl-, HFE-236ea2	1490
Ether, 1,2,2-trifluoroethyl trifluoromethyl-, HFE-236fa	1180
Ether, 2-chloro-1,1,2-trifluoroethyl difluoromethyl-, HCFE-235ca2 (enflurane)	705
Ether, bis(2,2,2-trifluoroethyl)-	20
Ether, di(difluoromethyl), HFE-134	6510
Ether, difluoromethyl 1,2,2,2-tetrafluoroethyl-, HFE-236ea2 (desflurane)	2140
Ether, difluoromethyl 2,2,2-trifluoroethyl-, HFE-245cb2	790
Ether, difluoromethyl 2,2,2-trifluoroethyl-, HFE-245fa1	997
Ether, difluoromethyl 2,2,2-trifluoroethyl-, HFE-245fa2	981
Ether, ethyl 1,1,2,2-tetrafluoroethyl-, HFE-374pc2	758
Ether, ethyl trifluoromethyl-, HFE-263m1	36
Ether, i-nonafluorobutane ethyl-, HFE569sf2 (i-HFE-7200)	54
Ether, n-nonafluorobutane ethyl-, HFE569sf2 (n-HFE-7200)	79
Ether, nonafluorobutane ethyl-, HFE569sf2 (HFE-7200)	69
Ether, pentafluoromethyl-, HFE-125	14000
Fluoridate, 1,1-difluoroethyl carbono-	33
Fluoridate, methyl carbono-	116
Fluoroxene	0.066
Formate, 1,1,1,3,3,3-hexafluoropropan-2-yl-	403
Formate, 1,2,2,2-tetrafluoroethyl-	569
Formate, 2,2,2-trifluoroethyl-	41
Formate, 3,3,3-trifluoropropyl-	21
Formate, perfluorobutyl-	475
Formate, perfluoroethyl-	703
Formate, perfluoropropyl-	456
Halothane	50

Heptanol, 3,3,4,4,5,5,6,6,7,7,7-undecafluoro-	0.166
Hexane, perfluoro-	8780
HFE-227EA	7380
HFE-236ca12 (HG-10)	6260
HFE-263fb2	2
HFE-329mcc2	3600
HFE-338mcf2	1120
HFE-338pcc13 (HG-01)	3470
HFE-43-10pccc124 (H-Galden1040x)	3350
HG-02	3250
HG-03	3400
Methane	34
Methane, (difluoromethoxy)((difluoromethoxy)difluoromethoxy)difluoro-	6200
Methane, biogenic	34
Methane, bromo-, Halon 1001	3
Methane, bromochlorodifluoro-, Halon 1211	2070
Methane, bromodifluoro-, Halon 1201	454
Methane, bromotrifluoro-, Halon 1301	7150
Methane, chlorodifluoro-, HCFC-22	2110
Methane, chlorotrifluoro-, CFC-13	15500
Methane, dibromo-	1
Methane, dibromodifluoro-, Halon 1202	280
Methane, dichloro-, HCC-30	11
Methane, dichlorodifluoro-, CFC-12	11500
Methane, dichlorofluoro-, HCFC-21	179
Methane, difluoro-, HFC-32	817
Methane, difluoro(fluoromethoxy)-	748
Methane, difluoro(methoxy)-	175
Methane, fluoro-, HFC-41	141
Methane, fluoro(fluoromethoxy)-	159
Methane, fluoro(methoxy)-	15
Methane, fossil	36.8
Methane, iodotrifluoro-	909
Methane, land transformation	36.8
Methane, monochloro-, R-40	15
Methane, tetrachloro-, CFC-10	2020
Methane, tetrafluoro-, CFC-14	7350
Methane, trichlorofluoro-, CFC-11	5350
Methane, trifluoro-, HFC-23	13900
Methyl acetate	3
Methyl formate	712
Methyl perfluoroisopropyl ether	440

Nitrogen fluoride	17900
Nonanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-pentadecafluoro-	0.229
Octa deca fluoro octane	8460
Pentafluorobutene-1	0.154
Pentane, 2,3-dihydroperfluoro-, HFC-4310mee	1950
Pentane, perfluoro-	9480
Pentanol, 2,2,3,3,4,4,5,5-octafluorocyclo-	16
Pentanone, 1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-	0.121
Perfluorobut-1-ene	0.111
Perfluorobut-2-ene	2
Perfluorobuta-1,3-diene	0.00435
Perfluorocyclopentene	2
Perfluorodecalin (trans)	6980
Perfluoroheptane	8680
Perfluoropropene	0.0853
PFC-9-1-18	7980
PFPMIE	10800
Propanal, 3,3,3-trifluoro-	0.0131
Propane, 1-ethoxy-1,1,2,2,3,3,3-heptafluoro	74
Propane, 1-ethoxy-1,1,2,3,3,3-hexafluoro-	28
Propane, 1,1,1-trifluoro-, HFC-263fb	92
Propane, 1,1,1,2,2-pentafluoro-, HFC-245cb	5300
Propane, 1,1,1,2,2,3-hexafluoro-, HFC-236cb	1440
Propane, 1,1,1,2,2,3,3-heptafluoro-, HFC-227ca	3080
Propane, 1,1,1,2,2,3,3-heptafluoro-3-(1,2,2,2-tetrafluoroethoxy)-	7370
Propane, 1,1,1,2,3-pentafluoro-, HFC-245eb	352
Propane, 1,1,1,2,3,3-hexafluoro-, HFC-236ea	1600
Propane, 1,1,1,2,3,3,3-heptafluoro-, HFC-227ea	3860
Propane, 1,1,1,3,3-pentafluoro-, HFC-245fa	1030
Propane, 1,1,1,3,3,3-hexafluoro-, HCFC-236fa	9000
Propane, 1,1,1,3,3,3-Hexafluoro-2-(difluoromethoxy)	3080
Propane, 1,1,1,3,3,3-hexafluoro-2-(fluoromethoxy)-	262
Propane, 1,1,1,3,3,3-hexafluoro-2-methoxy-(9CI)	17
Propane, 1,1,2,2-tetrafluoro-3-methoxy-	1
Propane, 1,1,2,2,3-pentafluoro-, HFC-245ca	863
Propane, 1,1,2,3,3-pentafluoro-, HFC-245ea	285
Propane, 1,3-dichloro-1,1,2,2,3-pentafluoro-, HCFC-225cb	633
Propane, 2,2-difluoro-, HFC-272ca	175
Propane, 3,3-dichloro-1,1,1,2,2-pentafluoro-, HCFC-225ca	155
Propane, perfluoro-	9880
Propane, perfluorocyclo-	10200
Propanol, 2,2,3,3-tetrafluoro-1-	16

Propanol, 3,3,3-trifluoro-1-	0.474
Propanol, pentafluoro-1-	23
Sulfur hexafluoride	26100
Tetrafluoroethylene	0.00353
trans-1,3,3,3-Tetrafluoropropene	1
Trifluorobutanol	0.023
Trifluoroethyl acetate	2
Trifluoromethylsulfur pentafluoride	19400
Trifluoropropene, HFC-1243zf	0.181
Vinylfluoride	0.0207
VOC, volatile organic compounds	4.23
Carbon dioxide, biogenic	0
Carbon dioxide, in air	0
Carbon dioxide, in air, biogenic (100yr)	-1
Carbon dioxide, land transformation	-1

Appendix B – Confidential data (if any)