



## **Carbon footprint for building products**

ECO2 data for materials and products with the focus on wooden building products



# **Carbon footprint for building products**

ECO2 data for materials and products with  
the focus on wooden building products

---

Antti Ruuska (ed.)

ISBN 978-951-38-8042-2 (URL: <http://www.vtt.fi/publications/index.jsp>)

VTT Technology 115

ISSN-L 2242-1211

ISSN 2242-122X (Online)

Copyright © VTT 2013

JULKAISIJA – UTGIVARE – PUBLISHER

VTT

PL 1000 (Tekniikantie 4 A, Espoo)

02044 VTT

Puh. 020 722 111, faksi 020 722 7001

VTT

PB 1000 (Teknikvägen 4 A, Esbo)

FI-2044 VTT

Tfn +358 20 722 111, telefax +358 20 722 7001

VTT Technical Research Centre of Finland

P.O. Box 1000 (Tekniikantie 4 A, Espoo)

FI-02044 VTT, Finland

Tel. +358 20 722 111, fax +358 20 722 7001

## **Carbon footprint for building products**

ECO2 data for materials and products with the focus on wooden building products

**Antti Ruuska (ed.)**. Espoo 2013. VTT Technology 115. 126 p. + app. 2 p.

## **Abstract**

This report presents a collection of carbon footprint data for building products. The information has been collected in the European ECO2 research project. The main objectives of the project were to define principles for carbon footprint assessment, and to assess greenhouse gas impacts of wooden building products and buildings.

The purpose of this report is to present the carbon footprint data of selected building products. This report focuses on wooden building products. It contains both country-level data from Europe, as well as European-level data. However, since one of the objectives of the ECO2 research project is to assess the greenhouse gas impacts of whole buildings, also other building products are included in the report.

The information collected in this report is based on either on publicly available information on greenhouse gases of building materials, or on information collected within ECO2 project work package 3. All information is given in a similar format in such a way that it covers the stages A1, A2 and A3 in accordance with EN 15804 (see Section 2.2).

In order to assess the environmental impacts of whole buildings, an easy-to-use calculation tool was also created. The carbon footprint data presented in this report serves as the background data for the calculation tool. All the greenhouse gas data presented in this report is built-in into the calculation tool. This allows both ease of assessments and transparency of data.

### **Keywords**

Carbon footprint, wood product, building product

## Preface

This report presents a collection of carbon footprint data for building products. The information has been collected in the European ECO2 research project. The main objectives of the project were to define principles for carbon footprint assessment, and to assess greenhouse gas impacts of wooden building products and buildings.

The purpose of this report is to present the carbon footprint data of selected building products. This report focuses on wooden building products. It contains both country-level data from Europe, as well as European-level data. However, since one of the objectives of the ECO2 research project is to assess the greenhouse gas impacts of whole buildings, also other building products are included in the report.

The information collected in this report is based on either on publicly available information on greenhouse gases of building materials, or on information collected within ECO2 project work package 3. All information is given in a similar format in such a way that it covers the stages A1, A2 and A3 in accordance with EN 15804 (see Section 2.2).

In order to assess the environmental impacts of whole buildings, an easy-to-use calculation tool was also created. The carbon footprint data presented in this report serves as the background data for the calculation tool. All the greenhouse gas data presented in this report is built-in into the calculation tool. This allows both ease of assessments and transparency of data.

The report is edited by Antti Ruuska. Introduction and background sections are written by Tarja Häkkinen and the chapter on biogenic carbon is prepared by Per-Erik Eriksson ja Diego Fernando Peñaloza. The Italian data was provided by Francesco Pittau, the Swedish data by Diego Fernando Peñaloza and the Finnish data by Sirje Vares.

# Contents

<b>Abstract .....</b>	<b>3</b>
<b>Preface.....</b>	<b>4</b>
<b>1. Introduction.....</b>	<b>11</b>
1.1 Objective of the work .....	11
1.2 The ECO2-approach to biogenic carbon emissions and sequestered carbon.....	11
1.3 Structure of individual material data sheets.....	12
1.3.1 Characterization of the product.....	12
1.3.2 Data sources, assumptions and coverage .....	13
1.3.3 Carbon footprint of the product.....	13
<b>2. Background.....</b>	<b>15</b>
2.1 The importance CF as a sustainable building indicator.....	15
2.2 Relevant standards.....	18
<b>3. Carbon footprints of the products .....</b>	<b>22</b>
3.1 Carbon footprints of all the products.....	22
<b>4. Fibreboard (porous) – Finland .....</b>	<b>26</b>
4.1 Characterization of the product .....	26
4.2 Data sources, assumptions and coverage .....	26
4.3 Carbon footprint of the product.....	26
<b>5. Chipboard (Raw) – Europe.....</b>	<b>28</b>
5.1 Characterization of the product .....	28
5.2 Data sources, assumptions and coverage .....	28
5.3 Carbon footprint of the product.....	29
<b>6. Chipboard (Melamine Faced) – Europe.....</b>	<b>30</b>
6.1 Characterization of the product .....	30
6.2 Data sources, assumptions and coverage .....	30
6.3 Carbon footprint of the product.....	31
<b>7. Gypsum Plasterboard – Europe.....</b>	<b>32</b>
7.1 Characterization of the product .....	32
7.2 Data sources, assumptions and coverage .....	33
7.3 Carbon footprint of the product.....	33
<b>8. High Density Fibreboard (raw) – Germany .....</b>	<b>34</b>
8.1 Characterization of the product .....	34
8.2 Data sources, assumptions and coverage .....	34
8.3 Carbon footprint of the product.....	35

<b>9. Medium Density Fibreboard (raw) – Germany</b>	<b>36</b>
9.1 Characterization of the product	36
9.2 Data sources, assumptions and coverage	36
9.3 Carbon footprint of the product	37
<b>10. Medium Density Fibreboard (raw) – Sweden</b>	<b>38</b>
10.1 Characterization of the product	38
10.2 Data sources, assumptions and coverage	38
10.3 Carbon footprint of the product	38
<b>11. Medium Density Fibreboard (Melamine Faced) – Germany</b>	<b>40</b>
11.1 Characterization of the product	40
11.2 Data sources, assumptions and coverage	40
11.3 Carbon footprint of the product	41
<b>12. Oriented Strand Board, OSB (Raw) – Germany</b>	<b>42</b>
12.1 Characterization of the product	42
12.2 Data sources, assumptions and coverage	42
12.3 Carbon footprint of the product	42
<b>13. Plywood (Standard Birch) – Finland</b>	<b>44</b>
13.1 Characterization of the product	44
13.2 Data sources, assumptions and coverage	44
13.3 Carbon footprint of the product	44
<b>14. Plywood (Standard Conifer) – Finland</b>	<b>46</b>
14.1 Characterization of the product	46
14.2 Data sources, assumptions and coverage	46
14.3 Carbon footprint of the product	46
<b>15. Plywood – Sweden</b>	<b>48</b>
15.1 Characterization of the product	48
15.2 Data sources, assumptions and coverage	48
15.3 Carbon footprint of the product	48
<b>16. Laminate Flooring – Europe</b>	<b>50</b>
16.1 Characterization of the product	50
16.2 Data sources, assumptions and coverage	50
16.3 Carbon footprint of the product	51
<b>17. Massive Parquet – Germany</b>	<b>52</b>
17.1 Characterization of the product	52
17.2 Data sources, assumptions and coverage	52
17.3 Carbon footprint of the product	52
<b>18. Multi-layer Parquet – Germany</b>	<b>54</b>
18.1 Characterization of the product	54
18.2 Data sources, assumptions and coverage	54



18.3	Carbon footprint of the product.....	54
<b>19.</b>	<b>Timber, Cross Laminated Timber (CLT) – Germany.....</b>	<b>56</b>
19.1	Characterization of the product .....	56
19.2	Data sources, assumptions and coverage .....	56
19.3	Carbon footprint of the product.....	57
<b>20.</b>	<b>Timber, Cross Laminated Timber (CLT) – Italy.....</b>	<b>59</b>
20.1	Characterization of the product .....	59
20.2	Data sources, assumptions and coverage .....	59
20.3	Carbon footprint of the product.....	59
20.3.1	Carbon footprint of the dry product .....	60
20.3.2	Carbon footprint of the product with 12% moisture content....	60
<b>21.</b>	<b>Timber, Dried (coniferous) – Germany .....</b>	<b>61</b>
21.1	Characterization of the product .....	61
21.2	Data sources, assumptions and coverage .....	61
21.3	Carbon footprint of the product.....	61
<b>22.</b>	<b>Timber, Dried (deciduous) – Germany.....</b>	<b>63</b>
22.1	Characterization of the product .....	63
22.2	Data sources, assumptions and coverage .....	63
22.3	Carbon footprint of the product.....	63
<b>23.</b>	<b>Timber, Dried – Finland.....</b>	<b>65</b>
23.1	Characterization of the product .....	65
23.2	Data sources, assumptions and coverage .....	65
23.3	Carbon footprint of the product.....	65
23.3.1	Carbon footprint of the dry product .....	66
23.3.2	Carbon footprint with 10,7% moisture content.....	66
<b>24.</b>	<b>Timber, Fresh – Germany.....</b>	<b>67</b>
24.1	Characterization of the product .....	67
24.2	Data sources, assumptions and coverage .....	67
24.3	Carbon footprint of the product.....	67
<b>25.</b>	<b>Timber, Fresh – Finland .....</b>	<b>69</b>
25.1	Characterization of the product .....	69
25.2	Data sources, assumptions and coverage .....	69
25.3	Carbon footprint of the product.....	69
25.3.1	Carbon footprint of dry timber.....	70
25.3.2	Carbon footprint with 35,5% moisture content.....	70
<b>26.</b>	<b>Timber, Glued laminated – Sweden .....</b>	<b>71</b>
26.1	Characterization of the product .....	71
26.2	Data sources, assumptions and coverage .....	71
26.3	Carbon footprint of the product.....	71

<b>27. Timber, Planed – Germany.....</b>	<b>73</b>
27.1 Characterization of the product .....	73
27.2 Data sources, assumptions and coverage .....	73
27.3 Carbon footprint of the product.....	73
<b>28. Timber, Shipping dry – Finland.....</b>	<b>75</b>
28.1 Characterization of the product .....	75
28.2 Data sources, assumptions and coverage .....	75
28.3 Carbon footprint of the product.....	75
28.3.1 Carbon footprint for dry wood.....	76
28.3.2 Carbon footprint with 18% moisture content.....	76
<b>29. Timber, Shipping dry – Sweden.....</b>	<b>77</b>
29.1 Characterization of the product .....	77
29.2 Data sources, assumptions and coverage .....	77
29.3 Carbon footprint of the product.....	77
<b>30. Glass Wool – Europe.....</b>	<b>79</b>
30.1 Characterization of the product .....	79
30.2 Data sources, assumptions and coverage .....	79
30.3 Carbon footprint of the product.....	79
<b>31. Polystyrene (EPS) – Europe.....</b>	<b>81</b>
31.1 Characterization of the product .....	81
31.2 Data sources, assumptions and coverage .....	81
31.3 Carbon footprint of the product.....	81
<b>32. Polyurethane (Rigid Foam) – Europe.....</b>	<b>82</b>
32.1 Characterization of the product .....	82
32.2 Data sources, assumptions and coverage .....	82
32.3 Carbon footprint of the product.....	82
<b>33. Wood fibre insulation – Finland.....</b>	<b>84</b>
33.1 Characterization of the product .....	84
33.2 Data sources, assumptions and coverage .....	84
33.3 Carbon footprint of the product.....	84
<b>34. Aerated Concrete Block, P2 04 and P4 05 (Europe) .....</b>	<b>86</b>
34.1 Characterization of the product .....	86
34.2 Data sources, assumptions and coverage .....	86
34.3 Carbon footprint of the product.....	87
<b>35. Aerated Concrete Block, P4 05, Reinforced (Europe).....</b>	<b>88</b>
35.1 Characterization of the product .....	88
35.2 Data sources, assumptions and coverage .....	89
35.3 Carbon footprint of the product.....	89

<b>36. Aluminium (Extrusion profile) – Europe .....</b>	<b>90</b>
36.1 Characterization of the product .....	90
36.2 Data sources, assumptions and coverage .....	90
36.3 Carbon footprint of the product.....	91
<b>37. Aluminium (Sheet) – Europe.....</b>	<b>92</b>
37.1 Characterization of the product .....	92
37.2 Data sources, assumptions and coverage .....	92
37.3 Carbon footprint of the product.....	92
<b>38. Ceramic tiles – Finland.....</b>	<b>94</b>
38.1 Characterization of the product .....	94
38.2 Data sources, assumptions and coverage .....	94
38.3 Carbon footprint of the product.....	94
<b>39. Cold Rolled Stainless Steel (Cr-Ni) – Finland, Sweden, U.K., US .....</b>	<b>96</b>
39.1 Characterization of the product .....	96
39.2 Data sources, assumptions and coverage .....	96
39.3 Carbon footprint of the product.....	97
<b>40. Copper (Sheet) – Europe.....</b>	<b>98</b>
40.1 Characterization of the product .....	98
40.2 Data sources, assumptions and coverage .....	98
40.3 Carbon footprint of the product.....	99
<b>41. Copper (Tube) – Europe.....</b>	<b>100</b>
41.1 Characterization of the product .....	100
41.2 Data sources, assumptions and coverage .....	100
41.3 Carbon footprint of the product.....	100
<b>42. Copper (Wire) – Europe.....</b>	<b>102</b>
42.1 Characterization of the product .....	102
42.2 Data sources, assumptions and coverage .....	102
42.3 Carbon footprint of the product.....	102
<b>43. Crushed Stone 16/32 – Europe .....</b>	<b>104</b>
43.1 Characterization of the product .....	104
43.2 Data sources, assumptions and coverage .....	104
43.3 Carbon footprint of the product.....	104
<b>44. Glass (Float Glass) – Europe .....</b>	<b>106</b>
44.1 Characterization of the product .....	106
44.2 Data sources, assumptions and coverage .....	106
44.3 Carbon footprint of the product.....	106
<b>45. Gravel 2/32 – Europe.....</b>	<b>108</b>
45.1 Characterization of the product .....	108
45.2 Data sources, assumptions and coverage .....	108

45.3	Carbon footprint of the product.....	108
<b>46.</b>	<b>Gypsum Plaster (CaSO<sub>4</sub>) – Germany .....</b>	<b>110</b>
46.1	Characterization of the product .....	110
46.2	Data sources, assumptions and coverage .....	110
46.3	Carbon footprint of the product.....	110
<b>47.</b>	<b>Gypsum Stone (CaSO<sub>4</sub>) – Germany .....</b>	<b>112</b>
47.1	Characterization of the product .....	112
47.2	Data sources, assumptions and coverage .....	112
47.3	Carbon footprint of the product.....	112
<b>48.</b>	<b>Lightweight Concrete Block – Europe .....</b>	<b>114</b>
48.1	Characterization of the product .....	114
48.2	Data sources, assumptions and coverage .....	115
48.3	Carbon footprint of the product.....	115
<b>49.</b>	<b>Polyethene (LDPE) – Europe.....</b>	<b>116</b>
49.1	Characterization of the product .....	116
49.2	Data sources, assumptions and coverage .....	116
49.3	Carbon footprint of the product.....	116
<b>50.</b>	<b>Pre-cast Concrete .....</b>	<b>118</b>
50.1	Characterization of the product .....	118
50.2	Data sources, assumptions and coverage .....	118
50.3	Carbon footprint of the product.....	118
<b>51.</b>	<b>Sand 0/2 – Europe .....</b>	<b>120</b>
51.1	Characterization of the product .....	120
51.2	Data sources, assumptions and coverage .....	120
51.3	Carbon footprint of the product.....	120
<b>52.</b>	<b>Interior Door – Sweden .....</b>	<b>122</b>
52.1	Characterization of the product .....	122
52.2	Data sources, assumptions and coverage .....	122
52.3	Carbon footprint of the product.....	122
<b>53.</b>	<b>Window – Sweden.....</b>	<b>124</b>
53.1	Characterization of the product .....	124
53.2	Data sources, assumptions and coverage .....	124
53.3	Carbon footprint of the product.....	124
<b>54.</b>	<b>Conclusions and recommendations.....</b>	<b>126</b>

## Appendices

Appendix A: Global warming potentials of different GHGs according to the IPCC 4th assessment report

Appendix B: Carbon Footprint

# 1. Introduction

## 1.1 Objective of the work

This report presents a collection of carbon footprint data for building products. The information has been collected in the European ECO2 research project. The main objectives of the project were to define principles for carbon footprint assessment, and to assess greenhouse gas impacts of wooden building products and buildings.

The purpose of this report is to present the carbon footprint data of selected building products. This report focuses on wooden building products. It contains both country-level data from Europe, as well as European-level data. However, since one of the objectives of the ECO2 research project is to assess the greenhouse gas impacts of whole buildings, also other building products are included in the report.

The information collected in this report is based on either on publicly available information on greenhouse gases of building materials, or on information collected within ECO2 project, with help of life cycle inventories (LCIs). All information is given in a similar format in such a way that it covers the stages A1, A2 and A3 in accordance with EN 15804 (see Section 2.2).

In order to assess the environmental impacts of whole buildings, an easy-to-use calculation tool was also created. The carbon footprint data presented in this report serves as the background data for the calculation tool. In other words, all the greenhouse gas data presented in this report is built-in into the calculation tool. This allows both ease of assessments and transparency of data.

## 1.2 The ECO2-approach to biogenic carbon emissions and sequestered carbon

The Greenhouse Gas Protocol defines “biogenic” carbon as produced by living organisms or biological processes, but not fossilized or from fossil sources<sup>1</sup>. The carbon neutrality of bio-based products and biomass energy production is a much debated topic.

---

<sup>1</sup> Greenhouse Gas Protocol – Product Life Cycle Accounting and Reporting Standard. World Resources Institute – WBCSD.

The selected approach of ECO2-project to biogenic carbon emissions takes into account that the biogenic carbon emissions directly attributed to a wood-based product result either from the use of biomass energy in the production phase, or from the combustion of the product at the end-of-life. These emissions are equal to the amount of carbon sequestered in the growing tree, which provides the biomass for the wood or the energy used.

Furthermore, the forest regrowth driven by re-planting harvested trees is also in balance with such emissions. All this assuming that the carbon stocks in the forest are not decreasing, which is a ground rule for sustainable forestry and a common requirement in European forestry practices.

These emissions and sequestration phenomena may be seen as part of an accelerated natural carbon cycle. This is why, if biogenic emissions are to be accounted for in the carbon footprint of a product; the carbon flows of the forest system should also be included in order to cover the full life cycle of the product.

This would increase the level of complexity in a carbon footprint calculation while the final result would not be affected, provided that the biomass originates from forests where the carbon stock is constant over time.

In Europe, the total standing forest biomass has increased steadily over many decades, which means that assuming “carbon neutrality” is a conservative assumption. This is why, for simplicity, it is recommended not to account for biogenic carbon sequestration and emissions in the carbon footprint calculations. It should also be noted that there is a temporal effect from the storage of carbon in wood products associated with the atmospheric dynamics of greenhouse gases.

This report gives the carbon footprint data of building products in a format, which aligns with the ECO2-approach. In other words, the biogenic carbon emissions and carbon sequestration are not included in the carbon footprint figures. The carbon footprint is expressed in terms of CO<sub>2</sub>e, or carbon dioxide equivalent. However, due to temporal effects of the storage of carbon in wood products, also the biogenic carbon storage is given (expressed as CO<sub>2</sub>uptake). This figure is not included in the carbon footprints, but expressed as a separate number.

### **1.3 Structure of individual material data sheets**

The individual material data sheets of this report are divided into three different sections. The information is outlined as follows: a short characterization of the product is followed by the presentation of data sources, assumptions and coverage. Finally, the carbon footprint of the specific product is presented. The following further explains the contents and purpose of these three sections.

#### **1.3.1 Characterization of the product**

The section “characterization of the product” gives information about the manufacture, contents and/or other issues of the product, in order to describe the product

under scrutiny. In addition, relevant information about density, moisture content etc. is given to enable the reasonable use of data.

The following presents the contents of this section for the profile of Finnish standard birch plywood as an example:

*Standard birch plywood consists of birch veneer and mainly phenol formaldehyde glue. It can be applied to transport equipment, concrete formwork systems and furniture and indoor cladding.*

*Unit weight: 660 kg/m<sup>3</sup>*

*Weight per square metre: 6.1–20.4 kg/m<sup>2</sup> (with a thickness of 9–30 mm)*

*Humidity: 9%*

### **1.3.2 Data sources, assumptions and coverage**

This section “data sources, assumptions and coverage” lists the information sources (literature references, names of environmental product declarations, etc.) used. The section lists all assumptions made in the formulation of the result (when the information is not entirely based on one source). In addition, the section describes the coverage of data (valid for one manufacture, country, European average, etc.).

The following presents the contents of this section for the profile of Finnish standard birch plywood as an example:

*The data is based on a Finnish RT Environmental Declaration “Standard Birch Plywood” by Puuinfo Oy. The environmental profile applies to standard birch plywood manufactured by one of the Finnish manufacturers (Metsaliitto Cooperative, Suolahti and Punkaharju plywood mills, UPM-Kymmene Wood, Heinola, Joensuu, Jyväskylä, Kaukas and Savonlinna mills, Visuvesi Oy, Visuvesi mill, Koskisen Oy, Järvelä mill). It should be noted that the mills of Heinola, Kaukas and Visuvesi have been shut down after the publication of the profile. As a result, the data from these mills still effect the profile, even if these are already out of operation.*

*The full declaration is available at: <http://www.rts.fi/ymparistoseloste/ys034eng.pdf>. It is based on the national methodology following the basic principles stated in the ISO standard series 14040 and 14020. The declaration covers the product stage A1–A3 (Cradle to Gate).*

### **1.3.3 Carbon footprint of the product**

The carbon footprint is expressed in terms of CO<sub>2</sub>e, where the CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The components of the CO<sub>2</sub>e (such as CO<sub>2</sub> fossil, CH<sub>4</sub> and N<sub>2</sub>O) are also expressed, if available in the source data.

## 1. Introduction

---

The CO<sub>2</sub>e figures exclude the biogenic carbon dioxide emissions, and sequestered carbon, an approach adopted by the ECO2-research project.

However, due to the temporal effect of the carbon storage, the amount of sequestered carbon is also given as a separate figure.

The unit in which the CO<sub>2</sub>e is expressed is “grams of CO<sub>2</sub>e per one kilogram of product”, or g/kg. For example, plywood (Finnish, standard birch), has the CO<sub>2</sub>e of 718 g/kg. This means that the production of one kilogram of this specific plywood results in greenhouse gas emissions, equivalent of 605 grams of CO<sub>2</sub>.

The following presents the contents of this section for the profile of Finnish standard birch plywood as an example:

*The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.*

*However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.*

**Table 1.** Carbon footprint (A1–3) of Plywood (Standard Birch) – Finland.

CO <sub>2</sub> e g/kg	718
CO <sub>2</sub> fossil g/kg	650
CH <sub>4</sub> g/kg	2.7
N <sub>2</sub> O g/kg	3.3 x 10 <sup>-3</sup>
CO <sub>2</sub> uptake g/kg	1188

It should be noted that the data of this report is used in a calculation tool for complete buildings. Therefore, the carbon footprints of products are expressed for actual products with moisture, not for dry wood, unless stated otherwise. The moisture content of each of the products is expressed in the chapter “characterization of the product”.



## 2. Background

### 2.1 The importance CF as a sustainable building indicator

The IPCC Guidelines include a list of greenhouse gases (GHG)<sup>2</sup>. The Global warming potential according to the IPPC 4th assessment report are given in a separate publication<sup>3</sup>. The global warming potentials of different GHGs according to the IPPC 4th assessment report are presented in Appendix A of this report.

Changes in the atmospheric abundance of greenhouse gases and aerosols, in solar radiation and in land surface properties alter the energy balance of the climate system. These changes are expressed in terms of radiative forcing, which is used to compare how a range of human and natural factors drive warming or cooling influences on global climate.

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values. Carbon dioxide is the most important anthropogenic greenhouse gas. The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005.

The primary source of the increased atmospheric concentration of carbon dioxide since the pre-industrial period results from fossil fuel use, with land-use change providing another significant but smaller contribution. The understanding of anthropogenic warming and cooling influences on climate has improved during recent years leading to very high confidence that the global average net effect of human activities since 1750 has been one of warming.<sup>4</sup>

---

<sup>2</sup> 2006 IPCC Guidelines for National Greenhouse Gas Inventories – Chapter 1: Introduction to the 2006 Guidelines p. 1.5 [http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1\\_Volume1/V1\\_1\\_Ch1\\_Introduction.pdf](http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_1_Ch1_Introduction.pdf).

<sup>3</sup> Climate Change 2007: Working Group I: The Physical Science Basis TS.2.5 Net Global Radiative Forcing, Global Warming Potentials and Patterns of Forcing ([http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/tssts-2-5.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/tssts-2-5.html)).

<sup>4</sup> IPCC Climate Change 2007: Working Group I: The Physical Science Basis.

## 2. Background

---

Climate change is widely considered as an issue of concern of sustainable development.

UN's Commission on Sustainable development CSD has approved a follow-up on the two earlier sets of sustainability indicators and defines the indicators of Sustainable Development in its publication<sup>5</sup>. It is claimed that these indicators cover the issues that are relevant to sustainable development in most countries. One of the themes addressed by CSD is Atmosphere (divided into Climate change, Ozone layer depletion and Air quality).

The Renewed EU Sustainable Development Strategy was adopted by the European Council in June 2006. It is an overarching strategy for all EU policies which sets out how we can meet the needs of present generations without compromising the ability of future generations to meet their needs. It addresses seven key challenges for sustainable development<sup>6</sup>. One of the seven key challenges is climate change and clean energy.

Europe 2020<sup>7</sup> is the EU's growth strategy for the present decade. Sustainable growth for Europe includes:

- building a competitive low-carbon economy that makes efficient, sustainable use of resources,
- capitalising on Europe's leadership in developing new green technologies and production methods and
- helping consumers make well-informed green choices.

The corresponding EU targets for sustainable growth include:

- Reducing greenhouse gas emissions by 20% compared to 1990 levels by 2020. The EU is prepared to go further and reduce by 30% if other developed countries make similar commitments and developing countries contribute according to their abilities, as part of a comprehensive global agreement.
- Increasing the share of renewables in final energy consumption to 20%.
- Moving towards a 20% increase in energy efficiency.

---

<sup>5</sup> Indicators of Sustainable Development: Guidelines and Methodologies, Third Edition (2007), UN publications, 93 pages

<sup>6</sup> COM(2009) 400 final. Communication from the Commission to the European Parliament the Council, the European Economic and Social Committee and the Committee of Regions. Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development. The 7 key challenges are: Climate change and clean energy, Sustainable transport, Sustainable consumption and production, Conservation and management of natural resources, Public health, Social inclusion, demography and migration, Global poverty.

<sup>7</sup> COM(2010) 0639 final. Communication from the Commission to the European Parliament the Council, the European Economic and Social Committee and the Committee of Regions. Energy 2020 – A strategy for competitive, sustainable and secure energy

In January 2008 the European Commission proposed binding legislation to implement the 20-20-20 targets. This 'climate and energy package' was agreed by the European Parliament and Council in December 2008 and became law in June 2009. The national targets range from a renewables share of 10% in Malta to 49% in Sweden – in Finland the share is 38%.<sup>8</sup>

The EEA indicators (which can be considered to reflect areas of environmental concerns): cover the following themes agriculture; air pollution; biodiversity; climate change; energy; fisheries; land management; transport; waste; and water<sup>9</sup>.

The inclusion of the GHG indicator to a number of sustainable building standards is also an indication about the general agreement about its importance in building and construction<sup>10</sup>. The indicator is included in important methods and standards that give (partly or fully) LCA/LCI based guidelines for the environmental or sustainability assessment of buildings and or building products. These include

- ISO 21929-1 Sustainability indicators – Part 1 – Framework for the development of indicators and a core set of indicators for buildings
- ISO 21931 Framework for methods of assessment of the environmental performance of construction works – Part 1 – Buildings
- ISO 21930 Sustainability in building construction – Environmental declaration of building products
- EN 15978 Assessment of environmental performance of buildings – Calculation method
- EN 15804 Environmental product declarations – Core rules for the product category of construction products
- EN 15942 Environmental product declarations – Communication format business-to-business
- SBA common metric<sup>11</sup>

Building sector has a significant effect on the overall release of greenhouse gases because of human activities.

---

<sup>8</sup> Directorate-General for Climate Action ("DG CLIMA"), "Climate Action" – Online portal. [http://ec.europa.eu/clima/policies/package/index\\_en.htm](http://ec.europa.eu/clima/policies/package/index_en.htm) (Accessed 17/07/09).

<sup>9</sup> European Environment Agency. Indicators about Europe's Environment <http://themes.eea.europa.eu/indicators/> (Accessed 17/07/09).

<sup>10</sup> SuPerBuildings Deliverable D4.2 Description and explanation of the selected indicators and related measurement and assessment methods with special focus on reliability, comparability and compatibility.

<sup>11</sup> A Framework for Common Metrics of Buildings. Pilot Draft Version 2009 (1.7) Sustainable Buildings Alliance 2009

## 2. Background

---

The construction industry is a large contributor to CO<sub>2</sub> emissions, with buildings responsible for 40% of the total European energy consumption and a third of CO<sub>2</sub> emissions<sup>12</sup>.

The Intergovernmental Panel on Climate Change (IPCC) synthesis report<sup>13</sup> lists buildings as having the largest estimated economic mitigation potential among the sector solutions investigated. This confirms and completes an earlier statement by the United Nations Environment Programme (UNEP) Sustainable Building and Construction Initiative (SBCI) which suggests that European buildings account for roughly 40% of the energy consumption in society, contributing to significant amounts of greenhouse gas (GHG) emissions<sup>14</sup>. UNEP concludes that the building sector offers the single largest potential for energy efficiency in Europe.

The IPCC also suggests that measures to reduce GHG emissions from buildings includes three categories: reducing energy consumption and embodied energy in buildings, switching to low-carbon fuels including a higher share of renewable energy, or controlling the emissions of non-CO<sub>2</sub> GHG gases (IPCC 2007). They however divide the building-sector relevant technology assessments into two parts: presenting information for energy efficiency in new and existing buildings (demand-side building GHG reduction technologies) separate from their assessment of centralized and decentralized (or distributed) energy systems (supply-side GHG reduction technologies). Since the decision makers in building sector can influence both demand and supply side technology adoption, simultaneous consideration of trade-offs made at the building (e.g., by architects, those in construction, etc.) and regional levels (e.g., by policy developers) is warranted. For example, which technologies should be implemented first at a specific site/region and how does the first implementation impact the effectiveness of subsequent installations from cost and environmental impact standpoints, is of interest.

### 2.2 Relevant standards

ISO and CEN have developed building and construction related sustainability standards, which cover all levels and all sustainability aspects as follows:

---

<sup>12</sup> Energy Efficient Buildings European Initiative.  
[http://www.ectp.org/cws/params/ectp/download\\_files/36D928v2\\_E2BA\\_Brochure.pdf](http://www.ectp.org/cws/params/ectp/download_files/36D928v2_E2BA_Brochure.pdf)

<sup>13</sup> Climate Change 2007: Synthesis report, IPCC, 2007. (IPCC 2007)  
[http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf)

<sup>14</sup> Buildings and climate change: Status, challenges and opportunities, UNEP, 2007.  
<http://www.unep.org/sbci/pdfs/BuildingsandClimateChange.pdf>

**Table 2.** Suite of related International Standards for sustainability in buildings and construction works. Adopted from ISO 15392<sup>15</sup>.

	Environmental aspects	Economical aspects	Social aspects
Methodological bases	ISO/15392: General principles ISO/TR 21932: Terminology		
Buildings	ISO 21929-1: Sustainability Indicators – Part 1 – Framework for the development of indicators and a core set of indicators for buildings		
	ISO/21931-1: Framework for methods of assessment of the environmental performance of construction works		
Products	ISO/21930: Environmental declaration of building products		

**Table 3.** The work programme of CEN/TC 350. Adopted from EN 15978<sup>16</sup>.

Framework level	EN 15643-1 Sustainability Assessment of Buildings – General Framework (TG)		
	EN 15643-2 Framework for Environmental Performance (TG)	EN 15643-3 Framework for Social Performance	EN 15643-4 Framework for Economic Performance
Building level	EN 15978 Assessment of Environmental Performance	prEN 16309 Assessment of Social Performance	Assessment of Economic Performance
Product level	EN 15804 Environmental Product Declarations		
	EN 15942 Communication Formats. Business-to-Business		
	CEN/TR 15941 Sustainability of construction works – Environmental product declarations – Methodology for selection and use of generic data		

<sup>15</sup> International Standard ISO 15392: Sustainability in building construction –General principle. ISO, 2008.

<sup>16</sup> European Standard EN 15978: Sustainability of construction works – Assessment of environmental performance of buildings - Calculation method. CEN, 2011.

## 2. Background

---

As this report defines carbon footprint as one of the LCA parameters and as this report deals with building products, the relevant standards are especially the product level environmental standards listed in Tables 2 and 3.

In addition to this, another important standard is the ISO DIS 15067<sup>17</sup>, which specifies principles, requirements and guidelines for the quantification and communication of the carbon footprint of a product (CFP), based on International Standards on life cycle assessment (ISO 14040 series) and on environmental claims, labels and declarations (ISO 14020 series). The following tables show the environmental indicators of the product level EN 15804 standard.

EN product level standards cover the following environmental indicators:

**Table 4.** EN 15804 indicators: Resources.

Parameter	Parameter unit expressed per functional/declared unit
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	MJ, net calorific value
Use of non renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of non renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of secondary material	kg
Use of renewable secondary fuels	MJ, net calorific value
Use of non renewable secondary fuels	MJ, net calorific value
Use of net fresh water	m <sup>3</sup>

---

<sup>17</sup> International Standard ISO 15067: Carbon footprint of products – Requirements and guidelines. ISO, 2012.

**Table 5.** EN 15804 Indicators: Emissions.

Impact Category	Parameter	Parameter unit expressed per functional/declared unit
Global Warming	Global warming potential, GWP;	kg CO <sub>2</sub> equiv
Ozone Depletion	Depletion potential of the stratospheric ozone layer, ODP;	kg CFC 11 equiv
Acidification for soil and water	Acidification potential of soil and water, AP;	kg SO <sub>2</sub> equiv
Eutrophication	Eutrophication potential, EP;	kg (PO <sub>4</sub> ) <sup>3-</sup> equiv
Photochemical ozone creation	Formation potential of tropospheric ozone,, POCP;	kg Ethene equiv
Depletion of abiotic resources-elements	Abiotic depletion potential (ADP-elements) for non fossil resources <sup>a</sup>	kg Sb equiv
Depletion of abiotic resources-fossil fuels	Abiotic depletion potential (ADP-fossil fuels) for fossil resources <sup>a</sup>	MJ, net calorific value
<sup>a</sup> The abiotic depletion potential is calculated and declared in two different indicators: <ul style="list-style-type: none"> <li>• ADP-elements: include all non renewable, abiotic material resources (i.e. excepting fossil resources);</li> <li>• ADP -fossil fuels include all fossil resources.</li> </ul>		

### 3. Carbon footprints of the products

#### 3.1 Carbon footprints of all the products

This section presents the carbon footprint and carbon uptake information for all the products (50pcs) of this report. Each of the products are presented in more detail in the following chapters of this report.

The following table shows the carbon footprint and carbon uptake information for building boards.

**Table 6.** Carbon footprint and carbon uptake information for building boards.

<b>Building board</b>	<b>CO<sub>2</sub>e g/kg</b>	<b>CO<sub>2</sub> uptake g/kg</b>
Fibreboard (porous) – Finland	425	1531
Chipboard (Raw) – Europe	409	1564
Chipboard (Melamine faced) – Europe	467	1527
Gypsum plasterboard – Europe	1967	–
High Density Fibreboard (Raw) – Germany	661	1437
Medium Density Fibreboard (Raw) – Germany	652	1418
Medium Density Fibreboard (Raw) – Sweden	340	1466
Medium Density Fibreboard (Melamine Faced) – Germany	788	1458
Oriented Strand Board (Raw) – Germany	208	1692
Plywood (Standard Birch) – Finland	718	1188
Plywood (Standard Conifer) – Finland	605	1708
Plywood – Sweden	229	1731



### 3. Carbon footprints of the products

---

The following table shows the carbon footprint and carbon uptake information for flooring materials.

**Table 7.** Carbon footprint and carbon uptake information for flooring materials.

<b>Flooring Material</b>	<b>CO<sub>2</sub>e g/kg</b>	<b>CO<sub>2</sub> uptake g/kg</b>
Laminate Flooring – Europe	750	1476
Massive Parquet – Germany	2942	1696
Multi-layer Parquet – Germany	7292	1638

The following table shows the carbon footprint and carbon uptake information for wood products.

**Table 8.** Carbon footprint and carbon uptake information for wood products.

<b>Wood Product</b>	<b>CO<sub>2</sub>e g/kg</b>	<b>CO<sub>2</sub> uptake g/kg</b>
Shipping Dry Timber – Finland	87	1505
Shipping Dry Timber – Sweden	13	1502
CLT – Germany	362	1611
CLT – Italy	408	1610
Dried Timber (Coniferous) – Germany	119	1637
Dried Timber (Deciduous) – Germany	167	1636
Special Dry Timber – Finland	108	1639
Timber, Fresh – Germany	49	1182
Timber, Fresh – Finland	44	1184
Glued laminated timber – Sweden	109	1730
Planed Timber – Germany	152	1638

### 3. Carbon footprints of the products

---

The following table shows the carbon footprint and carbon uptake information for insulation materials.

**Table 9.** Carbon footprint and carbon uptake information for insulation materials.

<b>Insulation Material</b>	<b>CO<sub>2</sub>e g/kg</b>	<b>CO<sub>2</sub> uptake g/kg</b>
Glass Wool – Europe	3148	–
Polystyrene (EPS) – Europe	3300	–
Polyurethane (Rigid Foam) – Europe	4200	–
Wood fibre insulation – Finland	243	1240

The following table shows the carbon footprint and carbon uptake information for wood products.

**Table 10.** Carbon footprint and carbon uptake information for other building products.

<b>Other building products</b>	<b>CO<sub>2</sub>e g/kg</b>	<b>CO<sub>2</sub> uptake g/kg</b>
Aerated Concrete Block, Europe	442	–
Reinforced Aerated Concrete Block, Europe	511	–
Aluminium extrusion profile, Europe	2264	–
Aluminium sheet, Europe	2980	–
Ceramic Tile, Finland	613	–
Stainless Steel, Cold Rolled	3778	–
Copper Sheet, Europe	973	–
Copper tube, Europe	981	–
Copper wire, Europe	788	–
Crushed stone, Europe	14	–
Float Glass, Europe	1230	–
Gravel 2/32, Europe	3	–
Gypsum plaster, Germany	243	–
Gypsum stone, Germany	3	–
Lightweight Concrete Block, Europe	240	–
Polyethene (LDPE), Europe	2130	–
Pre-cast Concrete 20/25 (Europe)	121	–
Sand 0/2 (Europe)	2	–

### 3. Carbon footprints of the products

---

The following table shows the carbon footprint and carbon uptake information for finished building components.

**Table 11.** Carbon footprint and carbon uptake information for finished building components.

<b>Insulation Material</b>	<b>CO<sub>2</sub>e g/kg</b>	<b>CO<sub>2</sub> uptake g/kg</b>
Internal Door – Sweden	18450	82500
Wooden window – Sweden	42175	27200

## **4. Fibreboard (porous) – Finland**

### **4.1 Characterization of the product**

Porous fibreboards are manufactured from woodchips and sawdust utilising the wet process. The raw materials are refined into fibre and mixed with water into pulp. Building board products are manufactured by compressing and drying the mixed pulp.

Possible uses for porous fibreboards are the weathershields and thermal insulation of buildings.

Unit weight: 300 kg/m<sup>3</sup>

Weight per square metre: 3.0–7.5 kg/m<sup>2</sup> (with a thickness of 10–25 mm)

Humidity: 5–7%

### **4.2 Data sources, assumptions and coverage**

The data is based on a Finnish RT Environmental Declaration “LION Fibreboard” by Finnish Fibreboard Ltd. The environmental profile applies to porous fibreboard manufactured by Finnish Fibreboard Ltd Pihlava Mill.

The full declaration is available at: <http://www.rts.fi/ymparistoseloste/ys028EN.pdf>. It is based on the national methodology following the basic principles stated in the ISO standard series 14040 and 14020. The declaration covers the product stage A1–A3 (Cradle to Gate).

### **4.3 Carbon footprint of the product**

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

The original data contains no information on the CO<sub>2</sub> uptake, so it needs to be calculated. The calculation is done by assuming the product to be 100% cellulose (C<sub>6</sub>H<sub>10</sub>O<sub>5</sub>), some 44% of which is carbon (by molecular weight). When the moisture content of the product is assumed to be 6%, the solid cellulose content of the product is:

$$1000 \text{ g/kg} * (1-0,06) = 940 \text{ g/kg.}$$

Since 44% of the cellulose is carbon, the carbon content of the product is:

$$940 \text{ g/kg} * 0,44 = 418 \text{ g/kg.}$$

And finally, since carbon dioxide (CO<sub>2</sub>) has 27% of carbon (by molecular weight), the CO<sub>2</sub> uptake of the product can be estimated to be:

$$418 \text{ g/kg} * (1/0,27) = 1531 \text{ g/kg.}$$

**Table 12.** Carbon footprint (A1–3) of Fibreboard (porous) – Finland, 6% moisture content.

CO <sub>2</sub> e g/kg	425
CO <sub>2</sub> fossil g/kg	400
CH <sub>4</sub> g/kg	0.74
N <sub>2</sub> O g/kg	21 x 10 <sup>-3</sup>
CO <sub>2</sub> uptake g/kg	1531

## 5. Chipboard (Raw) – Europe

### 5.1 Characterization of the product

Chipboard (or particle board) is used for furniture in dry conditions.

The board production starts by reducing different assortments of wood into chips. The chips are then dried in a cylinder cycling machine to the wanted moisture level, after which they are glued. A moulding strap is used to heap up the different chip fractions into a mat. The mat of wood chips and glue then enter a press, which uses heat and pressure to turn the mat into primary boards. The primary boards are finalized using a trimming cutter and saw machine, after which they are sanded to give them finished surface.

The primary boards may be further processed, as their end-use may require. Boards are stacked and packed into a PE-film for transportation.

All the material wastage during production is re-used in the process for heat production.

Unit weight: 670 kg/m<sup>3</sup>

Moisture content: 5.5%

### 5.2 Data sources, assumptions and coverage

The process description is based on ELCD database 2.0, Process data set: “Particle board; P2 (Standard FPY); production mix, at plant; 7,8% water content”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/bd7fdac9-40d5-4613-9374-6969803269d9\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/bd7fdac9-40d5-4613-9374-6969803269d9_02.01.000.xml).

The CO<sub>2</sub>-data is based on an environmental product declaration of Fritz EGGER GmbH & Co. OG, “Environmental Product Declaration: EGGER EUROSPAN® Raw Chipboard EURODEKOR® Melamine faced Chipboard”, published by Institut Bauen und Umwelt e.V. The declaration is available at: [http://bau-umwelt.de/download/CY2c949065X135a0570574XY603e/EPD\\_EHW\\_2008511\\_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e](http://bau-umwelt.de/download/CY2c949065X135a0570574XY603e/EPD_EHW_2008511_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e).

The data covers the manufacturer’s factories in Austria, France, Germany, Netherlands, Romania, Russia and UK.

The declaration is in compliance with ISO 14045 and ISO 14040. The original data of the EPD (cradle-to-grave) has been modified to cover only the product stage A1–A3 (Cradle to Gate).

### 5.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 13.** Carbon footprint (A1–3) of Chipboard (Raw) – Europe, 5.5% moisture content.

CO <sub>2</sub> e g/kg	409.0
CO <sub>2</sub> fossil g/kg	409.0
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1564.2

## 6. Chipboard (Melamine Faced) – Europe

### 6.1 Characterization of the product

Chipboard (or particle board) is used for furniture in dry conditions.

The board production starts by reducing different assortments of wood into chips. The chips are then dried in a cylinder cycling machine to the wanted moisture level, after which they are glued. A moulding strap is used to heap up the different chip fractions into a mat. The mat of wood chips and glue then enter a press, which uses heat and pressure to turn the mat into primary boards. The primary boards are finalized using a trimming cutter and saw machine, after which they are sanded to give them finished surface.

The primary boards are then further processed, by attaching a impregnated material on the top and bottom surfaces of the chipboard. Boards are stacked and packed into a PE-film for transportation.

All the material wastage during production are re-used in the process for heat production.

Unit weight: 11.79 kg/m<sup>2</sup> (with a thickness of 17.6 mm)

Unit weight: 670 kg/m<sup>3</sup>

Moisture content: 5.5%

### 6.2 Data sources, assumptions and coverage

The process description is based on ELCD database 2.0, Process data set: “Particle board; P2 (Standard FPY); production mix, at plant; 7,8% water content”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://ca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/bd7fdac9-40d5-4613-9374-6969803269d9\\_02.01.000.xml](http://ca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/bd7fdac9-40d5-4613-9374-6969803269d9_02.01.000.xml).

The CO<sub>2</sub>-data is based on an environmental product declaration of Fritz EGGER GmbH & Co. OG, “Environmental Product Declaration: EGGER EUROSPAN® Raw Chipboard EURODEKOR® Melamine faced Chipboard”, published by Institut Bauen und Umwelt e.V. The declaration is available at: [http://bau-umwelt.de/download/CY2c949065X135a0570574XY603e/EPD\\_EHW\\_2008511\\_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e](http://bau-umwelt.de/download/CY2c949065X135a0570574XY603e/EPD_EHW_2008511_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e).



The data covers the manufacturers' factories in Austria, France, Germany, Netherlands, Romania, Russia and UK.

The declaration is in compliance with ISO 14045 and ISO 14040. The original data of the EPD (cradle-to-grave) has been modified to cover only the product stage A1–A3 (Cradle to Gate).

### 6.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 14.** Carbon footprint (A1–3) of Chipboard (Melamine faced) – Europe, 5.5% moisture content.

CO <sub>2e</sub> g/kg	466.5
CO <sub>2</sub> fossil g/kg	466.5
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1526.7

## 7. Gypsum Plasterboard – Europe

### 7.1 Characterization of the product

Gypsum plasterboard is a standard mineral product used as dry mortarless building material indoors. It consists of two sheets of cardboard and a gypsum layer in between them.

The raw materials for gypsum plasterboards are calcinated gypsum, cardboard and additives. The gypsum is either from mined gypsum, gypsum from flue-gas desulphurization in coal plants (FSG), other synthetic gypsum, or recycled gypsum.

The mined gypsum is mainly from open cast mining. The FSG gypsum includes electricity consumption due to dehydration and purification of the product. The desulphurization is done due to environmental reasons, so the complete electricity consumption of FSG, or lime stone consumption are not considered. Recycled gypsum considers the energy consumption of recycling process and waste flow treatment.

The source of gypsum varies from country to country, due to differing availability of natural gypsum stone, FGD, other synthetic gypsum and recycled gypsum. For example, in Germany, the ratio between FGD and gypsum stone is 50:50, whereas in France it is 100% gypsum stone. All the gypsum varieties are dried and calcinated. The process turns calcium sulphate dehydrates into beta-hemihydrates using mainly thermal energy.

The cardboard is recycled paper and the additives are also considered in the profile.

The gypsum plasterboard is produced by continuously feeding beta-hemihydrate gypsum and water between the two cardboard layers. The mixing of hemihydrate and water results in a reaction which turns the hemihydrate gypsum to dehydrate gypsum. After the reaction is settled, the plasterboard is cut to size. The excess water is removed in a dryer oven.

Unit weight: 800 kg/m<sup>3</sup>

## 7.2 Data sources, assumptions and coverage

The source data is from plasterboard production of Germany, France and Great Britain, which represent for 53% of the EU27's market volume.

The data is based on ELCD database 2.0, Process data set: "Gypsum plasterboard; technology mix of plasterboard production; production mix at factory; 12.5 mm thick, 10 kg/m<sup>2</sup> (en). The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/cc39e70e-4a40-42b6-89e3-7305f0b95dc4\\_01.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/cc39e70e-4a40-42b6-89e3-7305f0b95dc4_01.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044 and it covers the product stage A1–A3 (Cradle to Gate).

## 7.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 15.** Carbon footprint (A1–3) of Gypsum plasterboard – Europe.

CO <sub>2</sub> e g/kg	1967
CO <sub>2</sub> fossil g/kg	1846
CH <sub>4</sub> g/kg	4.03
N <sub>2</sub> O g/kg	6.8 x 10 <sup>-2</sup>
CO <sub>2</sub> uptake g/kg	0

## 8. High Density Fibreboard (raw) – Germany

### 8.1 Characterization of the product

HDF-boards are used for furniture and as coreboards for floorings.

The boards consist of wood chips (82%), water (5–7%), UF-glue (11%) and paraffin wax (<1%).

The manufacturing process starts with boiling of wood chips, after which they are defibrated in a refiner. After the chips are dried, they are bonded with resins and spread onto a moulding conveyor. The chip-resin-matt is then compressed with continuous hot press, after which it is cut and trimmed to size. Once the ready rawboards are cooled in a radial cooler, they are destacked into large stacks and let to acclimatise. The raw boards are finalized by sanding top and bottom surfaces.

All the waste is re-used in process for heat generation.

Unit weight: 900 kg/m<sup>3</sup>

Moisture content: 6%

### 8.2 Data sources, assumptions and coverage

The CO<sub>2</sub>-data is based on an environmental product declaration of Fritz EGGER GmbH & Co. OG, “Environmental Product Declaration: EGGER EUROSPAN® Raw Chipboard EURODEKOR® Melamine faced Chipboard”, published by Institut Bauen und Umwelt e.V. The declaration is available at: [http://bau-umwelt.de/download/C69eabf0eX135c8458dc6XY7d18/EPD\\_EHW\\_2008311\\_E.pdf?ITServ=CY5ca1fbdX13c8e5099f3XY522e?ITServ=CY5ca1fbdX13c8e5099f3XY522e](http://bau-umwelt.de/download/C69eabf0eX135c8458dc6XY7d18/EPD_EHW_2008311_E.pdf?ITServ=CY5ca1fbdX13c8e5099f3XY522e?ITServ=CY5ca1fbdX13c8e5099f3XY522e).

The data covers the manufacturers' factories in Brilon and Wismar, Germany.

The declaration is in compliance with ISO 14045 and ISO 14040. The original data of the EPD (cradle-to-grave) has been modified to cover only the product stage A1–A3 (Cradle to Gate).

### 8.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 16.** Carbon footprint (A1–3) of High Density Fibreboard (Raw) – Germany, 6% moisture content.

CO <sub>2</sub> e g/kg	661.1
CO <sub>2</sub> fossil g/kg	661.1
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1436.7

## 9. Medium Density Fibreboard (raw) – Germany

### 9.1 Characterization of the product

MDF-boards are used mainly for furniture in dry conditions.

The boards consist of wood chips (82%), water (5–7%), UF-glue (11%) and paraffin wax (<1%).

The manufacturing process starts with boiling of wood chips, after which they are defibrated in a refiner. After the chips are dried, they are bonded with resins and spread onto a moulding conveyor. The chip-resin-matt is then compressed with continuous hot press, after which it is cut and trimmed to size. Once the ready rawboards are cooled in a radial cooler, they are destacked into large stacks and let to acclimatise. The raw boards are finalized by sanding top and bottom surfaces.

All the waste is re-used in process for heat generation.

Unit weight: 730 kg/m<sup>3</sup>

Moisture content: 5–7%

### 9.2 Data sources, assumptions and coverage

The CO<sub>2</sub>-data is based on an environmental product declaration of Fritz EGGER GmbH & Co. OG, “Environmental Product Declaration: EGGER EUROSPAN® Raw Chipboard EURODEKOR® Melamine faced Chipboard”, published by Institut Bauen und Umwelt e.V. The declaration is available at: [http://bau-umwelt.de/download/C69eabf0eX135c8458dc6XY7d18/EPD\\_EHW\\_2008311\\_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e?ITServ=CY5ca1fbdbX13c8e5099f3XY522e](http://bau-umwelt.de/download/C69eabf0eX135c8458dc6XY7d18/EPD_EHW_2008311_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e?ITServ=CY5ca1fbdbX13c8e5099f3XY522e).

The data covers the manufacturers’ factories in Brilon and Wismar, Germany.

The declaration is in compliance with ISO 14045 and ISO 14040. The original data of the EPD (cradle-to-grave) has been modified to cover only the product stage A1–A3 (Cradle to Gate).

### 9.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 17.** Carbon footprint (A1–3) of Medium Density Fibreboard (Raw) – Germany, 6% moisture content.

CO <sub>2</sub> e g/kg	652.0
CO <sub>2</sub> fossil g/kg	652.0
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1417.8

## **10. Medium Density Fibreboard (raw) – Sweden**

### **10.1 Characterization of the product**

MDF-boards are used mainly for furniture in dry conditions.

The boards consist of wood chips, water, UF-glue and paraffin wax.

The manufacturing process starts with boiling of wood chips, after which they are defibrated in a refiner. After the chips are dried, they are bonded with resins and spread onto a moulding conveyor. The chip-resin-matt is then compressed with continuous hot press, after which it is cut and trimmed to size. Once the ready rawboards are cooled in a radial cooler, they are destacked into large stacks and let to acclimatise. The raw boards are finalized by sanding top and bottom surfaces.

Unit weight: 740–810 kg/m<sup>3</sup>

Moisture content: 5.5%

### **10.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an environmental product declaration “Trätek, 1998. Medium density fiber board, Karlit AB. Environmental Product Declaration 9906815900002” (in Swedish).

The data covers the product stage A1–A3 (Cradle to Gate).

### **10.3 Carbon footprint of the product**

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.



**Calculation of CO<sub>2</sub> uptake**

It is assumed that the dry wood content of the product is 80% = 800 g/kg. It is further assumed that dry wood binds 1.832 kg of carbon dioxide per kg, therefore the carbon uptake can be estimated to be:

$$0.8 * 1.832 \text{ kg/kg} = 1.466 \text{ kg/kg.}$$

**Table 18.** Carbon footprint (A1–3) of Medium Density Fibreboard (Raw) – Sweden, 5.5% moisture content.

CO <sub>2</sub> e g/kg	340
CO <sub>2</sub> fossil g/kg	265
CH <sub>4</sub> g/kg	3
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1466

## 11. Medium Density Fibreboard (Melamine Faced) – Germany

### 11.1 Characterization of the product

MDF-boards are used mainly for furniture in dry conditions.

The boards consist of wood chips (82%), water (5–7%), UF-glue (11%), paraffin wax (<1%), decorative paper (60–120g/m<sup>2</sup>) and melamine formaldehyde resin.

The melamine faced fibreboards use MDF-boards as their raw boards.

The impregnating substances are made by first unrolling the base papers and uptaking the impregnating resin in the system. After this the impreganated paper is dried with heaters and cut to desired dimensions. The ready boards are then stacked onto pallets.

The melamine-faced boards are made by placing the impregnated material on the top / bottom surface of the raw board and pressing the board in hot press. After this the ready boards are stacked and let to acclimatise.

All the waste is re-used in process for heat generation.

Unit weight: 6,79 kg/m<sup>2</sup>

Moisture content: 5–7%

### 11.2 Data sources, assumptions and coverage

The CO<sub>2</sub>-data is based on an environmental product declaration of Fritz EGGER GmbH & Co. OG, “Environmental Product Declaration: EGGER EUROSPAN® Raw Chipboard EURODEKOR® Melamine faced Chipboard”, published by Institut Bauen und Umwelt e.V. The declaration is available at: [http://bau-umwelt.de/download/C69eabf0eX135c8458dc6XY7d18/EPD\\_EHW\\_2008311\\_E.pdf?ITServ=CY5ca1fbdX13c8e5099f3XY522e?ITServ=CY5ca1fbdX13c8e5099f3XY522e](http://bau-umwelt.de/download/C69eabf0eX135c8458dc6XY7d18/EPD_EHW_2008311_E.pdf?ITServ=CY5ca1fbdX13c8e5099f3XY522e?ITServ=CY5ca1fbdX13c8e5099f3XY522e)

The data covers the manufacturers’ factories in Brilon and Wismar, Germany.

The declaration is in compliance with ISO 14045 and ISO 14040. The original data of the EPD (cradle-to-grave) has been modified to cover only the product stage A1–A3 (Cradle to Gate).

### 11.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 19.** Carbon footprint (A1–3) of Medium Density Fibreboard (Melamine Faced) – Germany, 6% moisture content.

CO <sub>2</sub> e g/kg	788.0
CO <sub>2</sub> fossil g/kg	788.0
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1458.2

## **12. Oriented Strand Board, OSB (Raw) – Germany**

### **12.1 Characterization of the product**

OSB, or oriented strand board from cross-oriented layers of thin, rectangular wooden strips compressed and bonded together with wax and resin adhesives.

Unit weight: 600 kg/m<sup>3</sup>

Weight per square metre: 2.0–20.0 kg/m<sup>2</sup> (with a thickness of 4–40 mm)

Humidity: 9% (±4%)

### **12.2 Data sources, assumptions and coverage**

The data is based on an environmental product declaration by Institut Bauen und Umwelt e.V. “Egger Holzwerkstoffe – EUROSTRAND OSB, OS´Brace”. The environmental profile applies to OSB manufactured by Egger Holzwerkstoffe Wismar GmbH in its factory in Wismar, Germany.

The full declaration is available at: [http://bau-umwelt.de/download/C150a5d33X12e80faa159XY3a77/EPD\\_EHW\\_2008112\\_D.pdf](http://bau-umwelt.de/download/C150a5d33X12e80faa159XY3a77/EPD_EHW_2008112_D.pdf). It is based on the ISO standard 14025. The declaration covers the product stage A1–A3 (Cradle to Gate) but also some stage C (End of Life) considerations.

The carbon footprint presented in the following chapter takes into account only the product stage.

### **12.3 Carbon footprint of the product**

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

The original data expressed the emissions in terms of kg/m<sup>3</sup> (of ready product), and it has been converted to g/kg, by using unit weight of 600 kg/m<sup>3</sup>.

The following table is based on the image 4 (Abbildung 4) of the original data and it contains CO<sub>2</sub>-emissions from cradle to gate, excluding packaging materials.

**Table 20.** Carbon footprint (A1–3) of Oriented Strand Board (Raw) – Germany, 9% moisture content.

CO <sub>2</sub> e g/kg	208
CO <sub>2</sub> fossil g/kg	197.6
CH <sub>4</sub> g/kg	0.33
N <sub>2</sub> O g/kg	7 x 10 <sup>-3</sup>
CO <sub>2</sub> uptake g/kg	1692

## 13. Plywood (Standard Birch) – Finland

### 13.1 Characterization of the product

Standard birch plywood consists of birch veneer and mainly phenol formaldehyde glue. It can be applied to transport equipment, concrete formwork systems and furniture and indoor cladding.

Unit weight: 660 kg/m<sup>3</sup>

Weight per square metre: 6.1–20.4 kg/m<sup>2</sup> (with a thickness of 9–30 mm)

Humidity: 9%

### 13.2 Data sources, assumptions and coverage

The data is based on a Finnish RT Environmental Declaration “Standard Birch Plywood” by Puuinfo Oy. The environmental profile applies to standard birch plywood manufactured by one of the Finnish manufacturers (Metsaliitto Cooperative, Suolahti and Punkaharju plywood mills, UPM-kymmene Wood, Heinola, Joensuu, Jyväskylä, Kaukas and Savonlinna mills, Visuvesi Oy, Visuvesi mill, Koskisen Oy, Järvelä mill). It should be noted that the mills of Heinola, Kaukas and Visuvesi have been shut down after the publication of the profile. As a result, the data from these mills still effect the profile, even if these are already out of operation.

The full declaration is available at: <http://www.rts.fi/ymparistoseloste/ys034eng.pdf>.

It is based on the national methodology following the basic principles stated in the ISO standard series 14040 and 14020. The declaration covers the product stage A1–A3 (Cradle to Gate).

### 13.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub> uptake.

**Table 21.** Carbon footprint (A1–3) of Plywood (Standard Birch) – Finland, 9% moisture content.

CO <sub>2</sub> e g/kg	718
CO <sub>2</sub> fossil g/kg	650
CH <sub>4</sub> g/kg	2.7
N <sub>2</sub> O g/kg	3.3 x 10 <sup>-3</sup>
CO <sub>2</sub> uptake g/kg	1188

## 14. Plywood (Standard Conifer) – Finland

### 14.1 Characterization of the product

Standard conifer plywood consists of coniferous veneer and mainly phenol formaldehyde glue. It is used when high strength birch veneer is not required. It can be applied to concrete formwork systems, packaging and buildings.

Unit weight: 450 tkg/m<sup>3</sup>

Weight per square metre: 4.1–13.8 kg/m<sup>2</sup> (with a thickness of 9–30 mm)

Humidity: 9%

### 14.2 Data sources, assumptions and coverage

The data is based on a Finnish RT Environmental Declaration “Standard Conifer Plywood” by Puuinfo Oy. The environmental profile applies to standard coniferous plywood manufactured by one of the Finnish manufacturers (Metsaliitto Cooperative, Suolahti mill, or UPM-kymmene Wood, Jyväskylä and Pellos mills).

The full declaration is available at: <http://www.rts.fi/ymparistoseloste/ys035eng.pdf>. It is based on the national methodology following the basic principles stated in the ISO standard series 14040 and 14020. The declaration covers the product stage A1–A3 (Cradle to Gate).

### 14.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.



**Table 22.** Carbon footprint (A1-3) of Plywood (Standard Conifer) – Finland, 9% moisture content.

CO <sub>2</sub> e g/kg	605
CO <sub>2</sub> fossil g/kg	560
CH <sub>4</sub> g/kg	1.8
N <sub>2</sub> O g/kg	1.5 x 10 <sup>-3</sup>
CO <sub>2</sub> uptake g/kg	1708

## 15. Plywood – Sweden

### 15.1 Characterization of the product

Standard plywood consists of veneer and mainly phenol formaldehyde glue. It can be applied to transport equipment, concrete formwork systems and furniture and indoor cladding.

Unit weight: 575 tkg/m<sup>3</sup>

Thickness: 15 mm

Humidity: 5.5%

### 15.2 Data sources, assumptions and coverage

The data is based on an environmental product declaration: “Trätek, 1997. Träbaserade skivor, 15 mm konstruktionsplywood Vänerply AB, Environmental Product Declaration 9709079”. (In Swedish.)

The declaration covers the product stage A1–A3 (Cradle to Gate).

### 15.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 23.** Carbon footprint (A1–3) of Plywood – Sweden, 5.5% moisture content.

CO <sub>2</sub> e g/kg	229
CO <sub>2</sub> fossil g/kg	182
CH <sub>4</sub> g/kg	1.9 *
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1731

\* Hydrocarbons of original data are assumed to be 100% methane.

## 16. Laminate Flooring – Europe

### 16.1 Characterization of the product

Laminate flooring is used as decorative hard surface floor elements. Due to thin structure, it can be used on both new building and renovations. The floor is installed as floating floor without any adhesives, using click connections.

The laminate flooring combines a coreboard with a decorative paper, which are pressed together in a hot press. The pressed product forms a single element, called master board. After the master board is cooled, it is cut to size, and click profile is added to its edges.

The ready product is packed in ready packets with protective film.

All material wastage is fed back to process for heat production.

Laminate flooring is classified into five different categories, AC 1 to AC 5, based on their abrasion resistance. AC 1 has the least abrasion resistance while AC 5 has the most. This profile covers wear classes AC 3 to AC 5, or from moderate to high. More information on classes and testing is available in EN 13329.

Unit weight: 900 kg/m<sup>3</sup> (± 20 kg)

Moisture content: 5–7%

### 16.2 Data sources, assumptions and coverage

The CO<sub>2</sub>-data is based on an environmental product declaration of EGGER Retail Products GmbH & Co. KG, “Environmental Product Declaration: EGGER Laminate Flooring”, published by Institut Bauen und Umwelt e.V. The declaration is available at: [http://bau-umwelt.de/download/CY3969297eX137a7270bd8X1533/EPD\\_EHW\\_2008211\\_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e](http://bau-umwelt.de/download/CY3969297eX137a7270bd8X1533/EPD_EHW_2008211_E.pdf?ITServ=CY5ca1fbdbX13c8e5099f3XY522e).

The data covers the manufacturers’ laminate floor manufacturing, which is based in Germany.

The declaration is in compliance with ISO 14045 and ISO 14040. The original data of the EPD includes the product stage A1–A3 (Cradle to Gate), and some end-of-life considerations. This profile includes only cradle-to-gate data.

### 16.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

#### Calculation of CO<sub>2</sub> emissions

The manufacturer's EPD expresses the emissions in terms of emissions per square meter of a ready product. However, the EPD does not include exact information on the mass per square meter. The emissions are converted here from kg/m<sup>2</sup> to kg/kg-basis, by using the unit weight, 900 kg/m<sup>3</sup>, and a thickness of 6 mm. These calculation assumptions result in a unit weight of 5,4 kg/m<sup>2</sup>.

The original data states that the CO<sub>2</sub> emissions from the raw material extraction, production and packaging is 4.05 kg/m<sup>2</sup> of product. With the unit weight of 5,4 kg/m<sup>2</sup>, this equals to  $4,05/5,4 \text{ kg/kg} = 0,75 \text{ kg/kg} = 750 \text{ g/kg}$  of emissions.

#### Calculation of CO<sub>2</sub> uptake

The original data states that 7,97 kg of carbon dioxide is bound in 1m<sup>2</sup> of the end product. With the unit weight of 5,4 kg/m<sup>2</sup>, this equals to  $7,97/5,4 \text{ kg/kg} = 1,476 \text{ kg/kg} = 1476 \text{ g/kg}$  of carbon dioxide uptake.

**Table 24.** Carbon footprint (A1–3) of Laminate Flooring – Europe, 6% moisture content.

CO <sub>2</sub> e g/kg	750
CO <sub>2</sub> fossil g/kg	750
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1476

## **17. Massive Parquet – Germany**

### **17.1 Characterization of the product**

Massive Parquet is used as floor covering material in buildings.

Unit weight: 11,7 kg/m<sup>2</sup>

Moisture content: 7,4%

### **17.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und Holzbiologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012. This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### **17.3 Carbon footprint of the product**

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12.)

The original data states (Tabelle 3.2.18.A: Zusammensetzung der funktionalen Einheit) that one m<sup>2</sup> of product has a dry wood content of 10,84 kg/m<sup>2</sup>.

Based on this information, it can be calculated that one square metre of product has a CO<sub>2</sub> uptake of:

$$10,84 \text{ kg/m}^2 * 1,832 \text{ kg/kg} = 19,858 \text{ kg/m}^2.$$

The unit weight of the product is 11,71 kg/m<sup>2</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$19,858 \text{ kg/m}^2 / 11,71 \text{ kg/m}^2 = 1,696 \text{ kg/kg (or 1696 g/kg)}.$$

### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.18.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>2</sup>]).

The GWP stated in the original data is 34,446 kg/m<sup>2</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$34,446 / 11,71 = 2.942 \text{ kg/kg (or 2942 g/kg)}.$$

**Table 25.** Carbon footprint (A1–3) of Massive Parquet (Germany), 7.4% moisture content.

CO <sub>2</sub> e g/kg	2942
CO <sub>2</sub> fossil g/kg	2942
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1696

## 18. Multi-layer Parquet – Germany

### 18.1 Characterization of the product

Laminate flooring is used as floor covering material in buildings.

It consists of wood (63,6%), plywood (4,1%), HDF (21,7%), water (6,7%), UF (3,6%), PVAc (0,2%), EPI (0,08), and PUR (0,1%).

Unit weight: 8,87 kg/m<sup>2</sup>

Moisture content: 6,7%

### 18.2 Data sources, assumptions and coverage

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und Holzbiologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012. This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### 18.3 Carbon footprint of the product

The emissions in the following table are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.



### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12)

The original data states (Tabelle 3.2.19.A: Zusammensetzung der funktionalen Einheit) that one m<sup>2</sup> of product has a dry wood content of 7.938 kg/m<sup>2</sup>.

Based on this information, it can be calculated that square metre of product has a CO<sub>2</sub> uptake of:

$$7,938 \text{ kg/m}^2 * 1,832 \text{ kg/kg} = 14,542 \text{ kg/m}^2.$$

The unit weight of the product is 8,878 kg/m<sup>2</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$14,542 \text{ kg/m}^2 / 8,878 \text{ kg/m}^2 = 1,638 \text{ kg/kg (or 1638 g/kg)}.$$

### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.19.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>2</sup>]).

The GWP stated in the original data is 64,736 kg/m<sup>2</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$64,736 / 8,878 = 7,292 \text{ kg/kg (or 7292 g/kg)}.$$

**Table 26.** Carbon footprint (A1–3) of Multi-layer Parquet (Germany), 6.7% moisture content.

CO <sub>2</sub> e g/kg	7292
CO <sub>2</sub> fossil g/kg	7292
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1638

## 19. Timber, Cross Laminated Timber (CLT) – Germany

### 19.1 Characterization of the product

Cross-Laminated timber (CLT) is used in buildings for load-bearing structures such as walls, roofs and ceilings, but also in non-load-bearing applications. This profile is based on average data and production of 1 m<sup>3</sup> of CLT.

CLT consists of layers of wood, which are arranged crosswise and glued together under high pressure, using polyurethane glue. The CLT-elements are large, solid wood elements, which are cut to size using CNC technology. All the elements are made to match the plans of a specific customer.

The CLT under study consists of the following materials: wood (87,9%), water 10,5%, MUF-adhesive (0,8%), PU-adhesive (0,7%) and emulsion-polymer-isocyanate adhesive (0,04%).

Unit weight: 489,2 kg/m<sup>3</sup>

Moisture content: 10,5%

### 19.2 Data sources, assumptions and coverage

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und Holzbiologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012.

This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### 19.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

#### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12.)

The original data states (Tabelle 3.2.9.A: Zusammensetzung der funktionalen Einheit am Werkstor) that one m<sup>3</sup> of product has a dry wood content of 430,23 kg/m<sup>3</sup>.

Based on this information, it can be calculated that one cubic metre of wood has a CO<sub>2</sub> uptake of:

$$430,23 \text{ kg/m}^3 * 1,832 \text{ kg/kg} = 788,2 \text{ kg/m}^3.$$

The unit weight of the product is 489,22 kg/m<sup>3</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$788,2 \text{ kg/m}^3 / 489,22 \text{ kg/m}^3 = 1,611 \text{ kg/kg (or 1611 g/kg)}.$$

#### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.4.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>3</sup>]).

The GWP stated in the original data is 155,757 kg/m<sup>3</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$155,757 / 489,2 = 0,3184 \text{ kg/kg (or 318,4 g/kg)}.$$

In here, it is assumed that the GWP consists of CO<sub>2</sub> only.

The emissions in the following table are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years).

## 19. Timber, Cross Laminated Timber (CLT) – Germany

---

**Table 27.** Carbon footprint (A1–3) of Cross-Laminated timber (Germany), 10.5% moisture content.

CO <sub>2</sub> e g/kg	362,0
CO <sub>2</sub> fossil g/kg	362,0
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1611,0

## **20. Timber, Cross Laminated Timber (CLT) – Italy**

### **20.1 Characterization of the product**

Cross-Laminated timber (CLT) is used in buildings for load-bearing structures such as walls, roofs and ceilings, but also in non-load-bearing applications. This profile is based on average data and production of 1 m<sup>3</sup> of CLT.

CLT consists of layers of wood, which are arranged crosswise and glued together under high pressure, using polyurethane glue. The CLT-elements are large, solid wood elements, which are cut to size using CNC technology. All the elements are made to match the plans of a specific customer.

The CLT under study consists of the following materials: wood (87,94%), water (12%), oil and lubricating (0,02%), PU-adhesive (0,04%).

Unit weight: 450 kg/m<sup>3</sup>

Moisture content: 12%

### **20.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an extensive research on Italian wood products' environmental impacts "Valutazione e ottimizzazione delle prestazioni energetiche, di comfort ed ambientali di sistemi costruttivi a base di legno", conducted by Politecnico di Milano.

The data covers an Italian manufacture of wooden products, on a regional scale (Tuscany).

The impacts are assessed in compliance with UNI EN ISO 14040-14044, and result datasets expressed as required by EN 15804:2012.

This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### **20.3 Carbon footprint of the product**

The carbon footprint of the product is given for two different forms; in terms of dry wood content of the product and in terms of the actual product with moisture.

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### 20.3.1 Carbon footprint of the dry product

The emissions in the following table are given for the dry CLT, with 0% moisture content.

**Table 28.** Carbon footprint (A1–3) of Cross-Laminated timber (Italy), dry product.

CO <sub>2</sub> e g/kg	463
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1830

### 20.3.2 Carbon footprint of the product with 12% moisture content

The emissions in the following table are given for the actual product, with 12% moisture content.

**Table 29.** Carbon footprint (A1–3) of Cross-Laminated timber (Italy), 12% moisture content.

CO <sub>2</sub> e g/kg	407.44
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1610

## **21. Timber, Dried (coniferous) – Germany**

### **21.1 Characterization of the product**

The dried timber is available at all typical cross-sections for building purposes. The product is typically dried to the range of 8 to 20%.

Unit weight: 484,5 kg/m<sup>2</sup>

Moisture content: 10,7%

### **21.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und Holzbiologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012.

This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### **21.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12.)

The original data states (Tabelle 3.2.1.A: Zusammensetzung der funktionalen Einheit) that one m<sup>3</sup> of product has a dry wood content of 432,59 kg/m<sup>3</sup>.

Based on this information, it can be calculated that one cubic metre of wood has a CO<sub>2</sub> uptake of:

$$432,59 \text{ kg/m}^3 * 1,832 \text{ kg/kg} = 792,5 \text{ kg/m}^3.$$

The unit weight of the product is 484,5 kg/m<sup>3</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$792,5 \text{ kg/m}^3 / 485,5 \text{ kg/m}^3 = 1,636 \text{ kg/kg (or 1636 g/kg)}.$$

### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.2.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>3</sup>]).

The GWP stated in the original data is 57,756 kg/m<sup>3</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$57,756 / 484,5 \text{ kg} = 0,1192 \text{ kg/kg (or 119,2 g/kg)}.$$

**Table 30.** Carbon footprint (A1–3) of Dried Timber (Coniferous), Germany, 10.7% moisture content.

CO <sub>2</sub> e g/kg	119,2
CO <sub>2</sub> fossil g/kg	119,2
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1636,9



## **22. Timber, Dried (deciduous) – Germany**

### **22.1 Characterization of the product**

The dried timber is available at all typical cross-sections for building purposes. The product is typically dried to the range of 8 to 20%.

Unit weight: 761,60 kg/m<sup>3</sup>

Moisture content: 10,7%

### **22.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und Holzbiologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012. This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### **22.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12.)

The original data states (Tabelle 3.2.3.A: Zusammensetzung der funktionalen Einheit am Werkstor) that one m<sup>3</sup> of product has a dry wood content of 680,0 kg/m<sup>3</sup>.

Based on this information, it can be calculated that one cubic metre of wood has a CO<sub>2</sub> uptake of:

$$680,0 \text{ kg/m}^3 * 1,832 \text{ kg/kg} = 1245,76 \text{ kg/m}^3.$$

The unit weight of the product is 761,60 kg/m<sup>3</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$1245,76 \text{ kg/m}^3 / 761,60 \text{ kg/m}^3 = 1,636 \text{ kg/kg (or 1636 g/kg)}.$$

### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.3.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>3</sup>]).

The GWP stated in the original data is 127,457 kg/m<sup>3</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$127,457 / 761,6 \text{ kg} = 0,1674 \text{ kg/kg (or 167,4 g/kg)}.$$

**Table 31.** Carbon footprint (A1–3) of Dried Timber (Deciduous), Germany, 10.7% moisture content.

CO <sub>2</sub> e g/kg	167,4
CO <sub>2</sub> fossil g/kg	167,4
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1636

## **23. Timber, Dried – Finland**

### **23.1 Characterization of the product**

LCA for the Finnish average timber production resulted to the assessment of unequally dried products where special dry timber is the product which exposed to the artificial drying. Special dry timber is seasoned in a drying process where the ordinarily moisture content is less than 16% content (here it is assumed that it is 12%). There are a number of advantages in seasoning related to the:

- shrinkage, which take place before the use,
- strength, which is grater in seasoned wood than not seasoned and
- decay and fungi development, which cannot grow in a wood with a moisture content less than 20.

Results are valid for the timber made from pine and spruce and calculated for the cradle to gate stage.

Special dry timber products, which are seasoned to the upper grade, are intended to the carpentry use. For some kinds of timber, such as interior finish and flooring, which is more exacting than timber out-doors, the relatively low moisture content required which can only be obtained by artificial drying to the level of special dry timber.

Density for the dry pine is  $420 \text{ kg/m}^3$  and for the dry spruce is  $380 \text{ kg/m}^3$ .

### **23.2 Data sources, assumptions and coverage**

Data bases to the Finnish Stora Enso and UPM saw mills, according to the production year 2011.

### **23.3 Carbon footprint of the product**

The carbon footprint of the product is given for two different forms; in terms of dry wood content of the product and in terms of the actual product with moisture.

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### 23.3.1 Carbon footprint of the dry product

The emissions in the following table are given for the dry timber. The results are firstly calculated for the m<sup>3</sup>-bases which then converted to the g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years).

**Table 32.** Carbon footprint (A1–3) for seasoned timber to the level of Special Dry Timber, result is given for the dry product.

CO <sub>2</sub> e g/kg	121
CO <sub>2</sub> fossil g/kg	130
CH <sub>4</sub> g/kg	0.33
N <sub>2</sub> O g/kg	0.00012
CO <sub>2</sub> uptake g/kg	1835

### 23.3.2 Carbon footprint with 10,7% moisture content

The emissions of the previous chapter are converted to ones with a 10,7% moisture content for comparison with the German profile. This is done by simple calculation, where the profile of the dry wood is multiplied by the dry wood content of a wood product with a 10,7% moisture content. This means, the profiles are multiplied by 0,893.

This gives a CO<sub>2</sub>e value of  $0,893 * 68 = 43.9$  and a CO<sub>2</sub>uptake value of  $0,893 * 1835 = 1183.6$ .

**Table 33.** Carbon footprint (A1–3) for seasoned timber to the level of Special Dry Timber, result is given for product with 10,7% moisture content.

CO <sub>2</sub> e g/kg	108.1
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1638.7

## **24. Timber, Fresh – Germany**

### **24.1 Characterization of the product**

The fresh timber is sawn, untreated wooden building material.

Unit weight: 674,7 kg/m<sup>3</sup>

Moisture content: 35,5%

### **24.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und biologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012.

This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### **24.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12.)

The original data states (Tabelle 3.2.1.A: Zusammensetzung der funktionalen Einheit) that one m<sup>3</sup> of fresh timber has a dry wood content of 435,31 kg/m<sup>3</sup>.

Based on this information, it can be calculated that one cubic metre of wood has a CO<sub>2</sub> uptake of:

$$435,31 \text{ kg/m}^3 * 1,832 \text{ kg/kg} = 797,5 \text{ kg/m}^3.$$

The unit weight of the product is 674,7 kg/m<sup>3</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$797,5 \text{ kg/m}^3 / 674,7 \text{ kg/m}^3 = 1,182 \text{ kg/kg}.$$

### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.1.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>3</sup>]).

The GWP stated in the original data is 32,97 kg/m<sup>3</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$32,97 / 674,7 \text{ kg} = 0,0489 \text{ kg/kg (or 48,9 g/kg)}.$$

**Table 34.** Carbon footprint (A1–3) of Fresh Timber (Germany), 35,5% moisture content.

CO <sub>2</sub> e g/kg	48.9
CO <sub>2</sub> fossil g/kg	48.9
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1182

## **25. Timber, Fresh – Finland**

### **25.1 Characterization of the product**

LCA for the Finnish average timber production resulted to the assessment of unequally dried products where green timber is the product which not exposed to the artificial drying. Results are valid for the pine and spruce timber and calculated for the cradle to gate stage.

Green or unseasoned timbers are commonly used in heavy rough construction such as bridges, scaffold boards and beams, mill constructed buildings. In these use cases consideration should be given to the possibility of decay, if untreated, also some maintenance can be expected where shrinkage is involved. Obvious use for unseasoned timber is the solutions under water and ground.

Density for the dry pine is  $420 \text{ kg/m}^3$  and for the dry spruce is  $380 \text{ kg/m}^3$ .

### **25.2 Data sources, assumptions and coverage**

Data bases to the Finnish Stora Enso and UPM saw mills, according to the production year 2011.

### **25.3 Carbon footprint of the product**

The carbon footprint of the product is given for two different forms; in terms of dry wood content of the product and in terms of the actual product with moisture.

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### 25.3.1 Carbon footprint of dry timber

The emissions in the following table are given for the dry timber. The results are firstly calculated for the m<sup>3</sup>-bases which then converted to the g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years).

**Table 35.** Carbon footprint (A1–3) of unseasoned, Green Timber, result is given for the dry product.

CO <sub>2</sub> e g/kg	68
CO <sub>2</sub> fossil g/kg	64
CH <sub>4</sub> g/kg	0.13
N <sub>2</sub> O g/kg	0.00012
CO <sub>2</sub> uptake g/kg	1835

### 25.3.2 Carbon footprint with 35,5% moisture content

The emissions of the previous chapter are converted to ones with a 35,5% moisture content for comparison with the German profile. This is done by simple calculation, where the profile of the dry wood is multiplied by the dry wood content of a wood product with a 35,5% moisture content. This means, the profiles are multiplied by 0,645.

This gives a CO<sub>2</sub>e value of  $0,645 * 68 = 43.9$  and a CO<sub>2</sub>uptake value of  $0,645 * 1835 = 1183.6$ .

**Table 36.** Carbon footprint (A1–3) of unseasoned, Green Timber with moisture content of 35,5%.

CO <sub>2</sub> e g/kg	43.9
CO <sub>2</sub> fossil g/kg	43.9
CH <sub>4</sub> g/kg	0.084
N <sub>2</sub> O g/kg	0.0000077
CO <sub>2</sub> uptake g/kg	1183.6



## **26. Timber, Glued laminated – Sweden**

### **26.1 Characterization of the product**

Glued laminated timber is in building products, such as columns and beams.

Density 430 kg/m<sup>3</sup>

Moisture content: 5.5%

### **26.2 Data sources, assumptions and coverage**

Data is based on environmental declaration of gluelam. Trätek, 1996. Limträ Hållfasthet L40, Moelven Töreboda Limträ AB. Environmental Product Declaration 9608065E. (In Swedish.)

### **26.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

#### **Calculation of CO<sub>2</sub> uptake**

The carbon uptake is calculated by assuming that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. As the dry wood content is 945 g/kg, the carbon uptake equals to  $0,945 * 1.832 \text{ kg} = 1,73 \text{ kg/kg} = 1730\text{g/kg}$ .

## 26. Timber, Glued laminated – Sweden

---

**Table 37.** Carbon footprint (A1–3) of glued laminated timber, Sweden, 5.5% moisture content.

CO <sub>2</sub> e g/kg	109.0
CO <sub>2</sub> fossil g/kg	104.9
CH <sub>4</sub> g/kg	0.167
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1730

## **27. Timber, Planed – Germany**

### **27.1 Characterization of the product**

The planed timber is oven dried, and at least one surface of the product is planed.

Unit weight: 484,5 kg/m<sup>2</sup>

Moisture content: 10,7%

### **27.2 Data sources, assumptions and coverage**

The CO<sub>2</sub>-data is based on an extensive research on German wood products' environmental impacts "ARBEITSBERICHT aus dem Institut für Holztechnologie und Holzbiologie Nr. 2012/1: – Ökobilanz-Basisdaten für Bauprodukte aus Holz", published by VTI, Johan Heinrich von Thünen Institut of Zentrum Holzwirtschaft Universität Hamburg.

The declaration is available at: [http://literatur.vti.bund.de/digbib\\_extern/dn050490.pdf](http://literatur.vti.bund.de/digbib_extern/dn050490.pdf).

The data covers German manufacture of wooden products in a comprehensive way.

The impacts are assessed in compliance with DIN EN ISO 14040, and result datasets expressed as required by EN 15804:2012.

This environmental profile covers the product stage A1–A3 (Cradle to Gate).

### **27.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### Calculation of CO<sub>2</sub> uptake

The original data gives assumes that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. (This is based on the assumption that dry wood has a carbon content of 50% and on the relation of molecular masses of CO<sub>2</sub> and carbon, 44:12.)

The original data states (Tabelle 3.2.4.A: Zusammensetzung der funktionalen Einheit am Werkstor) that one m<sup>3</sup> of product has a dry wood content of 433,31 kg/m<sup>3</sup>.

Based on this information, it can be calculated that one cubic metre of wood has a CO<sub>2</sub> uptake of:

$$433,31 \text{ kg/m}^3 * 1,832 \text{ kg/kg} = 793,82 \text{ kg/m}^3.$$

The unit weight of the product is 484,51 kg/m<sup>3</sup>. Hence, the CO<sub>2</sub> uptake of 1 kg of the product equals to:

$$793,82 \text{ kg/m}^3 / 484,51 \text{ kg/m}^3 = 1,638 \text{ kg/kg (or 1638 g/kg)}.$$

### Calculation of CO<sub>2</sub>e

The original data includes only GWP totals. The GWP values are taken from the original data table (Tabelle 3.2.4.E: Haupteinflussfaktoren auf die Ergebnisse der drei relevantesten Wirkungsindikatoren (nach Normierung) [kg/m<sup>3</sup>]).

The GWP stated in the original data is 73,823 kg/m<sup>3</sup> of product. By dividing the number with the unit mass of the product, the GWP value can be expressed in the unit kg/kg (kg of emissions of kg of product) as follows:

$$73,823 / 484,51 \text{ kg} = 0,1524 \text{ kg/kg (or 152,4 g/kg)}.$$

**Table 38.** Carbon footprint (A1–3) of Planed Timber (Germany), 10.7% moisture content.

CO <sub>2</sub> e g/kg	152,4
CO <sub>2</sub> fossil g/kg	152,4
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1638

## 28. Timber, Shipping dry – Finland

### 28.1 Characterization of the product

LCA for the Finnish average timber production resulted to the assessment of unequally dried products where shipping dry timber is the product which exposed to the artificial drying. Shipping dry timber is partially seasoned in a drying process to the level of 18% moisture content (likely to have a moisture content of 16 to 20 per cent). There are a number of advantages in seasoning related to the:

- shrinkage, which take place before the use,
- strength, which is grater in seasoned wood than not seasoned and
- decay and fungi development, which cannot grow in a wood with a moisture content less than 20.

Results are valid for the timber made from pine and spruce and calculated for the cradle to gate stage.

Lower grade seasoning (shipping dry) products are intended for general use.

### 28.2 Data sources, assumptions and coverage

Data bases to the Finnish Stora Enso and UPM saw mills, according to the production year 2011.

Density for the dry pine is  $420 \text{ kg/m}^3$  and for the dry spruce is  $380 \text{ kg/m}^3$ .

### 28.3 Carbon footprint of the product

The carbon footprint of the product is given for two different forms; in terms of dry wood content of the product and in terms of the actual product with moisture.

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### 28.3.1 Carbon footprint for dry wood

The emissions in the following table are given for the dry timber. The results are firstly calculated for the m<sup>3</sup>-bases which then converted to the g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years).

**Table 39.** Carbon footprint (A1–3) for seasoned timber to the level of Shipping Dry Timber, result is given for the dry product.

CO <sub>2</sub> e g/kg	108
CO <sub>2</sub> fossil g/kg	101
CH <sub>4</sub> g/kg	0.25
N <sub>2</sub> O g/kg	0.00012
CO <sub>2</sub> uptake g/kg	1835

### 28.3.2 Carbon footprint with 18% moisture content

The emissions of the previous chapter are converted to ones with a 18% moisture content for comparison with other profiles profile. This is done by simple calculation, where the profile of the dry wood is multiplied by the dry wood content of a wood product with a 18% moisture content. This means, the profiles are multiplied by 0,82.

This gives a CO<sub>2</sub>e value of  $0,82 * 108 = 88.6$  and a CO<sub>2</sub>uptake value of  $0,82 * 1835 = 1504.7$ .

**Table 40.** Carbon footprint (A1–3) for seasoned timber to the level of Shipping Dry Timber, result is given product with a 18% moisture content.

CO <sub>2</sub> e g/kg	88.6
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1504.7

## 29. Timber, Shipping dry – Sweden

### 29.1 Characterization of the product

Shipping dry timber is partially seasoned in a drying process to the level of 18% moisture content (likely to have a moisture content of 16 to 20 per cent). There are a number of advantages in seasoning related to the:

- shrinkage, which take place before the use,
- strength, which is grater in seasoned wood than not seasoned and
- decay and fungi development, which cannot grow in a wood with a moisture content less than 20.

Lower grade seasoning (shipping dry) products are intended for general use.

Unit weight: 502,7 kg/m<sup>3</sup>  
Moisture content: 18,0%

### 29.2 Data sources, assumptions and coverage

Data is based on environmental product declaration: Träteck, 2000. Miljöfakta om trä och träprodukter, Träteck Kontenta. Environmental Product Declaration 0009032. (In Swedish.)

It is collected from 15 different sawmills in Sweden. (Coverage A1–A3.)

### 29.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

### Calculation of CO<sub>2</sub> uptake

The CO<sub>2</sub> uptake is calculated by assuming that 1 kg of dry wood binds 1,832 kg of carbon dioxide. The dry wood content of the product is 0,82 kg/kg, thus the amount of carbon uptake is  $0.82 * 1.832 \text{ kg/kg} = 1.502 \text{ kg/kg}$ .

**Table 41.** Carbon footprint (A1–3) for seasoned timber to the level of Shipping Dry Timber with moisture content of 18%.

CO <sub>2</sub> e g/kg	12.7
CO <sub>2</sub> fossil g/kg	12.7
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1502



## 30. Glass Wool – Europe

### 30.1 Characterization of the product

Glass wool is a standard mineral product used as an insulation product in construction industry.

The profile includes the melting of mineral primary glass at 1400°C. Energy used for melting is electricity and natural gas (50% / 50% ratio). The molten glass is centrifuged with a rotating drum with a secondary container and defibrated in a hot-air flow.

The fibres are cooled and solidified with help of evaporating water. After the fibres are solid, they are put through a tunnel oven with binder. Once ready, the insulation is cut to size and packed. The insulation can also be made into insulation boards where the glass wool board is coated with yellow glass fleece on one side.

Unit weight: 10–100 kg/m<sup>3</sup> (External walls with wooden supports 22 kg/m<sup>3</sup>, wall panels for partition walls 14 kg/m<sup>3</sup>, insulation of partition walls 100 kg/m<sup>3</sup>)

### 30.2 Data sources, assumptions and coverage

The data is based on ELCD database 2.0, Process data set: “Glass wool; fleeces; production mix, at plant; density between 10 to 100 kg/m<sup>3</sup>”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://ca.jrc.ec.europa.eu/lcaifohub/datasets/elcd/processes/898618b8-3306-11dd-bd11-0800200c9a66\\_02.01.000.xml](http://ca.jrc.ec.europa.eu/lcaifohub/datasets/elcd/processes/898618b8-3306-11dd-bd11-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### 30.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub> uptake.

**Table 42.** Carbon footprint (A1–3) of Glass wool.

CO <sub>2</sub> e g/kg	3148
CO <sub>2</sub> fossil g/kg	2909
CH <sub>4</sub> g/kg	7.7
N <sub>2</sub> O g/kg	0.16
CO <sub>2</sub> uptake g/kg	0

## 31. Polystyrene (EPS) – Europe

### 31.1 Characterization of the product

EPS is used as an insulation material in buildings.

EPS is produced from crude oil and natural gas. The main components used in EPS production are styrene and pentane, the latter of which typically vaporises during the production processes.

Unit weight: 10–60 kg/m<sup>3</sup>

### 31.2 Data sources, assumptions and coverage

The data is based on a report by Plastics Europe: “Eco-profiles of the European Plastics Industry POLYSTYRENE (Expandable) (EPS)”. The full report is available at: <http://www.plasticseurope.org/plastics-sustainability/eco-profiles/browse-by-flowchart.aspx?LCAID=r300>.

The data covers the product stage A1–A3 (Cradle to Gate) to form EPS pellets from raw materials.

### 31.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 43.** Carbon footprint (A1–3) of Polystyrene (EPS) – Europe.

CO <sub>2</sub> e g/kg	3300
CO <sub>2</sub> fossil g/kg	2500
CH <sub>4</sub> g/kg	31
N <sub>2</sub> O g/kg	0
CO <sub>2</sub> uptake g/kg	0

## **32. Polyurethane (Rigid Foam) – Europe**

### **32.1 Characterization of the product**

PU Rigid Foam is used as an insulation material in buildings.

Unit weight: 30–100 kg/m<sup>3</sup>

Polyurethane can be produced from different precursors such as MDI, TDI and polyols. This profile considers PUR-foam blown with pentane, which is typically used in insulation.

### **32.2 Data sources, assumptions and coverage**

The data is based on a report by Plastics Europe: “Eco-profiles of the European Plastics Industry POLYURETHANE RIGID FOAM”. The full report is available at: <http://www.plasticseurope.org/plastics-sustainability/eco-profiles/browse-by-flowchart.aspx?LCAID=r503>.

The data covers the product stage A1–A3 (Cradle to Gate) to form rigid foam PU from raw materials.

### **32.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 44.** Carbon footprint (A1–3) of Polyurethane (Rigid Foam) – Europe.

CO <sub>2</sub> e g/kg	4200
CO <sub>2</sub> fossil g/kg	3400
CH <sub>4</sub> g/kg	32
N <sub>2</sub> O g/kg	0,01
CO <sub>2</sub> uptake g/kg	0

## **33. Wood fibre insulation – Finland**

### **33.1 Characterization of the product**

Finnish wood fibre insulation materials are insulation products, made of certain types of newspaper. In the manufacturing process, boric minerals are added to the insulation mix to provide protection against fire and decay.

The material is used as insulation material in roofs, walls, and floors.

When used for walls, the insulation material is sprayed with a hose and a separate adhesive is mixed with the insulation material simultaneously.

Unit weight: 26–65 kg/m<sup>3</sup>

### **33.2 Data sources, assumptions and coverage**

The data is based on a Finnish RT Environmental Declaration “Termex wood fibre insulation” by Termex-Eriste Oy.

The original declaration is based on ISO standard series 14040 and 14044 and EN 15804. The declarations cover the product stage A1–A3 (Cradle to Gate).

### **33.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

**Table 45.** Carbon footprint (A1–3) of wood fibre insulation, Finland.

CO <sub>2</sub> e g/kg	243
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	1240

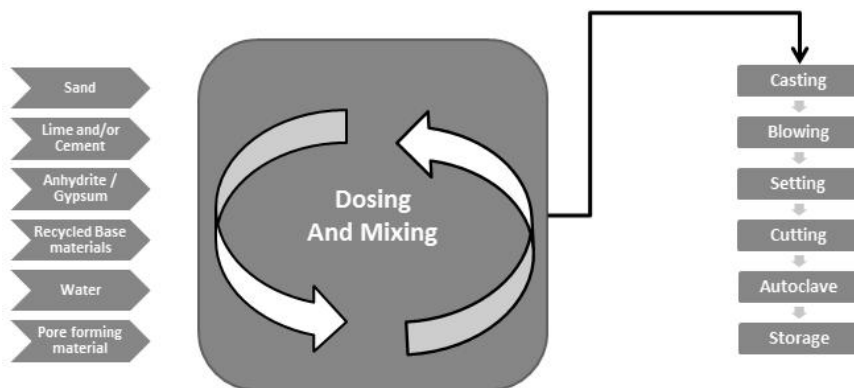
## 34. Aerated Concrete Block, P2 04 and P4 05 (Europe)

### 34.1 Characterization of the product

This profile presents the emissions from the production of aerated concrete block, which can be used in partition walls, inner walls and exterior walls.

Unit weight: 433 kg/m<sup>3</sup>

The main raw materials used for aerated concrete production are: quartz sand (60 to 70%), cement (CEMI, 20 to 30%), quick lime (10 to 20%) and gypsum (2 to 5%). The following figure illustrates the aerated concrete block production process. The process starts with mixing of the raw materials, after which the blocks are cast. The blocks are thereafter hardened using steam, and further processed (cut, rubbed), as necessary.



**Figure 1.** Aerated Concrete Block Production.

The data is based on ELCD database 3.0, Process data set: "Aerated concrete block;mix of P2 04 and P4 05;production mix, at plant; average density 433 kg/m<sup>3</sup>". The Owner of the data set is PE INTERNATIONAL and the dataset is available at:



<http://elcd.jrc.ec.europa.eu/ELCD3/resource/processes/898618b5-3306-11dd-bd11-0800200c9a66?format=html&version=03.00.000>.

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### 34.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 46.** Carbon footprint (A1–3) of Aerated Concrete Block, Europe.

CO <sub>2e</sub> g/kg	442.3
CO <sub>2</sub> fossil g/kg	429.2
CH <sub>4</sub> g/kg	0.49
N <sub>2</sub> O g/kg	3.5 x 10 <sup>-6</sup>
CO <sub>2</sub> uptake g/kg	–

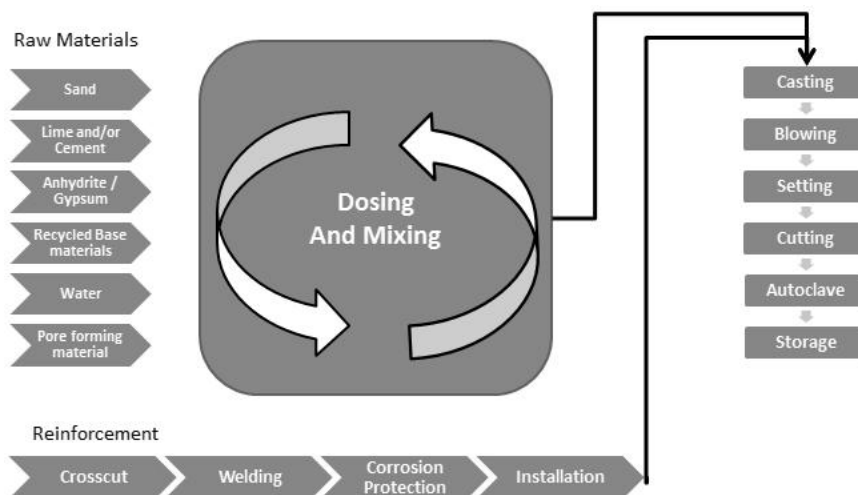
## 35. Aerated Concrete Block, P4 05, Reinforced (Europe)

### 35.1 Characterization of the product

This profile presents the emissions from the production of aerated concrete block, which can be used in partition walls, inner walls and exterior walls.

Unit weight: 433 kg/m<sup>3</sup>

The main raw materials used for aerated concrete production are: quartz sand (60 to 70%), cement (CEMI, 20 to 30%), quick lime (10 to 20%) and gypsum (2 to 5%). The production process of aerated concrete block is illustrated in the following figure. The process starts with mixing of the raw materials and production of reinforcement, after which the reinforcement is installed and blocks are cast. The blocks are thereafter hardened using steam, and further processed (cut, rubbed), as necessary.



**Figure 2.** Reinforced Aerated Concrete Block Production.

## 35.2 Data sources, assumptions and coverage

The data is based on ELCD database 3.0, Process data set: “Aerated concrete block;type P4 05 reinforced;production mix, at plant;average density 485 kg/m<sup>3</sup>”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: <http://elcd.jrc.ec.europa.eu/ELCD3/resource/processes/a8b2c610-429d-11dd-ae16-0800200c9a66?format=html&version=03.00.000>.

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

## 35.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 47.** Carbon footprint (A1–3) of Reinforced Aerated Concrete Block, Europe.

CO <sub>2e</sub> g/kg	511.3
CO <sub>2</sub> fossil g/kg	495.3
CH <sub>4</sub> g/kg	0.59
N <sub>2</sub> O g/kg	4.5 x 10 <sup>-6</sup>
CO <sub>2</sub> uptake g/kg	0

## 36. Aluminium (Extrusion profile) – Europe

### 36.1 Characterization of the product

Extruded aluminium profiles are used in buildings i.e. for window frames, balconies and scaffoldings.

Unit weight: 2700 kg/m<sup>3</sup>

The manufacture of aluminium consists of following stages:

- extraction of aluminium bauxite (from mines)
- processing of aluminium bauxite into aluminium oxide (in alumina plants)
- the aluminium metal is produced from aluminium oxide by an electrolytic process (also aluminium fluoride and carbon anodes are needed as raw materials)
- aluminium is alloyed and cast into ingots for rolling, extrusion or casting
- aluminium products are fabricated from ingots by hot working (mainly rolling/extrusion), usually followed by cold working.

Aluminium production scrap, formed during various fabrication steps is either recycled in a closed loop at the plant, or recycled outside by a specialised smelter.

The average recycling rate for extruded aluminium products is 88%.

### 36.2 Data sources, assumptions and coverage

The data is based on ELCD database 2.0, Process data set: “Aluminium extrusion profile; primary production; production mix, at plant; aluminium semi-finished extrusion product, including primary production, transformation and recycling”. The Owner of the data set is European aluminium association (EAA) and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/09215eb0-5fc9-11dd-ad8b-0800200c9a66\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/09215eb0-5fc9-11dd-ad8b-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### 36.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 48.** Carbon footprint (A1–3) of Aluminium extrusion profile.

CO <sub>2</sub> e g/kg	2264
CO <sub>2</sub> fossil g/kg	2147
CH <sub>4</sub> g/kg	4.2
N <sub>2</sub> O g/kg	4.2 x 10 <sup>-2</sup>
CO <sub>2</sub> uptake g/kg	–

## **37. Aluminium (Sheet) – Europe**

### **37.1 Characterization of the product**

Aluminium sheets are used in building sector i.e. for roofing and façade panels.

Typical thickness of aluminium sheets is between 0,2 and 4 mm, aluminium foil is not covered by this profile.

Unit weight: 2700 kg/m<sup>3</sup>

The average recycling rate for aluminium sheets is 79%.

The manufacturing process is described in the chapter “Aluminium (Extrusion profile)”.

### **37.2 Data sources, assumptions and coverage**

The data is based on ELCD database 2.0, Process data set: “Aluminium sheet; primary production; production mix, at plant; aluminium semi-finished sheet product, including primary production, transformation and recycling”. The Owner of the data set is European aluminium association (EAA) and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/09215eb1-5fc9-11d4-ad8b-0800200c9a66\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/09215eb1-5fc9-11d4-ad8b-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **37.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 49.** Carbon footprint (A1–3) of Aluminium sheet.

CO <sub>2</sub> e g/kg	2980
CO <sub>2</sub> fossil g/kg	2835
CH <sub>4</sub> g/kg	5.2
N <sub>2</sub> O g/kg	5.2 x 10 <sup>-2</sup>
CO <sub>2</sub> uptake g/kg	–

## 38. Ceramic tiles – Finland

### 38.1 Characterization of the product

The ceramic tiles are hard surface materials, which are used in buildings for floor and wall surfaces. The tiles made in numerous types, shapes and sizes. This profile covers an average tile of a Finnish tile manufacturer, Pukkila Oy Ab.

Ceramic tiles consist of clay, orthoclase, calcite, sand, glazing and additives.

Unit weight: 1350–1650 kg/m<sup>3</sup>\*

\*Calculated from the basis weight (10.7 kg/m<sup>2</sup>), by assuming thickness of 6.5–8 mm.

### 38.2 Data sources, assumptions and coverage

The data is based on a Finnish RT Environmental Declarations “Keraaminen laatta” by Pukkila Oy Ab. This environmental profile applies on an average ceramic tile by the producer.

The full declaration is available at: <http://www.rts.fi/ymparistoseloste/ys036.pdf> (in Finnish). The declaration is based on the national methodology following the basic principles stated in the ISO standard series 14040 and 14020. The declaration covers the product stage A1–A3 (Cradle to Gate).

### 38.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.



**Table 50.** Carbon footprint (A1–3) of Ceramic tile, Finland.

CO <sub>2</sub> e g/kg	612.5
CO <sub>2</sub> fossil g/kg	600
CH <sub>4</sub> g/kg	0.5
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	0

## **39. Cold Rolled Stainless Steel (Cr-Ni) – Finland, Sweden, U.K., US**

### **39.1 Characterization of the product**

The Cr-Ni stainless steels are general purpose grades with good resistance to atmospheric corrosion and to both organic and inorganic chemicals. It is often used in building-related applications where steel is in contact with food or drinking water.

Stainless steel is made of recycled stainless steel and carbon steel, together with ferrochrome and nickel. Chromium provides the corrosion resistance, while nickel further enhances it and improves the workability of the stainless steel. Recycled content is typically 85 to 90%.

The manufacturing of stainless steel consists of the following phases:

- the recycled steel is melted in the furnace and refined in a converter, and additional alloying components are added
- the stainless steel, which is cast in the form of slabs is hot rolled into thinner and longer strips
- the thickness is further reduced with cold rolling
- the material is softened by annealing and cleaned by pickling.

Density: 7750...8050 kg/m<sup>3</sup>

### **39.2 Data sources, assumptions and coverage**

The data is based on an environmental product declaration by Outokumpu Oyj: "ENVIRONMENTAL DECLARATION FOR COLD ROLLED Cr-Ni STAINLESS STEEL", published in September 2010. It is based on a LCI, done by PE International, utilizing data from manufacturing sites of Outokumpu.

The data is in compliance with ISO 14044. It covers the product stage A1–A3 (Cradle to Gate).

### 39.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 51.** Carbon footprint (A1–3) of Stainless steel.

CO <sub>2</sub> e g/kg	3778
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	0

## 40. Copper (Sheet) – Europe

### 40.1 Characterization of the product

Copper sheets are used in building sector i.e. for roofing and façade panels. Typical thickness of aluminium sheets for this purpose is 0.6 mm.

Unit weight: 8960 kg/m<sup>3</sup>

The average European recycling rate for copper is 95%.

The copper sheets are made of copper cathode, or virgin copper, and scrap. The scrap can be from both inside (from cuttings, etc.) and outside the process. The basic production process for copper cathode is similar worldwide.

The state of the art copper sheet production process starts with mining and processing. This is followed by copper cathode production, by either hydrometallurgy or pyrometallurgy. The first production method (hydrometallurgy) includes leaching, solvent extraction and electro winning, while the latter (pyrometallurgy) consists of smelting, converting, fire refining and electrolytic refining.

After the copper cathode production, the semi-fabricated products are produced from the cathodes and scrap by melting and alloying and then by casting and rolling.

### 40.2 Data sources, assumptions and coverage

The data is based on ELCD database 2.0, Process data set: “Copper sheet; technology mix; consumption mix, at plant; 0,6 mm thickness”. The Owner of the data set is European Copper Institute (ECI) and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/contacts/42a11490-573c-11dd-ae16-0800200c9a66\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/contacts/42a11490-573c-11dd-ae16-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### 40.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 52.** Carbon footprint (A1–3) of Copper sheet, Europe.

CO <sub>2</sub> e g/kg	973.2
CO <sub>2</sub> fossil g/kg	921
CH <sub>4</sub> g/kg	1.8
N <sub>2</sub> O g/kg	$2 \times 10^{-2}$
CO <sub>2</sub> uptake g/kg	0

## **41. Copper (Tube) – Europe**

### **41.1 Characterization of the product**

Copper tubes are used in building sector i.e. for drinking water, heating and gas systems. This profile is based on a typical tube for such solutions, with a diameter of 15 mm and 1 mm wall thickness.

Unit weight: 8960 kg/m<sup>3</sup>

The production process for copper is illustrated in detail in chapter “Copper (Sheet) – Europe”.

### **41.2 Data sources, assumptions and coverage**

The data is based on ELCD database 2.0, Process data set: “Copper tube; technology mix; consumption mix, at plant; diameter 15 mm, 1 mm thickness”. The Owner of the data set is European Copper Institute (ECI) and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/a1baa4f2-50d3-44a1-b806-465c3d9ef1a7\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/a1baa4f2-50d3-44a1-b806-465c3d9ef1a7_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **41.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 53.** Carbon footprint (A1–3) of Copper tube, Europe.

CO <sub>2</sub> e g/kg	980.8
CO <sub>2</sub> fossil g/kg	927.5
CH <sub>4</sub> g/kg	1.9
N <sub>2</sub> O g/kg	2.1 x 10 <sup>-2</sup>
CO <sub>2</sub> uptake g/kg	–

## **42. Copper (Wire) – Europe**

### **42.1 Characterization of the product**

Copper wire is a standard in residential buildings' electric installations. It's also used in building systems in transformers and motors. This profile is based on an uninsulated wire with 1 mm<sup>2</sup> cross-section.

Unit weight: 8960 kg/m<sup>3</sup>

The production process for copper is illustrated in detail in chapter “Copper (Sheet) – Europe”.

### **42.2 Data sources, assumptions and coverage**

The data is based on ELCD database 2.0, Process data set: “Copper wire; technology mix; consumption mix, at plant; cross section 1 mmy (en)”. The Owner of the data set is European Copper Institute (ECI) and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/11bceac4-b3d8-4048-8e80-b691ecd2c261\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/11bceac4-b3d8-4048-8e80-b691ecd2c261_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **42.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.



**Table 54.** Carbon footprint (A1–3) of Copper wire, Europe.

CO <sub>2</sub> e g/kg	788.3
CO <sub>2</sub> fossil g/kg	745.0
CH <sub>4</sub> g/kg	1.6
N <sub>2</sub> O g/kg	2 x 10 <sup>-2</sup>
CO <sub>2</sub> uptake g/kg	–

## **43. Crushed Stone 16/32 – Europe**

### **43.1 Characterization of the product**

Crushed stone 16/32 is a standard mineral product used as an aggregate in construction industry.

The profile includes limestone quarrying and crushing. The milling is done by roller mills, after which the product is sorted by size in vibration sieves, or an upstream classifier. The profile does not include the infrastructure or production of the manufacturing facility.

Unit weight: 1400 kg/m<sup>3</sup>

### **43.2 Data sources, assumptions and coverage**

The data is based on ELCD database 2.0, Process data set: “Crushed stone 16/32; open pit mining; production mix, at plant; undried”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b3-3306-11dd-bd11-0800200c9a66\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b3-3306-11dd-bd11-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **43.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 55.** Carbon footprint (A1–3) of Crushed stone, Europe.

CO <sub>2</sub> e g/kg	13.7
CO <sub>2</sub> fossil g/kg	12.9
CH <sub>4</sub> g/kg	0.02
N <sub>2</sub> O g/kg	9.6 x 10 <sup>-4</sup>
CO <sub>2</sub> uptake g/kg	0

## **44. Glass (Float Glass) – Europe**

### **44.1 Characterization of the product**

Float glass is used in windows and glazing of buildings.

Unit weight: 2500 kg/m<sup>3</sup>

The raw materials of float glass include primarily sand, soda ash, dolomite, limestone and glass cullet. The batch materials and fuels are fed into a furnace melt, where they form molten glass. The molten glass is then floated on top of a molten tin bath, thus giving the product its name. The flotation causes the glass to form a ribbon of uniform thickness. After this the mass is cooled down and cut into size. The process allows producing glass sheets with uniform thickness and ready, finished surface.

The glass is then treated (coated etc.) to give it the needed properties. This data covers only the environmental impacts of the float glass, excluding surface finishes, coatings, etc.

### **44.2 Data sources, assumptions and coverage**

The data is based on a life cycle assessment of float glass: “Life Cycle Assessment of Float Glass”, done in 2011. The Owner of the data set is Glass for Europe (GfE).

The data covers the product stage A1–A3 (Cradle to Gate), but includes only the float glass, not coatings, frames, or other components of windows.

### **44.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 56.** Carbon footprint (A1–3) of Float Glass, Europe.

CO <sub>2</sub> e g/kg	1230
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	–

## **45. Gravel 2/32 – Europe**

### **45.1 Characterization of the product**

Gravel 2/32 is a standard mineral product used as an aggregate in construction industry.

The profile includes quarrying of the stone and its preparation. The raw materials are extracted, after which they are washed. The product is sorted by size in vibration sieves, or an upstream classifier. The profile does not include the infrastructure or production of the manufacturing facility.

Unit weight: 1700 kg/m<sup>3</sup>

### **45.2 Data sources, assumptions and coverage**

The data is based on ELCD database 2.0, Process data set: “Gravel 2/32; wet and dry quarry; production mix, at plant; undried (en)”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b2-3306-11dd-bd11-0800200c9a66\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b2-3306-11dd-bd11-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **45.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 57.** Carbon footprint (A1–3) of Gravel 2/32, Europe.

CO <sub>2</sub> e g/kg	3.3
CO <sub>2</sub> fossil g/kg	3.2
CH <sub>4</sub> g/kg	0.01
N <sub>2</sub> O g/kg	6.1 x 10 <sup>-5</sup>
CO <sub>2</sub> uptake g/kg	0

## 46. Gypsum Plaster (CaSO<sub>4</sub>) – Germany

### 46.1 Characterization of the product

Gypsum plaster is a standard mineral product used as bonding agent and moulding in the building industry.

Gypsum plaster is made by calcinating calcium sulphate hydrate to hemihydrate in rotary kilns. The sulphate hydrate comes from open-cast mining (45%) and from flue gas desulphurization in hard coal power plants (55%). The impacts of the sulphate hydrate from power plants includes electricity consumption of the dehydration and purification of the gypsum slurry.

Unit weight: 2760 kg/m<sup>3</sup>

### 46.2 Data sources, assumptions and coverage

The data is based on ELCD database 2.0, Process data set: “Gypsum plaster (CaSO<sub>4</sub> alpha hemihydrates); via calcination of calcium sulphate dihydrate; production mix, at plant; grinded and purified product (en). The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/xdatasets/elcd/processes/8b190559-3845-4ba8-a9a6-77ca998b38b1\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/xdatasets/elcd/processes/8b190559-3845-4ba8-a9a6-77ca998b38b1_02.01.000.xml)

The declaration is in compliance with ISO 14040 to 14044 and it covers the product stage A1–A3 (Cradle to Gate).

The unit weight of the product is based on IPCS's datasheet “Plaster of Paris, Gypsum hemihydrate”. Available at: <http://www.inchem.org/documents/icsc/icsc/eics1217.htm>.

### 46.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.



**Table 58.** Carbon footprint (A1–3) of Gypsum plaster, Germany.

CO <sub>2</sub> e g/kg	243.2
CO <sub>2</sub> fossil g/kg	230
CH <sub>4</sub> g/kg	0.47
N <sub>2</sub> O g/kg	4.7 x 10 <sup>-3</sup>
CO <sub>2</sub> uptake g/kg	0

## 47. Gypsum Stone (CaSO<sub>4</sub>) – Germany

### 47.1 Characterization of the product

Gypsum stone is a standard mineral product used as bonding agent and moulding in the building industry.

Gypsum stone (calcium sulphate dehydrate) is produced by open-pit mining. The stone is crushed, grinded, dried and purified.

Unit weight: 2320 kg/m<sup>3</sup>

### 47.2 Data sources, assumptions and coverage

The data is based on ELCD database 2.0, Process data set: “Gypsum stone (CaSO<sub>4</sub>-dihydrate); underground and open pit mining; production mix, at plant; grinded and purified product; via calcination of calcium sulphate dihydrate; production mix, at plant; grinded and purified product (en). The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/5adbdf6-401f-4dfa-a3ec-1699064adb34\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/5adbdf6-401f-4dfa-a3ec-1699064adb34_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044 and it covers the product stage A1–A3 (Cradle to Gate).

The unit weight of the product is based on UNEP’s publication “SIDS Initial Assessment Report: Calcium sulphate, dehydrate”. Available at: <http://www.inchem.org/documents/sids/sids/10101414.pdf>.

### 47.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 59.** Carbon footprint (A1–3) of Gypsum stone, Germany.

CO <sub>2</sub> e g/kg	2.7
CO <sub>2</sub> fossil g/kg	2.4
CH <sub>4</sub> g/kg	$3.6 \times 10^{-3}$
N <sub>2</sub> O g/kg	$6.2 \times 10^{-4}$
CO <sub>2</sub> uptake g/kg	0

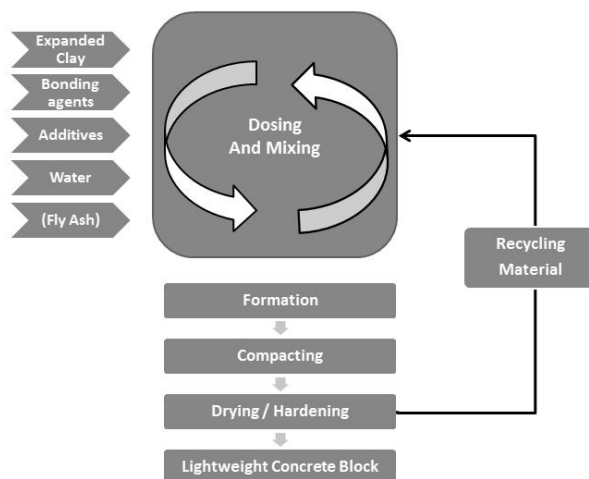
## 48. Lightweight Concrete Block – Europe

### 48.1 Characterization of the product

This profile presents the emissions from the production of lightweight concrete brick, which can be used in partition walls, inner walls and exterior walls.

Unit weight: 500...1600 kg/m<sup>3</sup>

The following figure illustrates the production of the lightweight concrete blocks. The lightweight concrete blocks are produced with a dry mixing process from expanded clay and bonding agents (8 to 12% of the mixture). After the dry mixing, water is added to form a formable concrete mix. The ready mixture is poured into moulds, compacted with vibration, and later on, removed from the moulds. The ready blocks are dried for 24 to 36 hours, after which they are cured and stacked to pallets for some four to six weeks.



**Figure 3.** Lightweight Concrete Block Production.

## 48.2 Data sources, assumptions and coverage

The data is based on ELCD database 3.0, Process data set: “Lightweight concrete block;expanded clay as base material;production mix, at plant”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: <http://elcd.jrc.ec.europa.eu/ELCD3/resource/processes/898618b6-3306-11dd-bd11-0800200c9a66?format=html&version=03.00.000>.

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

## 48.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2e</sub> is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2e</sub> figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 60.** Carbon footprint (A1–3) of Lightweight Concrete Block, Europe.

CO <sub>2e</sub> g/kg	239.7
CO <sub>2</sub> fossil g/kg	231.7
CH <sub>4</sub> g/kg	0.29
N <sub>2</sub> O g/kg	3.1 x 10 <sup>-6</sup>
CO <sub>2</sub> uptake g/kg	0

## 49. Polyethene (LDPE) – Europe

### 49.1 Characterization of the product

LDPE films are used as packaging and building materials used as an insulation material in buildings. This profile covers the LDPE-resin manufacture process, excluding the film extrusion phase. Therefore, the values stated here underestimate the emissions of LDPE-film manufacturing.

Unit weight:  $<940 \text{ kg/m}^3$

LDPE is polyethene with a density of  $<940 \text{ kg/m}^3$ . It is produced by a high pressure process, therefore often referred to, as high pressure polyethylene. The starting material for polyethene is ethylene. Co-monomers, such as vinyl acetate, butyl acetate, methyl methacrylate are used to gain specific density and physical properties. The main technology used for LDPE-production is so called autoclave and tubular high pressure technology.

### 49.2 Data sources, assumptions and coverage

The data is based on an EPD by Plastics Europe: “Environmental Product Declarations of the European Plastics Manufacturers: – Low density polyethylene (LDPE)”.

The full EPD is available at: <http://www.plasticseurope.org/plastics-sustainability/eco-profiles/browse-by-flowchart.aspx?LCAID=r29>. The data covers the product stage A1–A3(Cradle to Gate) to form LDEP.

### 49.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 61.** Carbon footprint (A1–3) of Polyethene (LDPE), Europe.

CO <sub>2</sub> e g/kg	2130
CO <sub>2</sub> fossil g/kg	1700
CH <sub>4</sub> g/kg	17
N <sub>2</sub> O g/kg	0
CO <sub>2</sub> uptake g/kg	0

## **50. Pre-cast Concrete**

### **50.1 Characterization of the product**

This profile presents the emissions from the production of pre-cast concrete, which is used as elements in the construction industry.

The profile includes all the phases of concrete element production, except the preparation of the casings. The product consists of concrete (C20/25) and reinforcement (share of 0,5%).

Unit weight: 2400 kg/m<sup>3</sup>

### **50.2 Data sources, assumptions and coverage**

The data is based on ELCD database 3.0, Process data set: “Pre-cast concrete;minimum reinforcement;production mix, at plant;concrete type C20/25, without consideration of casings”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: <http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b0-3306-11dd-bd11-0800200c9a66.xml>.

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **50.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.



**Table 62.** Carbon footprint (A1–3) of Pre-cast Concrete 20/25 (Europe).

CO <sub>2</sub> e g/kg	120,5
CO <sub>2</sub> fossil g/kg	117.7
CH <sub>4</sub> g/kg	0.1
N <sub>2</sub> O g/kg	9.6 x 10 <sup>-7</sup>
CO <sub>2</sub> uptake g/kg	0

## **51. Sand 0/2 – Europe**

### **51.1 Characterization of the product**

Sand 0/2 is a standard mineral product used as an aggregate in construction industry.

The profile includes quarrying of the stone and its preparation. The raw materials are extracted, after which they are washed. The product is sorted by size in vibration sieves, or an upstream classifier. The profile does not include the infrastructure or production of the manufacturing facility.

Unit weight: 1500 kg/m<sup>3</sup>

### **51.2 Data sources, assumptions and coverage**

The data is based on ELCD database 2.0, Process data set: “Sand 0/2; wet and dry quarry; production mix, at plant; undried”. The Owner of the data set is PE INTERNATIONAL and the dataset is available at: [http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b1-3306-11dd-bd11-0800200c9a66\\_02.01.000.xml](http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/898618b1-3306-11dd-bd11-0800200c9a66_02.01.000.xml).

The declaration is in compliance with ISO 14040 to 14044. It covers the product stage A1–A3 (Cradle to Gate).

### **51.3 Carbon footprint of the product**

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

**Table 63.** Carbon footprint (A1–3) of Sand 0/2 (Europe).

CO <sub>2</sub> e g/kg	2.4
CO <sub>2</sub> fossil g/kg	2.3
CH <sub>4</sub> g/kg	$3.7 \times 10^{-3}$
N <sub>2</sub> O g/kg	$3.8 \times 10^{-5}$
CO <sub>2</sub> uptake g/kg	0

## 52. Interior Door – Sweden

### 52.1 Characterization of the product

This profile presents the environmental impacts of an interior door, made of veneer (type: modul 10–21, SSC 1998). The size of the door is 1 m x 2.1 m.

Unit weight: 50 kg/pcs

Moisture content: 10% (not available, estimated)

### 52.2 Data sources, assumptions and coverage

The data is based on an environmental declaration: Tråtek, 2000. Environmental product declaration 9804021, veneer interior door module 10-21, SSC 1998, covering the phases A1–A3.

### 52.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPPC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

The carbon dioxide uptake is calculated by assuming that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. As the dry wood content is 900 g/kg, the carbon uptake equals to  $0,9 * 1.832 \text{ kg} = 1,65 \text{ kg/kg} = 1650 \text{ g/kg}$ .

As the mass of a single door is 50 kg, the total amount of carbon dioxide uptake is:  $1650 \text{ g/kg} * 50 \text{ kg} = 82\,500 \text{ g} = 82,5 \text{ kg}$ .

**Table 64.** Carbon footprint (A1–3) of internal door (1pc, 1 m x 2,1m).

CO <sub>2</sub> e g/kg	18 450
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	82 500

## 53. Window – Sweden

### 53.1 Characterization of the product

This profile presents the environmental impacts of a wood window. The material composition of the product is as follows:

- Glass 31 kg/window, pine wood impregnated 16,5 kg/window, Steel (fittings, etc) 1,6 kg/window, Aluminum profiles 0,8 kg/window, PVAc glue 0,02 kg/window, Urea alkyd paint 0,8 kg/window, LDPE 0,026 kg/window, ASA/TPE 0,23 kg/window, ABS 0,12 kg/window, EPDM 0,14 kg/window, acrylic putty 0,004 kg/window, Butyl 0,04 kg/window, polysulfide 0,32 kg /window.

The size of the window is 1.2 m x 1.2 m.

Unit weight: 51.6 kg/pcs

Moisture content of wood: 10% (not available, estimate)

### 53.2 Data sources, assumptions and coverage

Elitfönster AB, 1998. Environmental product declaration No. 9810067, wood window KIFI 12x12. (updated 2002), covering the phases A1–A3.

### 53.3 Carbon footprint of the product

The emissions in the following tables are given in g/kg. The CO<sub>2</sub>e is a sum of fossil based emissions calculated with help of IPCC weighting factors (for 100 years). The CO<sub>2</sub>e figure excludes the biogenic carbon dioxide emissions and sequestered carbon.

However, the amount of sequestered carbon is also given as a separate figure, named as CO<sub>2</sub>uptake.

The carbon dioxide uptake is calculated by assuming that one kilogram of dry wood binds 1.832 kg of CO<sub>2</sub>. As the dry wood content is 0,9 \* 16,5 kg = 14.85 kg/window,

the carbon uptake equals to

$14.85 \text{ kg/window} * 1.832 \text{ kg} = 27.2 \text{ kg/window} = 27200 \text{ g/window}$ .

**Table 65.** Carbon footprint (A1–3) of a wood window (1pc, 1.2 m x 1.2 m), Sweden.

CO <sub>2</sub> e g/kg	42 175
CO <sub>2</sub> fossil g/kg	–
CH <sub>4</sub> g/kg	–
N <sub>2</sub> O g/kg	–
CO <sub>2</sub> uptake g/kg	27 200

## **54. Conclusions and recommendations**

The data of this report can be used in assessing the material-related GHG-emissions from building materials. These figures can be used in assessing the cradle to gate GHG-emissions from building material production.



## Appendix A: Global warming potentials of different GHGs according to the IPCC 4th assessment report

The following table presents the global warming potential for different GHGs according to the IPCC 4<sup>th</sup> assessment report. (Available online at: [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/tssts-2-5.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/tssts-2-5.html).)

Chemical species	100 year GWP
Methane	23
Nitrous oxide	296
Perfluoromethane	5700
Perfluoroethane	11900
Sulphur Hexafluoride	22200
HFC-23	12000
HFC-134a	1300
HFC152a	120



## Appendix B: Carbon Footprint

Carbon footprint is defined here as a net sum of all greenhouse gases (GHGs) associated with a product's whole life cycle or a defined part of it.

ISO TR 15067-1 Carbon footprint of products – Part 1: Quantification (ISO/TC 207/SC 7 2010-09-02) defines the related terms as follows:

### Carbon footprint, CF

*Net<sup>18</sup> amount of greenhouse gas emissions and greenhouse gas removals, expressed in CO<sub>2</sub> equivalents*

*The CO<sub>2</sub> equivalent is calculated using the mass of a given GHG multiplied by its global warming potential.*

### Greenhouse Gas, GHG

*Gaseous constituent of the atmosphere, both natural and anthropogenic, that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the earth's surface, the atmosphere, and clouds  
GHGs include among others carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).*

### Carbon dioxide equivalent, CO<sub>2</sub> equivalent, CO<sub>2</sub>e

*Unit for comparing the radiative forcing of a GHG to carbon dioxide*

*The carbon dioxide equivalent is calculated using the mass of a given GHG multiplied by its global warming potential.*

### Global warming potential, GWP

*Factor describing the radiative forcing impact of one mass-based unit of a given GHG relative to an equivalent unit of carbon dioxide over a given period of time*

### Climate change

*Change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.*

---

<sup>18</sup> Including total mass of greenhouse gas emissions (GHG emission) of a GHG released to the atmosphere, over a specified period of time, and total mass of greenhouse gas removals (GHG removal) of a GHG removed from the atmosphere over a specified period of time.



Title	<b>Carbon footprint for building products ECO2 data for materials and products with the focus on wooden building products</b>
Author(s)	Antti Ruuska (ed.)
Abstract	<p>This report presents a collection of carbon footprint data for building products. The information has been collected in the European ECO2 research project. The main objectives of the project were to define principles for carbon footprint assessment, and to assess greenhouse gas impacts of wooden building products and buildings.</p> <p>The purpose of this report is to present the carbon footprint data of selected building products. This report focuses on wooden building products. It contains both country-level data from Europe, as well as European-level data. However, since one of the objectives of the ECO2 research project is to assess the greenhouse gas impacts of whole buildings, also other building products are included in the report.</p> <p>The information collected in this report is based on either on publicly available information on greenhouse gases of building materials, or on information collected within ECO2 project work package 3. All information is given in a similar format in such a way that it covers the stages A1, A2 and A3 in accordance with EN 15804.</p> <p>In order to assess the environmental impacts of whole buildings, an easy-to-use calculation tool was also created. The carbon footprint data presented in this report serves as the background data for the calculation tool. All the greenhouse gas data presented in this report is built-in into the calculation tool. This allows both ease of assessments and transparency of data.</p>
ISBN, ISSN	ISBN 978-951-38-8042-2 (URL: <a href="http://www.vtt.fi/publications/index.jsp">http://www.vtt.fi/publications/index.jsp</a> ) ISSN-L 2242-1211 ISSN 2242-122X (Online)
Date	August 2013
Language	English
Pages	126 p. + app. 2 p.
Name of the project	
Commissioned by	
Keywords	Carbon footprint, wood product, building product
Publisher	VTT Technical Research Centre of Finland P.O. Box 1000, FI-02044 VTT, Finland, Tel. 020 722 111

## **Carbon footprint for building products**

ECO2 data for materials and products with the focus on wooden building products

ISBN 978-951-38-8042-2 (URL: <http://www.vtt.fi/publications/index.jsp>)

ISSN-L 2242-1211

ISSN 2242-122X (Online)

