

Pellets by Stora Enso

Environmental Product Declaration



Manufacturer: Stora Enso Wood Products Oy Ltd, P.O.Box 309, FI-00101 Helsinki, Finland

Manufacturing sites: Ala (Sweden), Gruvön (Sweden), Imavere (Estonia), Impilahti (Russia), Launkalne (Latvia), Näpi (Estonia), Nebolchi (Russia), Zdirec (Czech Republic)

Declared units:

- 1) 15kg of packed high-quality wood pellets in weight-fitting HDPE bag
- 2) 12kg of packed high-quality wood pellets in weight-fitting cardboard box
- 3) 500 kg of packed high-quality wood pellets in weight-fitting PP/PE bag
- 4) 1000 kg of high-quality wood pellets as bulk

Functional units:

- 1) Provide 1000 MJ of thermal energy produced by burning high-quality wood pellets
- 2) Provide bedding material for an average size adult horse in a typical horse stable in Sweden for 1 year and thus being equal to 1000 kg of high-quality wood pellets

Approval date: 2021-12-09

Valid until: 2026-12-08

Reference year: 2018/2019

The declaration is calculated on the basis of standards ISO 14025, ISO 14040 and ISO 14044. The results are compliant and applicable for Environmental Product Declarations (EPDs) following EN 15804:2013+A2:2019

Verification: Verification of the declaration and data is done according to EN ISO 14025 except those parts that include a program operator.

☐ internal verification ☒ external verification



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The renewable materials company

Stora Enso is a leading global provider of renewable solutions in packaging, biomaterials, wooden construction and paper. Our aim is to replace fossil-based materials by innovating and developing new products and services based on wood and biomass. Being responsible – doing good for people and the planet – underpins our strategy and our business approach.

We make every effort to use 100% of the tree for our products as well as for producing bioenergy. In production, we are pushing towards carbon neutrality as much as it is technically and commercially feasible. We practice and promote sustainable forestry, and work to ensure that more trees are planted than are harvested.

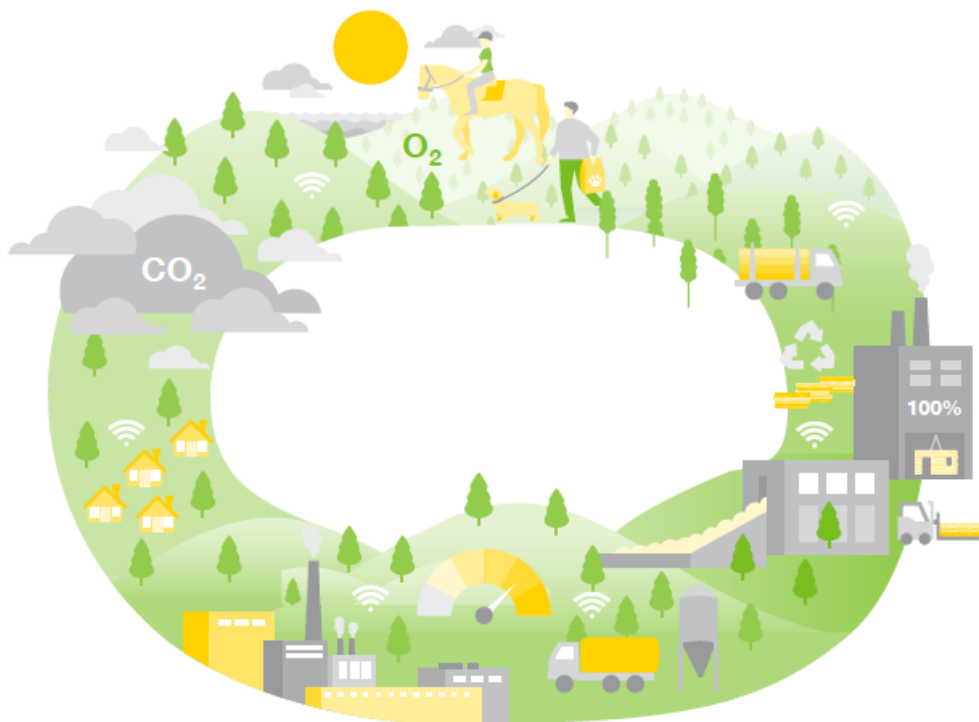
Our Wood Products range covers all areas of building construction, including massive wood elements, wood components, engineered wood products and pellets. All our mills operate under an integrated management system, which is certified in accordance with Chain of Custody (FSC®¹ and/or PEFC™), quality management (ISO 9001), environmental management (ISO 14001), health and safety (ISO 45001), and energy management (ISO 50001) requirements. The Wood Products division operates globally and has 18 production units in Europe, including eight pellet mills. Located close to our customers, our mills serve all segments with a focus on residential and mid-scale clients.

Good for the environment

Major global trends such as global warming, eco-awareness and changing lifestyles are driving the world's demand for renewable materials. Biomass energy responds to many of these trends.

Wood has many advantages over materials made from non-renewable resources. Wood is renewable, recyclable and can be used as bioenergy at the end of its life cycle. Wood provides further environmental benefits when it replaces emissions-intensive fossil-based products.

Pellets are a prime example of how we utilise our raw material in a highly efficient manner: We produce pellets from our sawmill by-products so we can offer natural, sustainable and renewable heating while ensuring that no raw material is wasted. In addition, our pellet production lines are integrated directly after the sawing line, which reduces unnecessary transportation.



¹ FSC trademark license number C125195

Technical information of pellets

Technical details	
Diameter	6/8 mm
Density	approx. 650 kg/m ³
Energy per kg	approx. 4,85 kWh
Energy per m ³	approx. 3.250 kWh
Dry content	approx. 92%
Ash content	approx. 0,4%
Ash melting point	approx. 1.400°C

Product composition

Materials / chemical substances	kg	%	Notes
Wood residues (from spruce or pine)	644	> 99	Water content 6-8 %
Starch	6	< 1	Binder
Potato		83 - 88	
Water		~ 10	
TOTAL	650	100	

The product does not contain any substances or products that are listed in the "Candidate List of Substances of Very High Concern for Authorisation".

Biogenic carbon content at the factory gate

Biogenic carbon content	Unit (expressed per declared unit)
Biogenic carbon content in product	1698 kg CO ₂ eq. / 1000 kg pellets
	463 kg C / 1000 kg pellets
<i>1 kg biogenic carbon is equivalent to 44/12 kg of CO₂</i>	

The sequestration of carbon dioxide (CO₂) happens in a unique manner with renewable materials. Biogenic carbon content of a renewable material is an outcome of the CO₂ that has effectively been removed from the atmosphere by photosynthesis of growing trees and other plants, and turned into sugars (carbon) and oxygen. The quantity of atmospheric CO₂ has thus been reduced. The longer the CO₂ is not in the atmosphere but stays stored in a material, the greater the environmental benefit.

Biogenic carbon of wood is calculated according to the EN 16485 and 16449 standards. Half of the dry mass of wood is carbon. Each kg of stored biogenic carbon is equal to ~3.67 kg of CO₂, which is effectively removed from the atmosphere. In case of 1 ton pellets the biogenic carbon content is -1698 kg CO₂ eq. Biogenic carbon enters the product system in forest (upstream / module A1) and for calculation purpose it is assumed to leave latest from the product system in the end-of-life stage (downstream / module C). This assumption can be made when wood is sourced from sustainably managed forest.

Product availability

Availability	Pellets in bulk	Small pellet bags	Big bags	PelletBox
				
Production sites	> 3 tons	15 / 16 kg	500 kg	12 kg
Ala (Sweden)	✓	✓		
Gruvön (Sweden)	✓	✓		
Imavere (Estonia)	✓			
Näpi (Estonia)	✓	✓	✓	✓
Launkalne (Latvia)	✓	✓		
Impilahti (Russia)	✓		✓	
Nebolchi (Russia)	✓		✓	
Zdirec (Czech)	✓	✓	✓	

Production capacity

	Ala	Gruvön	Näpi	Imavere	Zdirec	Launkalne	Nebolchi	Impilahti	Total
Capacity (tons/year)	95	100	30	100	70	50	60	30	535
Production start	2017/01	2008/12	2012/11	2011/11	2015/07	2020/08	2009/06	2009/04	



Use applications

Heating



Wood pellets provide three key heating benefits, with advantages related to the economy, efficiency and the environment. Our pellets can be bought any time of the year and easily stored, thanks to their compact size. Compared with firewood, wood pellets are easier to store and burn more efficiently.

Horse bedding



Stora Enso's premium horse bedding pellets are made from locally sourced and sustainably managed wood. Our horse bedding pellets quickly absorb liquid and moisture, transforming into a bed that is fluffy, soft and comfy underfoot. Additionally, our pellets contain

natural resins and oils to combat ammonia, keeping your stable smelling sweet. Pellets are heat-treated and therefore naturally antiseptic and free from mold and bacteria. They are a safe choice and provide a healthy hoof and limb environment for all ponies and horses. The virtually dust-free pellet bedding can also benefit horses prone to respiratory conditions.



With 1000 kg of pellets it's possible to produce about 4,85 MWh of heat or to bed a horse for one year.

Life cycle assessment rules and scenarios

Study goal

The goal of this study is to produce a transparent and third party verified EPD and additional documents. The EPD can be used as an environmental assessment of a renewable heating or horse bedding source and to demonstrate the environmental benefits of using Stora Enso pellets.

Declared unit

The declared unit selected as the reference flow to report the environmental results was differentiated in four groups, since there are different packaging materials and sizes available. These different groups represent the available packaging units at Stora Enso. Therefore, different environmental performance tables are shown in the later chapters.

Declared units are defined as follows:

- 1) 1000 kg of high-quality wood pellets as bulk
- 2) 500 kg of packed high-quality wood pellets in weight-fitting PP/PE bag
- 3) 15kg of packed high-quality wood pellets in weight-fitting HDPE bag
- 4) 12kg of packed high-quality wood pellets in weight-fitting cardboard box

Functional unit

As described above, there are two different use applications possible. Therefore, information about the impacts to fulfill the requirements of producing heat or bed horses is given. The functional units are defined as follows:

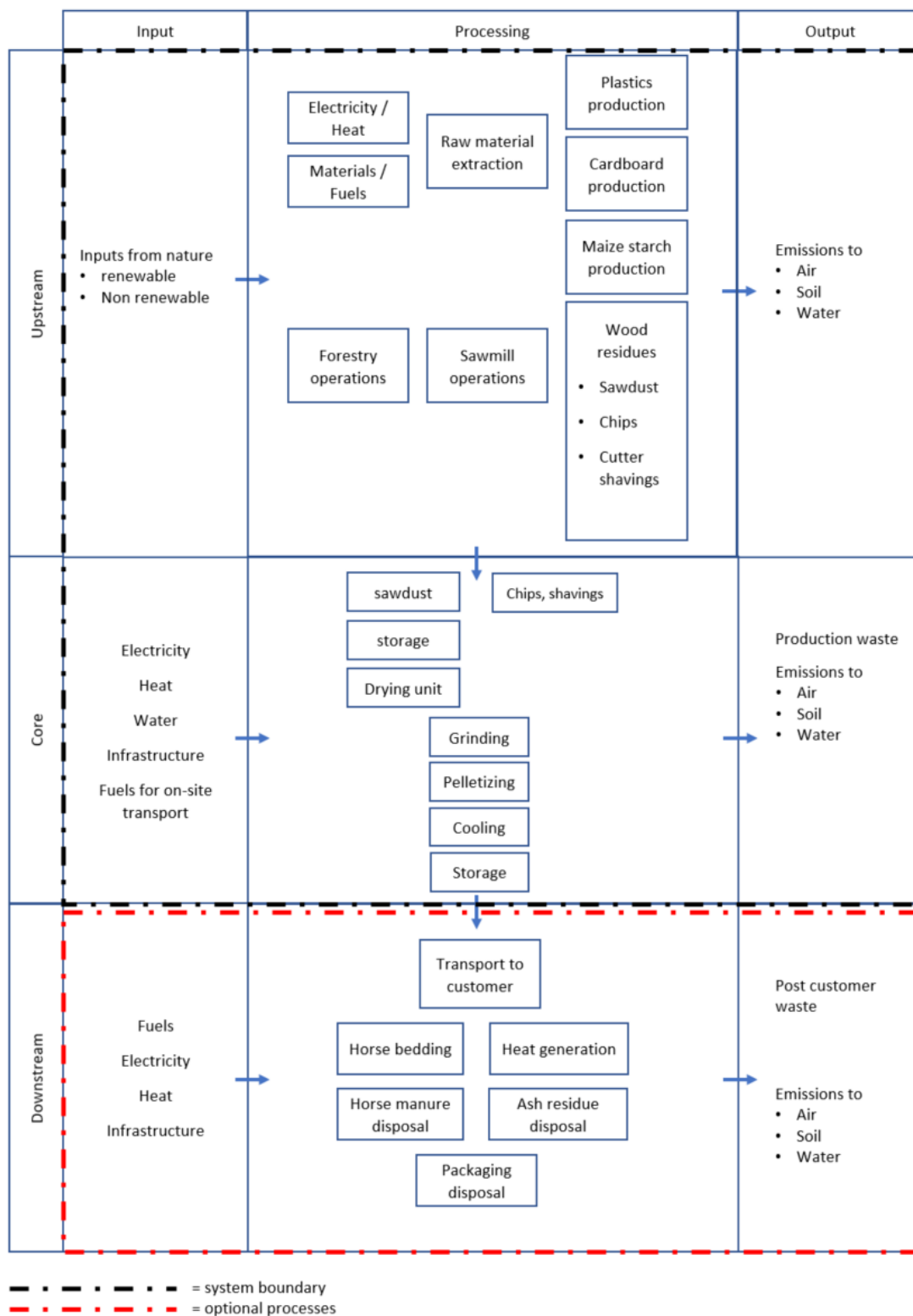
- 1) Provide 1000 MJ of thermal energy, produced by burning 57,14 kg high-quality wood pellets, which are delivered as bulk
- 2) Provide bedding material for an average size adult horse in a typical horse stable in Sweden for one year and thus is equal to 1000 kg of high-quality wood pellets, which are delivered in 15 kg HDPE bags

Production process description

The pellet production is integrated directly after the sawing line. Only wood shavings, dry chips and sawdust are used for the base material of pellets; these basic ingredients are why pellets are extremely energy-rich and produce a very small volume of ash. All sawdust falls into the container right before the drying unit. The drying unit uses hot air - partially waste heat from the timber driers - to dry the sawdust. The drying method ensures that the sawdust is not mixed with unknown particles. Already dried materials such as wood shavings and wood chips are then mixed with the sawdust and grinded to the right fraction size for making pellets. Carefully controlling the input through the pellet presses enables reaching a high quality level with consistent dry content, volume and weight. After the pellet presses, the pellets are cooled and packaged before being delivered.

System boundary

The system boundary of a product system determines the unit processes to be included in the life cycle assessment (LCA) study and which data as inputs and/or outputs to/from the system can be omitted. In this LCA study and resulting EPD, the system boundary was defined as cradle-to-gate, which comprises the extraction of raw materials, pellet production, packaging production and packaging. Downstream processes including transportation to customer, end-of-life of packaging used to package pellets and end-of-life of the wood pellets are optional in this system boundary, based on scenario assumptions. Inclusion and exclusion of downstream processes is declared in each impact assessment for the different functional and declared units. Specific information on transportation can be provided by Stora Enso on request. A system diagram for the investigated product system is provided below.



Raw material supply (upstream / A1 & A2 according EN15804)

Extraction and processing of the raw materials, e.g. forestry operations and processing of the by-products in sawmills are considered in this stage. The data covers all raw material supply and different packaging materials for the final product. Transport details for each raw material are separately recorded. Information that is included are the type of vehicle, average utilization rate of the load and average two-way transport distance.



Manufacturing (core / A3)

The manufacturing process of the pellets is shown in chapter Production process description. There is no extra waste from manufacturing considered in the LCA model, because it is already included in the by-product's datasets from previous sawmill processes.



Transport to customer (downstream / A4)

Different ways of transport modelling are applied based on assumptions, in line with the different declared and functional units. The intention is to provide the user of this EPD with the possibility of calculating emissions based on the given figures in the results tables.



- The transport of one 15 kg pellet bag is assumed to be 100 km as a reference value. One pallet is assumed to have a load capacity of 1000 kg.
- The transport of one 500 kg big bag is assumed to be 100 km as a reference value.
- The transport of one 12 kg pellet box is assumed to be 100km as a reference value. One pallet is assumed to have a load capacity of 1 000 kg. Additionally, the carry home from the point of sale to the customer is shown. It is taken into account that one box is transported over a distance of 10 km and 10 pellet boxes are transported at the same time in an average car.
- The transport of pellets as bulk is assumed to be 100 km as a reference value.

Heating / horse bedding (downstream / A5)

No specific heating or horse bedding scenario are considered, due to too many uncertainties in the specific further usage of the pellets. These uncertainties are, for example, storage conditions, heating technology and underlying burning efficiency, water usage for horse bedding and treatment of the horse bedding pellets after use. Environmental impacts shown in this stage are therefore coming from packaging waste processing and the associated transport.

Stora Enso is aware of the different scenarios related to customers further usage of pellets. There is a clear commitment and interest to develop the downstream scenarios, which are included in the system boundary of this EPD as optional, together with customers and take into consideration the actual use conditions.

- The empty 15 kg pellet bag as well as the secondary packaging (stretch film & top film) are assumed to be transported 20km to the waste processing facility. An incineration scenario is assumed at the end-of-life, which represents a realistic scenario for countries belonging to Stora Enso's pellet market.
- The empty 500 kg pellet bag is assumed to be transported over 20 km to the waste processing facility. An incineration scenario is assumed at the end-of-life, which represents a realistic scenario for countries belonging to Stora Enso's pellet market.
- The empty 12 kg pellet box as well as the secondary packaging (stretch film & top film) is assumed to be transported 20 km to the waste processing facility. An incineration scenario is assumed at the end-of-life, which represents a realistic scenario for countries belonging to Stora Enso's pellet market. One pallet is assumed to have a load capacity of 1 000 kg. Additionally, the carry home from the point of sale to the customer is shown. It is presumed that one box is transported 10 km and 10 pellets boxes are transported at the same time in an average car, approved for usage in the EU.

Data sources and quality

Specific data have been collected from Stora Enso pellets production units covering production data (12 months) of year 2019. All inputs and outputs of units are recorded and included in the calculations. Wood residues as raw materials are calculated as by-products from the LCA studies of other Stora Enso products: Classic Sawn, Classic Planed, Cladding and Decking, KVH® and Industrial Components EPDs. Depending on the capacity of the pellet mills, production volumes and yield factors of the previous sawmill processes, the mix of the by-products in the pellets can vary. All by-products, except bark which is mainly intended to be used for mill energy purposes, can be considered in the pellet production. For the impact assessment of the functional and declared units, weighted production averages from all Stora Enso pellet mills are considered. Data collection for the wood-residues LCA was done for year 2018.

Selected generic data were collected for the majority of the upstream lifecycle stage from the LCI database ecoinvent v3.6 (cut-off)

This EPD covers 100% of Stora Enso's pellet production operations.

Allocation

In processes in which more than one product is generated, the environmental impacts must be allocated to the different product outcomes. According to the EN 15804 standard flows leaving the system at the end-of-waste boundary of the product stage (A1–A3) shall be allocated as by-products. Wood residues as raw materials, needed for pellet production, are calculated as a by-product from Stora Enso Classic Sawn, Classic Planed, Cladding and Decking, KVH® and Industrial Components EPDs. When the difference in revenue is more than 25%, than it's regarded as high and, in this case, economic allocation shall be used. Allocation is done process wise as proposed in EN 16485.

LCA software used

SimaPro 9.1

Background database used

Ecoinvent 3.6 database

Cut-Off Rule

1%. This rule assumes that the input flows do not have a major impact on environmental impacts as a whole.

Target group

Business to business
Business to consumers
LCA practitioners

Life Cycle Impact methodology and types

This EPD's results/impact assessment part fulfils the requirements of ISO14044; therefore, the "selection of impact categories, category indicators and characterization models used in the LCIA methodology shall be consistent with the goal of the study." Both impact categories as required in EN15804+A2 and the former EN15804+A1, which gives the possibility to better interpret the results and use for further studies, are shown in the Environmental performance chapter.

Reading guide

$3,70\text{E}-01 = 3,70 \times 10^{-1} = 0,370$

$2,65\text{E}-03 = 2,65 \times 10^{-3} = 0,00265$

$3,55\text{E}+01 = 3,55 \times 10^1 = 35,5$

Environmental performance

1000 kg of high-quality wood pellets as bulk – indicators according EN15804+A2

Parameters describing environmental impacts								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	Fossil	kg CO ₂ eq.	55,96	20,04	0,01	76,01	60,30	- 125,45
	Biogenic ³⁾	kg CO ₂ eq.	-1697,36	1,28	0,00	-1696,08	-1697,33	- -1691,49
	Land use and land transformation	kg CO ₂ eq.	1,05	0,27	0,00	1,32	0,60	- 3,65
	TOTAL	kg CO ₂ eq.	-1640,35	21,59	0,01	-1618,75	-1636,43	- -1562,40
Ozone depletion potential (ODP)		kg CFC 11 eq.	1,24E-05	6,05E-06	2,14E-09	1,84E-05	1,37E-05	- 2,73E-05
Acidification potential (AP)		mol H ⁺ eq.	3,70E-01	4,59E-01	3,82E-05	8,28E-01	5,89E-01	- 1,24E+00
Eutrophication potential (EP)	freshwater	kg PO ₄ eq.	2,65E-03	1,94E-03	6,93E-08	4,59E-03	9,70E-03	- 8,00E-02
	marine	kg N eq.	1,17E-01	1,12E-01	1,15E-05	2,29E-01	1,77E-01	- 2,95E-01
	terrestrial	mol N eq.	1,34E+00	1,85E+00	1,27E-04	3,19E+00	2,29E+00	- 4,38E+00
Formation potential of tropospheric ozone (POCP)		kg NMVOC eq.	4,76E-01	3,24E-01	4,08E-05	8,00E-01	5,17E-01	- 1,19E+00
Abiotic depletion potential – Elements (ADPE) ⁴⁾		kg Sb eq.	7,31E-04	6,84E-04	1,55E-07	1,42E-03	8,15E-04	- 1,71E-03
Abiotic depletion potential – Fossil resources (ADPF) ⁴⁾		MJ, net calorific value	1,03E+03	8,71E+02	1,41E-01	1,90E+03	9,07E+02	- 3,16E+03
Water scarcity potential ⁴⁾		m ³ eq.	3,55E+01	1,07E+01	4,59E-04	4,62E+01	2,09E+01	- 6,68E+01

Parameters describing use of resources								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Use of renewable primary energy resources – use as energy carrier		MJ	9,09E+02	2,35E+03	1,78E-03	3,25E+03	3,60E+01	- 7,26E+01
Use of renewable primary energy resources – use as raw materials		MJ	2,19E+04	0,00E+00	0,00E+00	2,19E+04	2,81E+02	- 3,64E+02
Use of renewable primary energy resources – total		MJ	2,28E+04	2,35E+03	1,78E-03	2,51E+04	3,27E+02	- 4,15E+02
Use of non-renewable primary energy resources – use as energy carrier		MJ	1,09E+03	8,98E+02	1,50E-01	1,98E+03	2,62E+01	- 6,34E+01
Use of non-renewable primary energy resources – use as raw materials		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,01E+00	- 5,01E+00
Use of non-renewable primary energy resources – total		MJ	1,09E+03	8,98E+02	1,50E-01	1,98E+03	3,12E+01	- 6,84E+01
Use of secondary material		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Net use of fresh water		m ³	1,01E+00	5,85E-01	1,61E-05	1,60E+00	1,48E-02	- 5,30E-02

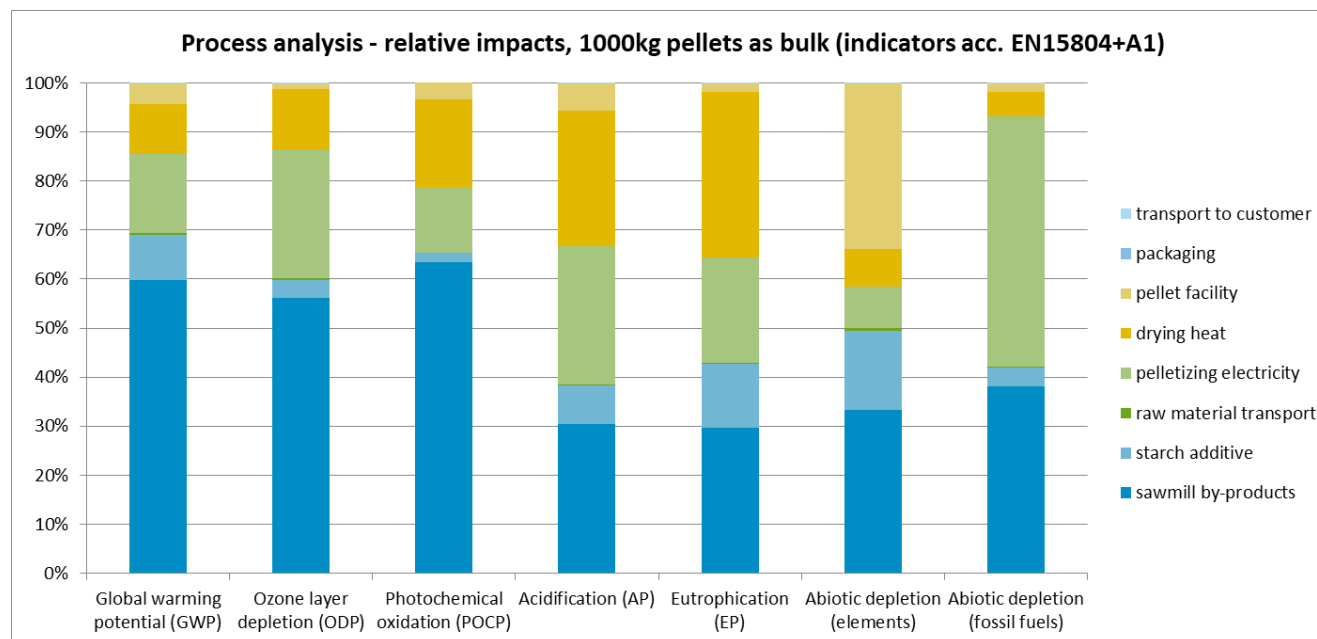
Parameters describing waste								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Hazardous waste disposed		kg	1,47E-03	1,19E-03	3,43E-07	2,66E-03	1,67E-03	- 4,27E-03
Non-hazardous waste disposed		kg	3,31E+01	8,26E+00	1,23E-02	4,14E+01	2,75E+01	- 5,34E+01
Radioactive waste disposed		kg	7,92E-03	9,06E-03	9,65E-07	1,70E-02	5,66E-03	- 3,72E-02

Parameters describing output flows								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Components for reuse		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Material for recycling		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, electricity		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, thermal		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00

- 1) 100 km transport to the customer is assumed. No packaging waste is assumed for bulk delivery. (see also page 9) Material inherent properties of the pellets, like stored biogenic carbon and energy resources used as raw materials will leave the system at the end-of-waste status (heating residues, horse litter) and are therefore not considered in the downstream stage.
- 2) The range is between the pellet mills that has the lowest and the highest impact.
- 3) biogenic carbon content in 1000 kg pellets is 1697,53 kg CO₂-eq.
- 4) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

1000 kg of high-quality wood pellets as bulk – indicators according EN15804+A1

Parameters describing environmental impacts							
INDICATOR	UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	kg CO ₂ eq.	-1642,18	20,44	0,01	-1621,73	-1636,43	-1562,40
Ozone layer depletion (ODP)	kg CFC-11 eq.	1,24E-05	6,05E-06	2,14E-09	1,84E-05	1,37E-05	2,73E-05
Photochemical oxidation (POCP)	kg C ₂ H ₄ eq.	4,37E-02	1,91E-02	1,19E-06	6,27E-02	3,14E-02	1,48E-01
Acidification (AP)	kg SO ₂ eq.	2,68E-01	3,12E-01	2,96E-05	5,81E-01	4,12E-01	9,56E-01
Eutrophication (EP)	kg PO ₄ eq.	7,85E-02	7,70E-02	4,85E-06	1,56E-01	1,63E-01	3,90E-01
Abiotic depletion - elements	kg Sb eq.	7,36E-04	6,86E-04	1,55E-07	1,42E-03	8,36E+02	2,59E+03
Abiotic depletion - fossil fuels	MJ	8,12E+02	3,13E+02	1,39E-01	1,12E+03	-1,70E+03	-1,70E+03



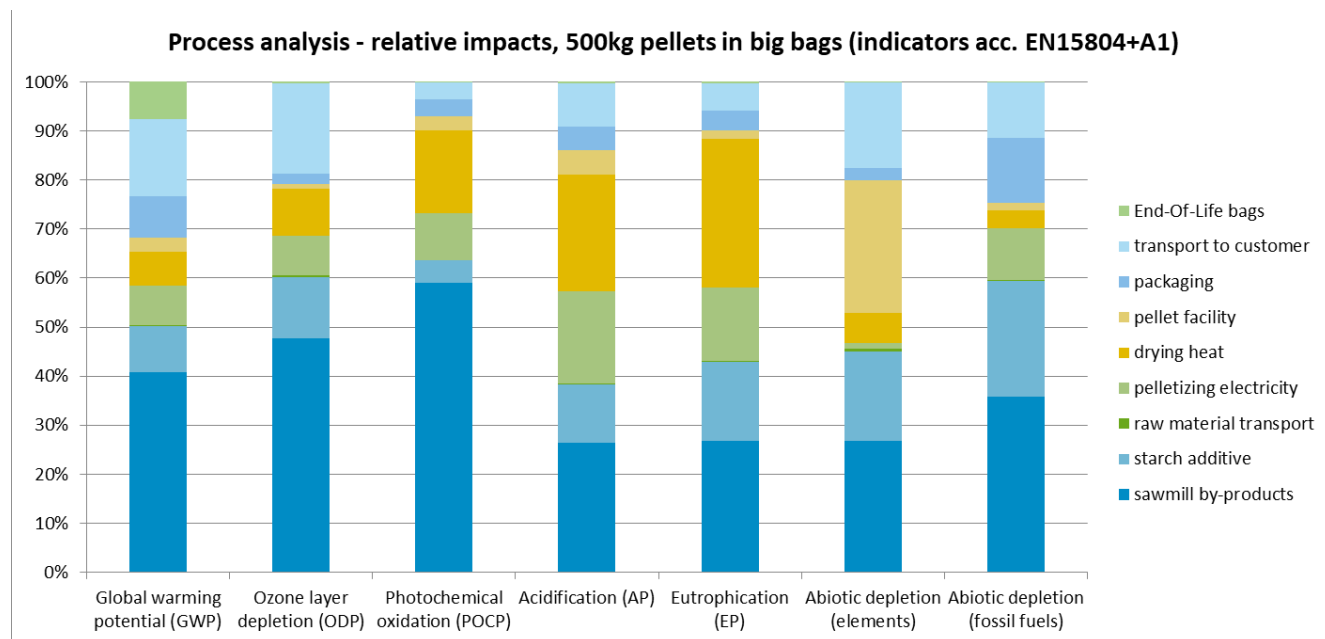
500 kg of packed high-quality wood pellets in weight-fitting PP/PE bag – indicators according EN15804+A2

Parameters describing environmental impacts								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	Fossil	kg CO ₂ eq.	33,02	10,02	13,46	56,49	47,94	- 81,30
	Biogenic ³⁾	kg CO ₂ eq.	-848,67	0,64	0,00	-848,02	-848,65	- -845,73
	Land use and land transformation	kg CO ₂ eq.	0,53	0,14	0,00	0,66	0,31	- 1,83
	TOTAL	kg CO ₂ eq.	-815,12	10,80	13,46	-790,86	-800,40	- -762,60
Ozone depletion potential (ODP)		kg CFC 11 eq.	6,46E-06	3,02E-06	2,18E-06	1,17E-05	9,10E-06	- 1,61E-05
Acidification potential (AP)		mol H ⁺ eq.	2,05E-01	2,29E-01	3,97E-02	4,74E-01	3,55E-01	- 6,81E-01
Eutrophication potential (EP)	freshwater	kg PO ₄ eq.	1,58E-03	9,70E-04	7,25E-05	2,62E-03	7,05E-03	- 4,22E-02
	marine	kg N eq.	6,24E-02	5,60E-02	1,21E-02	1,31E-01	1,05E-01	- 1,64E-01
	terrestrial	mol N eq.	7,17E-01	9,23E-01	1,34E-01	1,77E+00	1,33E+00	- 2,37E+00
Formation potential of tropospheric ozone (POCP)		kg NMVOC eq.	2,55E-01	1,62E-01	4,27E-02	4,59E-01	3,18E-01	- 6,55E-01
Abiotic depletion potential – Elements (ADPE) ⁴⁾		kg Sb eq.	3,89E-04	3,42E-04	1,57E-04	8,88E-04	5,90E-04	- 1,04E-03
Abiotic depletion potential – Fossil resources (ADPF) ⁴⁾		MJ, net calorific value	6,85E+02	4,35E+02	1,43E+02	1,26E+03	7,39E+02	- 1,89E+03
Water scarcity potential ⁴⁾		m ³ eq.	2,13E+01	5,37E+00	5,12E-01	2,71E+01	1,45E+01	- 3,74E+01
Parameters describing use of resources								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Use of renewable primary energy resources – use as energy carrier		MJ	4,69E+02	1,17E+03	1,86E+00	1,64E+03	3,60E+01	- 7,26E+01
Use of renewable primary energy resources – use as raw materials		MJ	1,09E+04	0,00E+00	0,00E+00	1,09E+04	2,81E+02	- 3,64E+02
Use of renewable primary energy resources – total		MJ	1,14E+04	1,17E+03	1,86E+00	1,26E+04	3,27E+02	- 4,15E+02
Use of non-renewable primary energy resources – use as energy carrier		MJ	7,24E+02	4,49E+02	1,52E+02	1,33E+03	2,62E+01	- 6,34E+01
Use of non-renewable primary energy resources – use as raw materials		MJ	7,40E+01	0,00E+00	0,00E+00	7,40E+01	5,01E+00	- 5,01E+00
Use of non-renewable primary energy resources – total		MJ	7,98E+02	4,49E+02	1,52E+02	1,40E+03	3,12E+01	- 6,84E+01
Use of secondary material		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Net use of fresh water		m ³	6,05E-01	2,92E-01	1,83E-02	9,16E-01	1,48E-02	- 5,30E-02
Parameters describing waste								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Hazardous waste disposed		kg	8,08E-04	5,94E-04	3,48E-04	1,75E-03	1,23E-03	- 2,55E-03
Non-hazardous waste disposed		kg	1,70E+01	4,13E+00	1,24E+01	3,35E+01	2,66E+01	- 3,95E+01
Radioactive waste disposed		kg	4,20E-03	4,53E-03	9,74E-04	9,71E-03	3,90E-03	- 1,98E-02
Parameters describing output flows								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Components for reuse		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Material for recycling		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, electricity		kg	0,00E+00	0,00E+00	6,39E+00	6,39E+00	6,39E+00	- 6,39E+00
Export energy, thermal		kg	0,00E+00	0,00E+00	1,29E+01	1,29E+01	1,29E+01	- 1,29E+01

- 1) 100 km transport to the customer is assumed. Packaging waste is transported 20 km to the waste processing facility, where an incineration scenario is applied (see also page 9) Material inherent properties of the pellets, like stored biogenic carbon and energy resources used as raw materials will leave the system at the end-of-waste status (heating residues, horse litter) and are therefore not considered in the downstream stage.
- 2) The range is between the pellet mills that has the lowest and the highest impact.
- 3) biogenic carbon content in 500 kg pellets is 848,77 kg CO₂-eq.
- 4) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

500 kg of packed high-quality wood pellets in weight-fitting PP/PE bag – indicators according from EN15804+A1

Parameters describing environmental impacts							
INDICATOR	UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	kg CO ₂ eq.	-816,12	10,22	13,36	-792,54	-800,40	-762,60
Ozone layer depletion (ODP)	kg CFC-11 eq.	6,46E-06	3,02E-06	2,18E-06	1,17E-05	9,10E-06	1,61E-05
Photochemical oxidation (POCP)	kg C ₂ H ₄ eq.	2,30E-02	9,53E-03	1,23E-03	3,37E-02	1,80E-02	7,63E-02
Acidification (AP)	kg SO ₂ eq.	1,51E-01	1,56E-01	3,06E-02	3,38E-01	2,54E-01	5,26E-01
Eutrophication (EP)	kg PO ₄ eq.	4,28E-02	3,85E-02	5,10E-03	8,64E-02	9,70E-02	2,10E-01
Abiotic depletion - elements	kg Sb eq.	3,92E-04	3,43E-04	1,57E-04	8,92E-04	5,92E-04	1,04E-03
Abiotic depletion - fossil fuels	MJ	5,60E+02	1,56E+02	1,40E+02	8,56E+02	7,05E+02	1,59E+03



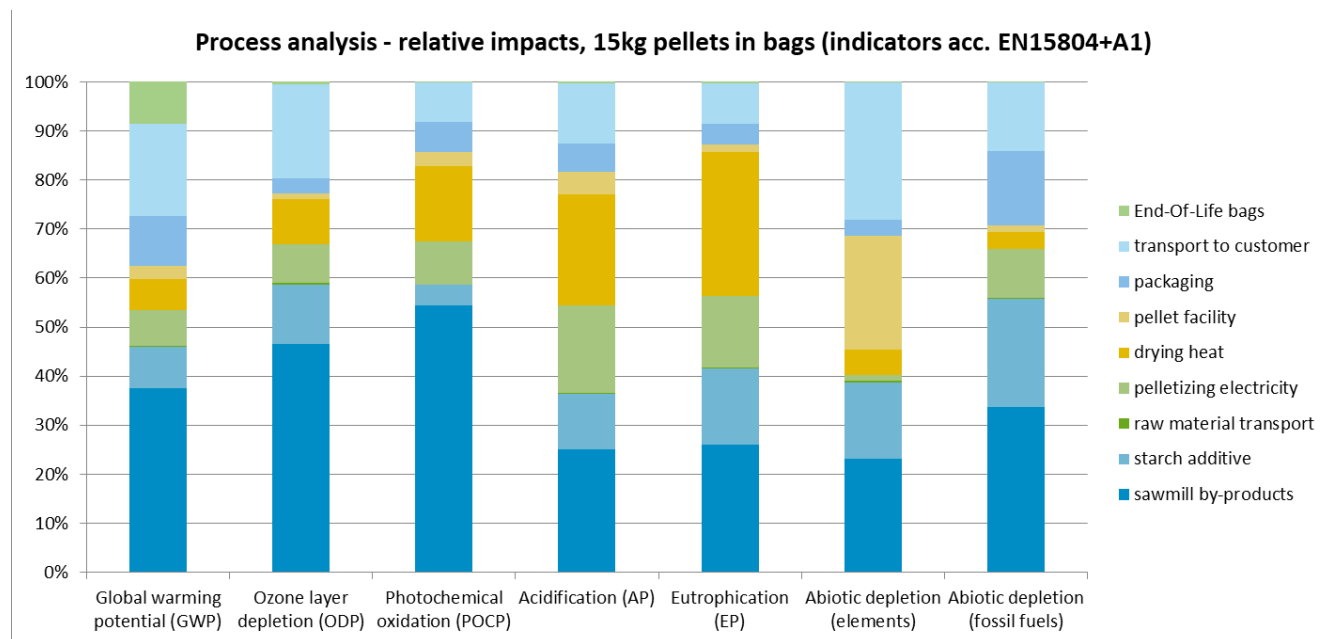
15 kg of packed high-quality wood pellets in weight-fitting HDPE bags – indicators according EN15804+A2

Parameters describing environmental impacts								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	Fossil	kg CO ₂ eq.	1,03	0,30	0,52	1,85	1,59	- 2,59
	Biogenic ³⁾	kg CO ₂ eq.	-25,46	0,02	0,00	-25,44	-25,46	- -25,37
	Land use and land transformation	kg CO ₂ eq.	0,02	0,00	0,00	0,02	0,01	- 0,06
	TOTAL	kg CO ₂ eq.	-24,41	0,32	0,52	-23,57	-23,86	- -22,72
Ozone depletion potential (ODP)		kg CFC 11 eq.	1,98E-07	9,07E-08	7,04E-08	3,59E-07	2,81E-07	- 4,92E-07
Acidification potential (AP)		mol H ⁺ eq.	6,31E-03	6,88E-03	1,73E-03	1,49E-02	1,13E-02	- 2,11E-02
Eutrophication potential (EP)	freshwater	kg PO ₄ eq.	4,59E-05	2,91E-05	7,35E-06	8,23E-05	2,18E-04	- 1,27E-03
	marine	kg N eq.	1,91E-03	1,68E-03	4,98E-04	4,09E-03	3,32E-03	- 5,09E-03
	terrestrial	mol N eq.	2,19E-02	2,77E-02	5,55E-03	5,51E-02	4,17E-02	- 7,29E-02
Formation potential of tropospheric ozone (POCP)		kg NMVOC eq.	7,84E-03	4,86E-03	1,88E-03	1,46E-02	1,03E-02	- 2,04E-02
Abiotic depletion potential – Elements (ADPE) ⁴⁾		kg Sb eq.	1,21E-05	1,03E-05	8,72E-06	3,10E-05	2,20E-05	- 3,54E-05
Abiotic depletion potential – Fossil resources (ADPF) ⁴⁾		MJ, net calorific value	2,16E+01	1,31E+01	5,73E+00	4,04E+01	2,46E+01	- 5,92E+01
Water scarcity potential ⁴⁾		m ³ eq.	6,75E-01	1,61E-01	4,44E-02	8,81E-01	5,01E-01	- 1,19E+00
Parameters describing use of resources								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Use of renewable primary energy resources – use as energy carrier		MJ	1,43E+01	3,52E+01	8,93E+00	5,84E+01	3,60E+01	- 7,26E+01
Use of renewable primary energy resources – use as raw materials		MJ	3,28E+02	0,00E+00	0,00E+00	3,28E+02	2,81E+02	- 3,64E+02
Use of renewable primary energy resources – total		MJ	3,43E+02	3,52E+01	8,93E+00	3,87E+02	3,27E+02	- 4,15E+02
Use of non-renewable primary energy resources – use as energy carrier		MJ	2,28E+01	1,35E+01	6,09E+00	4,24E+01	2,62E+01	- 6,34E+01
Use of non-renewable primary energy resources – use as raw materials		MJ	5,01E+00	0,00E+00	0,00E+00	5,01E+00	5,01E+00	- 5,01E+00
Use of non-renewable primary energy resources – total		MJ	2,78E+01	1,35E+01	6,09E+00	4,74E+01	3,12E+01	- 6,84E+01
Use of secondary material		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Net use of fresh water		m ³	1,89E-02	8,77E-03	1,47E-03	2,92E-02	1,48E-02	- 5,30E-02
Parameters describing waste								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Hazardous waste disposed		kg	2,47E-05	1,78E-05	1,46E-05	5,71E-05	4,14E-05	- 8,12E-05
Non-hazardous waste disposed		kg	5,13E-01	1,24E-01	2,10E-01	8,47E-01	6,34E-01	- 1,02E+00
Radioactive waste disposed		kg	1,25E-04	1,36E-04	3,20E-05	2,93E-04	1,19E-04	- 5,96E-04
Parameters describing output flows								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Components for reuse		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Material for recycling		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, electricity		kg	0,00E+00	0,00E+00	2,38E-01	2,38E-01	2,38E-01	- 2,38E-01
Export energy, thermal		kg	0,00E+00	0,00E+00	4,81E-01	4,81E-01	4,81E-01	- 4,81E-01

- 1) 100 km transport to the customer is assumed. Packaging waste as well as the secondary packaging (stretch film & top film) is transported 20 km to the waste processing facility, where an incineration is scenario applied (see also page 9) Material inherent properties of the pellets, like stored biogenic carbon and energy resources used as raw materials will leave the system at the end-of-waste status (heating residues, horse litter) and are therefore not considered in the downstream stage.
- 2) The range is between the pellet mills that has the lowest and the highest impact.
- 3) biogenic carbon content in 15 kg pellets is 25,46 kg CO₂-eq.
- 4) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

15 kg of packed high-quality wood pellets in weight-fitting HDPE bags – indicators according EN15804+A1

Parameters describing environmental impacts							
INDICATOR	UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	kg CO ₂ eq.	-24,44	0,31	0,51	-23,62	-23,86	-22,72
Ozone layer depletion (ODP)	kg CFC-11 eq.	1,98E-07	9,07E-08	7,04E-08	3,59E-07	2,81E-07	4,92E-07
Photochemical oxidation (POCP)	kg C ₂ H ₄ eq.	7,23E-04	2,86E-04	8,92E-05	1,10E-03	6,28E-04	2,38E-03
Acidification (AP)	kg SO ₂ eq.	4,64E-03	4,69E-03	1,34E-03	1,07E-02	8,14E-03	1,63E-02
Eutrophication (EP)	kg PO ₄ eq.	1,29E-03	1,16E-03	2,28E-04	2,68E-03	3,01E-03	6,40E-03
Abiotic depletion - elements	kg Sb eq.	1,21E-05	1,03E-05	8,72E-06	3,11E-05	2,20E-05	3,55E-05
Abiotic depletion - fossil fuels	MJ	1,79E+01	4,69E+00	5,51E+00	2,81E+01	2,35E+01	5,01E+01



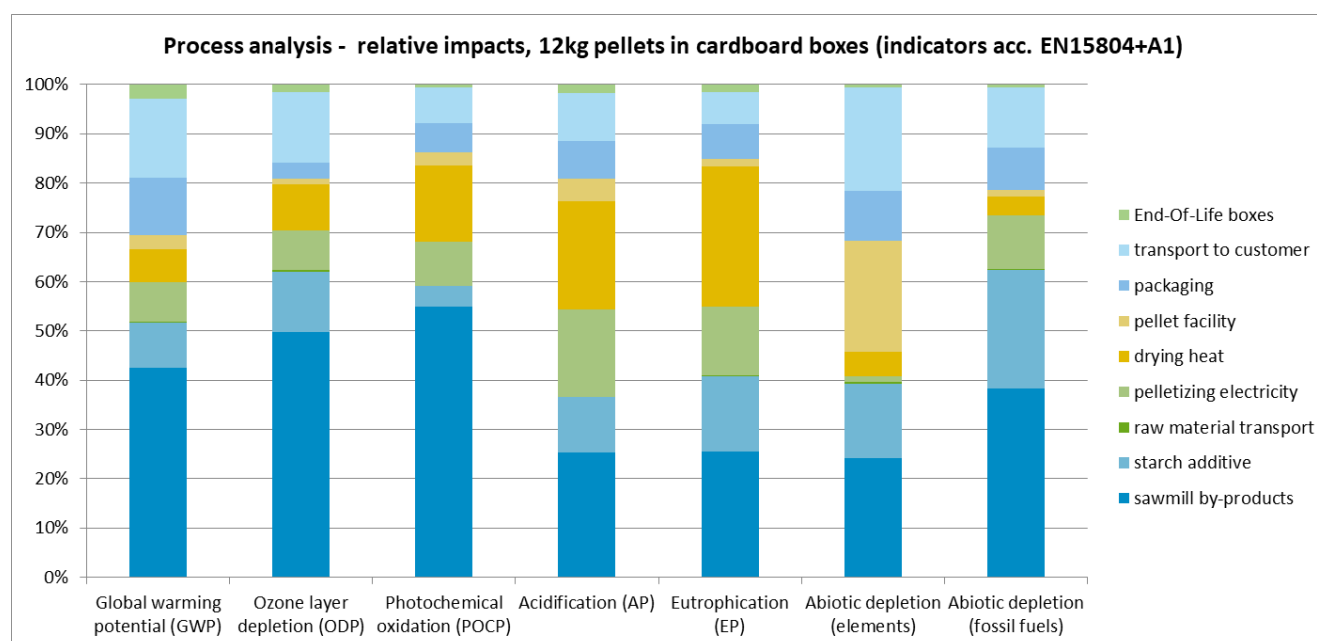
12 kg of packed high-quality wood pellets in weight-fitting cardboard boxes – indicators according EN15804+A2

Parameters describing environmental impacts								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	Fossil	kg CO ₂ eq.	0,85	0,24	0,26	1,35	1,15	- 1,95
	Biogenic ³⁾	kg CO ₂ eq.	-20,36	0,02	0,00	-20,34	-20,36	- -20,29
	Land use and land transformation	kg CO ₂ eq.	0,02	0,00	0,00	0,02	0,02	- 0,05
	TOTAL	kg CO ₂ eq.	-19,49	0,26	0,27	-18,97	-19,20	- -18,29
Ozone depletion potential (ODP)		kg CFC 11 eq.	1,65E-07	7,26E-08	4,50E-08	2,83E-07	2,21E-07	- 3,89E-07
Acidification potential (AP)		mol H ⁺ eq.	5,35E-03	5,50E-03	1,30E-03	1,22E-02	9,28E-03	- 1,71E-02
Eutrophication potential (EP)	freshwater	kg PO ₄ eq.	5,21E-05	2,33E-05	5,81E-06	8,12E-05	5,41E-05	- 1,45E-04
	marine	kg N eq.	1,60E-03	1,34E-03	3,89E-04	3,33E-03	2,62E-03	- 4,09E-03
	terrestrial	mol N eq.	1,81E-02	2,21E-02	4,35E-03	4,46E-02	3,39E-02	- 5,88E-02
Formation potential of tropospheric ozone (POCP)		kg NMVOC eq.	6,57E-03	3,89E-03	1,50E-03	1,20E-02	8,56E-03	- 1,67E-02
Abiotic depletion potential – Elements (ADPE) ⁴⁾		kg Sb eq.	1,19E-05	8,21E-06	5,57E-06	2,57E-05	1,85E-05	- 2,93E-05
Abiotic depletion potential – Fossil resources (ADPF) ⁴⁾		MJ, net calorific value	1,53E+01	1,05E+01	3,81E+00	2,96E+01	1,70E+01	- 4,47E+01
Water scarcity potential ⁴⁾		m ³ eq.	4,98E-01	1,29E-01	3,84E-02	6,65E-01	3,61E-01	- 9,11E-01
Parameters describing use of resources								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Use of renewable primary energy resources – use as energy carrier		MJ	1,15E+01	2,82E+01	7,13E+00	4,68E+01	3,60E+01	- 7,26E+01
Use of renewable primary energy resources – use as raw materials		MJ	2,66E+02	0,00E+00	0,00E+00	2,66E+02	2,81E+02	- 3,64E+02
Use of renewable primary energy resources – total		MJ	2,77E+02	2,82E+01	7,13E+00	3,12E+02	3,27E+02	- 4,15E+02
Use of non-renewable primary energy resources – use as energy carrier		MJ	1,62E+01	1,08E+01	4,06E+00	3,11E+01	2,62E+01	- 6,34E+01
Use of non-renewable primary energy resources – use as raw materials		MJ	4,58E-01	0,00E+00	0,00E+00	4,58E-01	5,01E+00	- 5,01E+00
Use of non-renewable primary energy resources – total		MJ	1,67E+01	1,08E+01	4,06E+00	3,15E+01	3,12E+01	- 6,84E+01
Use of secondary material		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Net use of fresh water		m ³	1,42E-02	7,02E-03	1,34E-03	2,26E-02	1,11E-02	- 4,16E-02
Parameters describing waste								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Hazardous waste disposed		kg	2,47E-04	1,43E-05	1,00E-05	2,72E-04	2,59E-04	- 2,91E-04
Non-hazardous waste disposed		kg	4,53E-01	9,92E-02	1,88E-01	7,40E-01	5,74E-01	- 8,84E-01
Radioactive waste disposed		kg	1,03E-04	1,09E-04	1,98E-05	2,32E-04	9,23E-05	- 4,74E-04
Parameters describing output flows								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Components for reuse		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Material for recycling		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, electricity		kg	0,00E+00	0,00E+00	5,61E-01	5,61E-01	5,61E-01	- 5,61E-01
Export energy, thermal		kg	0,00E+00	0,00E+00	1,17E+00	1,17E+00	1,17E+00	- 1,17E+00

- 1) 100 km transport on pallets to the point-of-sale is assumed. 10 pellets boxes are transported 10km from the point of sale to the customer in an average car. Packaging waste as well as the secondary packaging (stretch film & top film) is transported 20 km to the waste processing facility, where an incineration scenario is applied. (see also page 9) Material inherent properties of the pellets, like stored biogenic carbon and energy resources used as raw materials will leave the system at the end-of-waste status (heating residues, horse litter) and are therefore not considered in the downstream stage.
- 2) The range is between the pellet mills that has the lowest and the highest impact.
- 3) biogenic carbon content in 12 kg pellets is 20,37 kg CO₂-eq.
- 4) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

12 kg of packed high-quality wood pellets in weight-fitting cardboard boxes –indicators according EN15804+A1

Parameters describing environmental impacts							
INDICATOR	UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	kg CO ₂ eq.	-19,52	0,25	0,26	-19,01	-19,20	-18,29
Ozone layer depletion (ODP)	kg CFC-11 eq.	1,65E-07	7,26E-08	4,50E-08	2,83E-07	2,21E-07	3,89E-07
Photochemical oxidation (POCP)	kg C ₂ H ₄ eq.	5,78E-04	2,29E-04	6,91E-05	8,76E-04	5,00E-04	1,90E-03
Acidification (AP)	kg SO ₂ eq.	3,95E-03	3,75E-03	1,00E-03	8,70E-03	6,68E-03	1,32E-02
Eutrophication (EP)	kg PO ₄ eq.	1,11E-03	9,24E-04	1,77E-04	2,21E-03	1,73E-03	2,74E-03
Abiotic depletion - elements	kg Sb eq.	1,20E-05	8,23E-06	5,57E-06	2,58E-05	1,63E+01	3,75E+01
Abiotic depletion - fossil fuels	MJ	1,25E+01	3,75E+00	3,65E+00	1,99E+01	-2,04E+01	-2,04E+01



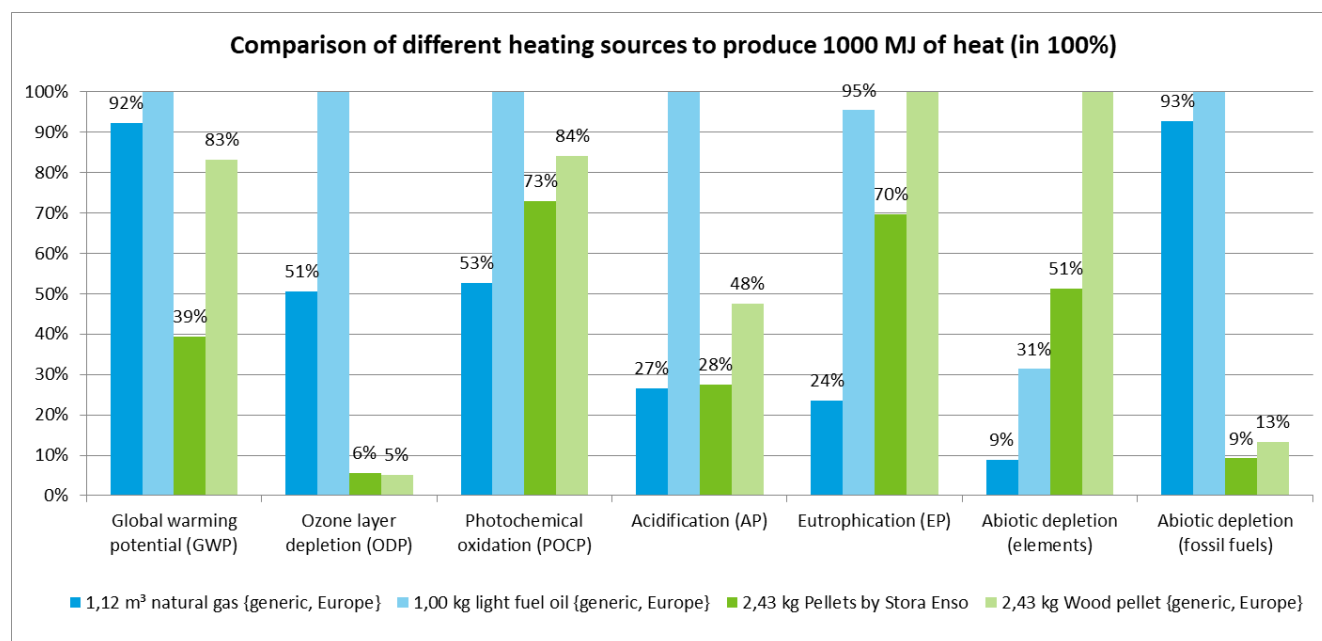
Provide 1000 MJ of thermal energy, produced by burning 57,14 kg wood pellets – indicators according EN15804+A2

Parameters describing environmental impacts								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	Fossil	kg CO ₂ eq.	3,20	1,15	0,00	4,34	3,36	- 7,17
	Biogenic ³⁾	kg CO ₂ eq.	-96,99	0,07	0,00	-96,92	-96,99	- -96,66
	Land use and land transformation	kg CO ₂ eq.	0,06	0,02	0,00	0,08	0,03	- 0,21
	TOTAL	kg CO ₂ eq.	-93,73	1,23	0,00	-92,50	-93,57	- -89,76
Ozone depletion potential (ODP)		kg CFC 11 eq.	7,07E-07	3,46E-07	1,22E-10	1,05E-06	7,59E-07	- 1,56E-06
Acidification potential (AP)		mol H ⁺ eq.	2,11E-02	2,62E-02	2,18E-06	4,73E-02	3,37E-02	- 7,09E-02
Eutrophication potential (EP)	freshwater	kg PO ₄ eq.	6,26E-04	7,14E-04	3,68E-08	1,34E-03	5,54E-04	- 4,57E-03
	marine	kg N eq.	6,80E-03	6,59E-03	6,63E-07	1,34E-02	1,01E-02	- 1,68E-02
	terrestrial	mol N eq.	7,67E-02	1,05E-01	7,26E-06	1,82E-01	1,31E-01	- 2,50E-01
Formation potential of tropospheric ozone (POCP)		kg NMVOC eq.	2,72E-02	1,85E-02	2,33E-06	4,57E-02	2,95E-02	- 6,81E-02
Abiotic depletion potential – Elements (ADPE) ⁴⁾		kg Sb eq.	4,18E-05	3,91E-05	8,86E-09	8,09E-05	4,66E-05	- 9,79E-05
Abiotic depletion potential – Fossil resources (ADPF) ⁴⁾		MJ, net calorific value	5,88E+01	4,98E+01	8,08E-03	1,09E+02	4,85E+01	- 1,80E+02
Water scarcity potential ⁴⁾		m ³ eq.	2,03E+00	6,14E-01	2,62E-05	2,64E+00	1,20E+00	- 3,81E+00
Parameters describing use of resources								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Use of renewable primary energy resources – use as energy carrier		MJ	5,19E+01	1,34E+02	1,02E-04	1,86E+02	1,01E+02	- 2,40E+02
Use of renewable primary energy resources – use as raw materials		MJ	1,25E+03	0,00E+00	0,00E+00	1,25E+03	1,07E+03	- 1,39E+03
Use of renewable primary energy resources – total		MJ	1,30E+03	1,34E+02	1,02E-04	1,44E+03	1,21E+03	- 1,54E+03
Use of non-renewable primary energy resources – use as energy carrier		MJ	6,20E+01	5,13E+01	8,58E-03	1,13E+02	5,17E+01	- 1,94E+02
Use of non-renewable primary energy resources – use as raw materials		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable primary energy resources – total		MJ	6,20E+01	5,13E+01	8,58E-03	1,13E+02	5,17E+01	- 1,94E+02
Use of secondary material		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Net use of fresh water		m ³	5,79E-02	3,34E-02	9,20E-07	9,14E-02	3,66E-02	- 1,82E-01
Parameters describing waste								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Hazardous waste disposed		kg	8,39E-05	6,79E-05	1,96E-08	1,52E-04	9,22E-05	- 2,44E-04
Non-hazardous waste disposed		kg	1,89E+00	4,72E-01	7,03E-04	2,37E+00	1,57E+00	- 3,05E+00
Radioactive waste disposed		kg	4,53E-04	5,18E-04	5,52E-08	9,71E-04	3,06E-04	- 2,13E-03
Parameters describing output flows								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Components for reuse		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Material for recycling		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, electricity		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, thermal		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00

- 1) 100 km transport to the customer is assumed. No packaging waste is assumed for bulk delivery. (see also page 9) The heating process itself is not considered due to the different possible storage conditions, heating technologies and underlying burning efficiencies. Material inherent properties of the pellets, like stored biogenic carbon and energy resources used as raw materials will leave the system at the end-of-waste status (heating residues) and are therefore not considered in the downstream stage.
- 2) The range is between the pellet mills that has the lowest and the highest impact.
- 3) biogenic carbon content in 57,14 kg pellets (1000 MJ) is 97 kg CO₂-eq.
- 4) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Provide 1000 MJ of thermal energy, produced by burning 57,14 kg wood pellets – indicators according EN15804+A1

Parameters describing environmental impacts							
INDICATOR	UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	kg CO ₂ eq.	-93,84	1,17	0,00	-92,67	-93,68	- -90,04
Ozone layer depletion (ODP)	kg CFC-11 eq.	7,07E-07	3,46E-07	1,22E-10	1,05E-06	7,59E-07	- 1,56E-06
Photochemical oxidation (POCP)	kg C ₂ H ₄ eq.	2,49E-03	1,09E-03	6,80E-08	3,58E-03	1,79E-03	- 2,23E-02
Acidification (AP)	kg SO ₂ eq.	2,49E-03	1,09E-03	6,80E-08	3,58E-03	2,35E-02	- 5,46E-02
Eutrophication (EP)	kg PO ₄ eq.	6,05E-03	6,41E-03	3,84E-07	1,25E-02	9,33E-03	- 2,23E-02
Abiotic depletion - elements	kg Sb eq.	4,20E-05	3,92E-05	8,86E-09	8,12E-05	4,67E-05	- 9,82E-05
Abiotic depletion - fossil fuels	MJ	4,64E+01	1,79E+01	7,93E-03	6,43E+01	4,69E+01	- 1,48E+02



Please note: the comparison should give an insight about the impacts of Stora Enso pellets compared to other possible heating sources based on generic data from ecoinvent database. It does not meet the requirement of a full LCA. For example, no boiler heating efficiencies or transmission losses are considered.

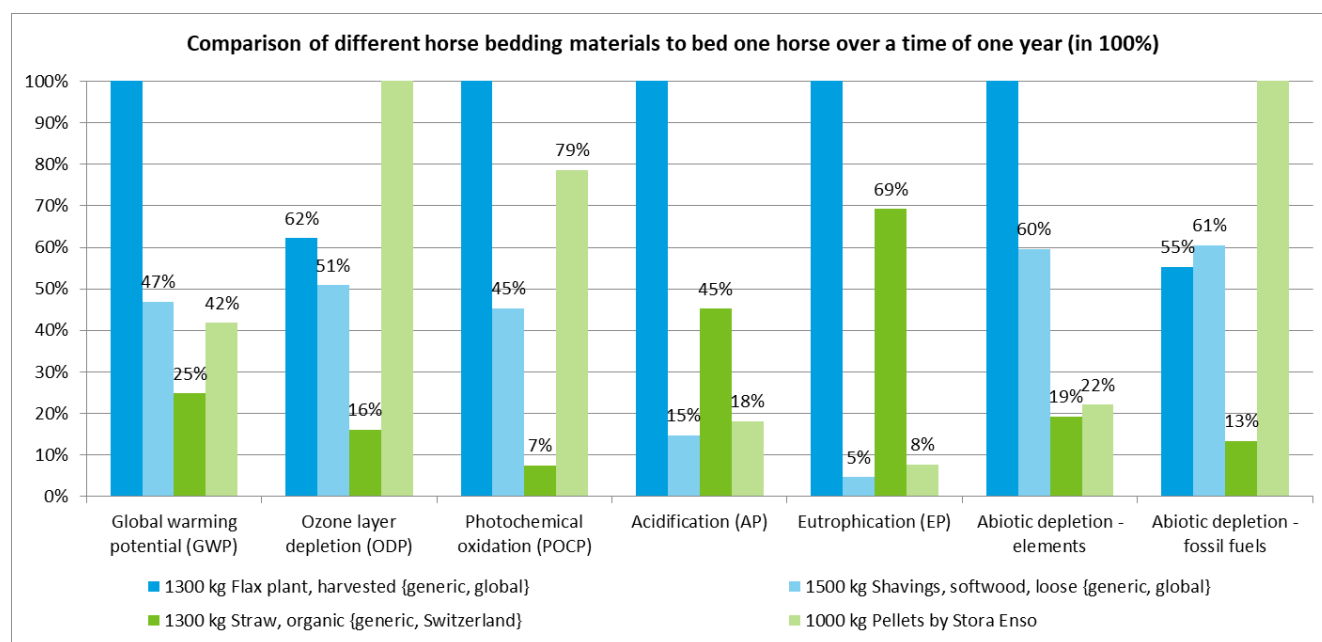
Provide **bedding material for an average size adult horse in a typical horse stable in Sweden for one year** and thus is equal to 1000 kg of high-quality wood pellets, which are delivered in 15 kg HDPE bags – according **EN15804+A2**

Parameters describing environmental impacts								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	Fossil	kg CO ₂ eq.	65,28	14,69	34,63	114,60	106,22	- 129,23
	Biogenic ³⁾	kg CO ₂ eq.	-1696,58	1,69	0,05	-1694,84	-1697,25	- -1691,41
	Land use and land transformation	kg CO ₂ eq.	1,23	0,30	0,03	1,56	0,66	- 3,70
	TOTAL	kg CO ₂ eq.	-1630,07	16,68	34,71	-1578,68	-1590,01	- -1558,47
Ozone depletion potential (ODP)		kg CFC 11 eq.	1,26E-05	5,88E-06	4,69E-06	2,32E-05	1,87E-05	- 2,73E-05
Acidification potential (AP)		mol H ⁺ eq.	3,86E-01	3,77E-01	1,15E-01	8,77E-01	7,54E-01	- 1,07E+00
Eutrophication potential (EP)	freshwater	kg PO ₄ eq.	2,90E-03	1,23E-03	4,90E-04	4,62E-03	3,23E-03	- 5,43E-03
	marine	kg N eq.	1,18E-01	9,85E-02	3,32E-02	2,50E-01	2,13E-01	- 3,21E-01
	terrestrial	mol N eq.	1,33E+00	1,63E+00	3,70E-01	3,33E+00	2,78E+00	- 3,97E+00
Formation potential of tropospheric ozone (POCP)		kg NMVOC eq.	5,40E-01	2,83E-01	1,26E-01	9,49E-01	6,89E-01	- 1,36E+00
Abiotic depletion potential – Elements (ADPE) ⁴⁾		kg Sb eq.	7,54E-04	7,30E-04	5,81E-04	2,07E-03	1,47E-03	- 2,36E-03
Abiotic depletion potential – Fossil resources (ADPF) ⁴⁾		MJ, net calorific value	1,45E+03	9,16E+02	3,82E+02	2,75E+03	1,64E+03	- 3,79E+03
Water scarcity potential ⁴⁾		m ³ eq.	4,47E+01	1,07E+01	2,96E+00	5,84E+01	3,34E+01	- 6,40E+01
Parameters describing use of resources								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Use of renewable primary energy resources – use as energy carrier		MJ	1,01E+03	2,22E+03	5,95E+02	3,83E+03	3,04E+03	- 4,84E+03
Use of renewable primary energy resources – use as raw materials		MJ	2,21E+04	0,00E+00	0,00E+00	2,21E+04	1,88E+04	- 2,43E+04
Use of renewable primary energy resources – total		MJ	2,31E+04	2,22E+03	5,95E+02	2,59E+04	2,18E+04	- 2,77E+04
Use of non-renewable primary energy resources – use as energy carrier		MJ	1,53E+03	9,27E+02	4,06E+02	2,86E+03	1,74E+03	- 3,90E+03
Use of non-renewable primary energy resources – use as raw materials		MJ	3,34E+02	0,00E+00	0,00E+00	3,34E+02	3,34E+02	- 3,34E+02
Use of non-renewable primary energy resources – total		MJ	1,87E+03	9,27E+02	4,06E+02	3,20E+03	2,08E+03	- 4,23E+03
Use of secondary material		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Use of non-renewable secondary fuels		MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Net use of fresh water		m ³	1,23E+00	4,67E-01	9,78E-02	1,79E+00	9,87E-01	- 1,95E+00
Parameters describing waste								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Hazardous waste disposed		kg	1,52E-03	1,19E-03	9,75E-04	3,68E-03	2,76E-03	- 5,41E-03
Non-hazardous waste disposed		kg	2,92E+01	7,91E+00	1,40E+01	5,11E+01	4,23E+01	- 5,96E+01
Radioactive waste disposed		kg	9,27E-03	1,21E-02	2,13E-03	2,35E-02	7,90E-03	- 3,98E-02
Parameters describing output flows								
INDICATOR		UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Components for reuse		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Material for recycling		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	- 0,00E+00
Export energy, electricity		kg	0,00E+00	0,00E+00	1,59E+01	1,59E+01	1,59E+01	- 1,59E+01
Export energy, thermal		kg	0,00E+00	0,00E+00	3,20E+01	3,20E+01	3,20E+01	- 3,20E+01

- 1) 100 km transport to the customer is assumed. Packaging waste as well as the secondary packaging (stretch film & top film) is transported 20 km to the waste processing facility, where an incineration is scenario applied (see also page 9) Material inherent properties of the pellets, like stored biogenic carbon and energy resources used as raw materials will leave the system at the end-of-waste status (horse litter) and are therefore not considered in the downstream stage..
- 2) The range is between the pellet mills that has the lowest and the highest impact and which are selling pellets in 15 kg bags.
- 3) biogenic carbon content in 1000 kg pellets (1 horse / 1 year) is 1697,53 kg CO₂-eq.
- 4) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Provide **bedding material for an average size adult horse in a typical horse stable in Sweden for one year** and thus is equal to 1000 kg of high-quality wood pellets, which are delivered in 15 kg HDPE bags – according **EN15804+A1**

Parameters describing environmental impacts							
INDICATOR	UNIT	upstream	core	downstream ¹⁾	Total	Range Total ²⁾	
Global warming potential (GWP)	kg CO ₂ eq.	-1632,30	15,75	34,29	-1582,26	-1592,56	- 1565,17
Ozone layer depletion (ODP)	kg CFC-11 eq.	1,26E-05	5,88E-06	4,69E-06	2,32E-05	1,87E-05	- 2,73E-05
Photochemical oxidation (POCP)	kg C ₂ H ₄ eq.	5,55E-02	1,67E-02	5,95E-03	7,82E-02	4,18E-02	- 1,58E-01
Acidification (AP)	kg SO ₂ eq.	2,85E-01	2,50E-01	8,94E-02	6,24E-01	5,42E-01	- 7,40E-01
Eutrophication (EP)	kg PO ₄ eq.	8,24E-02	6,75E-02	1,52E-02	1,65E-01	1,38E-01	- 2,00E-01
Abiotic depletion - elements	kg Sb eq.	7,59E-04	7,32E-04	5,81E-04	2,07E-03	1,47E-03	- 2,37E-03
Abiotic depletion - fossil fuels	MJ	1,13E+03	1,57E+02	3,68E+02	1,65E+03	1,57E+03	- 1,81E+03



Please note: the comparison should give an insight about the impacts of Stora Enso pellets compared to other possible horse bedding materials based on generic data from ecoinvent database. It does not meet the requirement of an full LCA.

References

Standards

ISO 14020:2000 Environmental labels and declarations – General principles

ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations. Principles and procedures.

ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006 Environmental management. Life Cycle Assessment. Requirements and guidelines.

EN 15804:2012 + A2:2019 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products

EN 16485:2014 Round and sawn timber – Environmental Product Declarations - Product category rules for wood and wood-based products for use in construction

EN 16449:2014 Wood and wood-based products. Calculation of the biogenic carbon content of wood and conversion to carbon dioxide

ISO 17225-1:2014 Solid biofuels. Fuel specifications and classes. Part 1: General requirements

ILCD Handbook: Recommendations for life cycle impact assessment in the European context. European Commission Joint Research Centre Institute for Environment and Sustainability.

Tools and databases

SimaPro 9.1 – LCA software by PRé Sustainability <http://simapro.com/>

Ecoinvent 3.6 database. <http://www.ecoinvent.org/>

Detailed product information



More pellets inspiration

storaenso.com/pellets

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