

Carbon sink attestation – for CO₂e potential at factory-gate

ID of C-sink attestation

cs000176

Sonnenerde GmbH

**Oberwarter Strasse 100
7422 Riedlingsdorf
Austria**

Operator ID: 458488
Production unit ID pu000017
GPS of production Latitude:47.3300432692775 ,
Longitude:16.153561287932853

The Carbon sink potential attestation of the mentioned batch at factorygate is derived according to the following standard:

**GLOBAL BIOCHAR C-SINK****Summary of C-sink potential**

Batch ID	ba000176
C-sink potential per ton of biochar (DM)	1.874 t CO ₂ e / t BC (DM)
C-Content	51.100 % (w/w)
H/Corg ratio	0.190
Total fossil GHG emissions per ton of biochar (DM) at factory-gate	0.068 t CO ₂ e / t BC (DM)
Total methane emissions per ton of biochar (DM) at factory-gate	0.114 kg CH ₄ / t BC (DM)
Absolute global warming potential of methane emissions per ton of biochar (DM) at factory-gate	0.144 t ACO ₂ e / t BC (DM)
Energy Efficiency	61.336 %

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Hans Matzenberger President
of board of directors



Franziska Staubli
Director

Operator ID: **458488**

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C-sink potential details at factory-gate (per ton of biochar (DM))

Fossil fuel derived emissions per ton of biochar (DM), must be offset with C-sink_1000+

Feedstock	
Type of feedstock	R-07 Residues from industrial biomass processing, Ag-05 Harvest residues
Total amount of feedstock (DM) used per ton of biochar (DM)	1.870 t (DM)/ t BC (DM)
Emissions due to fertilization of feedstock	0.000 t CO ₂ e / t BC (DM)
Emissions due to cultivation and harvest of feedstock	0.000 t CO ₂ e / t BC (DM)
Emissions due to transportation of feedstock to pyrolysis site	0.011 t CO ₂ e / t BC (DM)
Emissions due to feedstock preparation	0.022 t CO ₂ e / t BC (DM)
Emissions for drying of feedstock	0.000 t CO ₂ e / t BC (DM)
Total feedstock related emissions	0.033 t CO₂e / t BC (DM)
Pyrolysis	
Emissions due to electricity usage	0.015 t CO ₂ e / t BC (DM)
Emissions due to preheating	0.000 t CO ₂ e / t BC (DM)
Emissions due to carrier gas	0.000 t CO ₂ e / t BC (DM)
Total pyrolysis related emissions	0.015 t CO₂e / t BC (DM)
Margin of Security	
Margin of security	0.020 t CO₂e / t BC (DM)
Total emissions	
Total fossil GHG emissions per ton of biochar (DM) at factory-gate, excl. Pro Rata	0.068 t CO ₂ e / t BC (DM)

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Methane emissions per ton of biochar (DM), must be offset with C-sink_20

Methane	
Methane emissions due to feedstock storage	0.000 kg CH ₄ / t BC (DM)
Methane emissions due to pyrolysis	0.112 kg CH ₄ / t BC (DM)
Total methane emissions at factory-gate	0.114 kg CH ₄ / t BC (DM)
Absolute global warming potential of methane emissions per ton of biochar (DM) at factory-gate	0.144 t ACO ₂ e / t BC (DM)
Biochar	
H/Corg ratio	0.190
Organic carbon content Corg	51.100 % (w/w)
C-sink potential per ton of biochar (DM)	1.874 t CO ₂ e / t BC (DM)

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Batch details at factory-gate

Batch		
Total biochar production of batch (expected) in t dry matter		185.000 t DM
Total fossil GHG emissions at factory-gate		12.580 t CO ₂ e / batch
Absolute global warming potential of methane emissions (based on GWP100)		26.670 t ACO ₂ e / batch
C-sink potential (gross C-sink)		346.690 t CO ₂ e
Energy Efficiency		
Energy content of feedstock (expected)		1768444.406 kWh
Energy content of feedstock preparation		14571.522 kWh
Energy content of feedstock transportation		7319.644 kWh
Energy content of biochar (expected)		796527.860 kWh
Produced quantity of electricity per batch		0.000 kWh
Produced quantity of valorised heat per batch		361870.000 kWh
Energy content of purified CO ₂		0.000 kWh
Energy efficiency (expected)		61.336 %
Pro Rata		
Pro rata		100.000 %

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The biochar batch ba000176 produced by Sonnenerde GmbH has carbon sink potential of 51.100 % (w/w). Each ton of biochar from the certified batch has a carbon sink potential of 1.874 t CO₂e / t BC (DM).

The carbon sink potential is equivalent to the C-content of 51.100 % (w/w) provides the percentage of a mass unit of biochar that, on a dry matter base, can be considered as a carbon sink at the time of application. For example, a big bag containing 131 kg biochar (dry matter) has a carbon sink potential of 66.941 which is the equivalent of 245.45 kg CO₂e per big bag.

The production of 1 t of biochar (dry matter) caused emissions of 0.068 t CO₂e / t BC (DM) due to feedstock production, transportation, storage, preparation and operation of the pyrolysis plant and 0.114 kg CH₄ / t BC (DM) methane emissions during both biomass storage and the combustion of the pyrolysis gases. These emissions have to be offset before the C-sink certificate can be issued.

The following rules apply for the offsetting:

All fossil fuel based CO₂ emissions, as well as N₂O emissions from biomass fertilization, must be offset by long-term carbon sinks. CO₂ must only be offset with geological C-sinks, such as the persistent aromatic carbon (PAC) fraction of soil-applied biochar, that are registered in the Global C-Sink Registry. The emission offsets can be realized with the registered permanent biochar C-sink whose production had caused the emission.

Methane compensation is defined as creating a carbon sink for 20 years that has a climate cooling effect equal to the climate warming effect of a methane emission over 100 years after the emission occurred. Thus, the total climate forcing of a methane emission must be compensated within 20 years after the initial emission.

The CO₂ emissions of the combustions of the pyrolysis gases used for energy production are considered as carbon neutral as the feedstock for the pyrolysis originated from Agricultural Harvest residues and Residues from industrial biomass processing.

The CH₄ emissions during the combustion of the pyrolysis gases were measured once during regular operation. The methane values are thus subject to some uncertainty regarding start-up and shut down of the process or possible problems during regular operation. For this reason, a margin of 50 % was added to the measured CH₄ emissions.

The CH₄ due to self-heating of the biomass during storage were not considered, as it was guaranteed that the feedstock is never stored longer than 30 days before drying to below 20% water content.

All electricity used for the production was provided by the country grid.

Neither the carbon expenditures necessary to transport the biochar from the production site to the location of the final C-sink nor the carbon expenditures when manufacturing or blending the biochar into a carbon sink product are considered so far. These emissions must be offset with a geological C-sink as well before the C-sink certificate can be issued. The C-sink will be registered with its degradation curve depending on the application matrix.

During the biochar production, 361870.000 kWh thermal energy will be valorised and 0.000 kWh electric energy will be produced. As all GHG emissions of the entire process were allocated to the biochar production, this estimated thermal energy is completely carbon neutral.

The present Global Biochar C-Sink attestation for CO₂e potential at factory gate is valid for the biochar batch ba000176 and can be used for carbon sink certification and trade procedures. The additional emissions after the factory-gate, e.g. transportation and or processing, have to be tracked by an endorsed dMRV system. The reported emissions must be offset before a C-sink can be registered.