

## Exhibit 1 - Soil Amendment Method and Methodology

Title: Pulp sludge based soil improver and carbon storage Methodology

This methodology quantifies the CO<sub>2</sub> Removal achieved by soil amendment use of **pulp and paper mill sludges**.

CO<sub>2</sub> Removal results from the soil amendment use of forest industry side streams, which would otherwise be incinerated. Utilizing these side streams as soil improver stores carbon into agricultural soils.

This methodology applies to certificates issued for Puro.earth CO<sub>2</sub> Removal Marketplace.

### 1. Eligible activity type

**Activity** that transforms pulp and paper mill sludges (fiber-, primary-, secondary-, tertiary-, and mixed sludges) to soil improver products that are utilized in agriculture (later: Product or Products).

The Long-Term CO<sub>2</sub> Removal is achieved by increasing the soil carbon stock of the field that the Products are applied on. When Products are used as soil improvers, a proportion of the inert organic matter contained in the Product is stored in the soil carbon pool as durable carbon compounds.

**Without the activity** - the soil amendment use of Products – the sludge would be incinerated by pulp and paper mills, releasing all the carbon (C) contained in the organic matter into the atmosphere. The moisture content of pulp and paper mill sludges is so high (60-75 %) that they have no energy value, and other fuels are needed to aid the incineration process (Alakangas et al. 2016).

#### 1.1. Requirements for activities to be eligible under the methodology

1.1.1 Products that are used as part of the Activity are manufactured from fiber-, primary-, secondary-, tertiary- or mixed sludge that is generated as a side stream in pulp, paper, or cardboard production.

1.1.2 Products made from these materials may be processed by mixing in additives, composting, and / or lime stabilization to modify their properties and to fulfill the requirements of fertilizer and soil amendment legislation. If additives that are used contain carbon, only the carbon from the sludges is included in the calculation of CO<sub>2</sub> Removal.

1.1.3 Products that are used as part of the Activity are registered and approved for soil amendment use as the local fertilizer legislation requires. In Finland, Products must be eligible either for the national type designation list of fertilizer products or, in the case of EC fertilizers, for the list of types of EC fertilizers designations specified in Annex I to EC Regulation 2003/2003 (EU Reg).

1.1.4 Soil amendment use of Products does not take place on Histosols.

#### 1.2 Requirements for the Product Processing and Use Audit

1.2.1 The Product Processing and Use Auditor checks the source, processing, and end use of the Products against the Requirements for activities to be eligible under the methodology (section 1.1.), and the Proofs and evidence needed from the CO<sub>2</sub> Removal Supplier (section 5). The main requirements include:

- The material used for the Products is of eligible type, they are processed in a suitable manner and the Products are approved for soil amendment use (see sections 1.1.1, 1.1.2, 1.1.3, 5.2.1, and 5.2.2)
- The Products are used in farms for soil amendment according to restrictions set in this methodology (see sections 1.1.4, 5.2.4, and 5.4)

1.2.2 The Product Processing and Use Auditor checks that the CO2 Removal Supplier is capable of metering and quantifying the Output and the Emissions from the Activity in a reliable manner for the Quantification of CO2 Removal (section 4). This check also prepares the CO2 Removal Supplier for producing the periodic Output Report.

- The quantity of Products delivered to farms is quantified and documented in a reliable manner (section 5.2.4)
- The Carbon content of the Products is quantified and documented in a reliable manner (section 5.2.3)
- Emissions from the activity are quantified and documented in a reliable manner (Section 5.3)
- The auditor goes through the Quantification of CO2 Removal requirements with the CO2 Removal Supplier, so that the Supplier is able to calculate the CO2 Removal independently in its Output Report.

1.2.3 Collection of standing data of the CO2 removal supplier

The Product Processing and Use Auditor collects and checks the standing data of the CO2 Removal Supplier. The data to be collected by the Auditor includes:

- A certified trade registry extract or similar official document stating that the organization is validly existing and founded under the laws of the mother country.
- Location of the processing & Product storage facilities.
- Removal Method(s) for which the facility is eligible to receive CO2 removal certificates.
- The Date on which the CO2 removal supplier becomes eligible to receive CO2 removal certificates.

2. Point of creation of the CO2 Removal certificate achieved by soil amendment use of **pulp and paper mill sludges**.

2.1. Point of creation

2.1.1. The point of creation of the certificate is the moment when the Product is delivered to the farm that has purchased it for soil amendment use. The application to the field can take place as soon as the weather conditions allow, but no later than what is required by the local agricultural regulation.

2.1.2. The seller of the Product is the CO2 Removal Supplier.

3. Activity boundary for the CO2 Removal Certificate

3.1. Activity

Included within the boundary

- Transportation from an industrial source to a processing site
- Processing (if processed)
- Transportation of the Product to the storage site (if used)

- Transportation of the Product to the end user (from processing site / from storage site)
- Application on to a field

Excluded from the boundary

- GHG emissions from the sludge processing done in pulp & paper mill
- CO<sub>2</sub> emissions from the soil after application

The reasoning for excluded items: GHG emissions from the sludge processing done in pulp & paper mill would occur even if the sludges would be incinerated. Biogenic CO<sub>2</sub> emissions from the soil after application of the Product are from the decomposition of renewable biomass.

#### 4. Quantification of CO<sub>2</sub> Removal – calculation methodology

##### 4.1 Net CO<sub>2</sub> Removal

$$\text{Net CO}_2 \text{ removal} = \text{CO}_2 \text{ storage (20 years)} - \text{Emissions}_{\text{activity}}$$

Where:

*CO<sub>2</sub> storage* = amount of CO<sub>2</sub> removed from the atmosphere and retained in the soil for 20 years (t CO<sub>2</sub>)

$$\text{Emissions}_{\text{activity}} = E_{\text{processing}} + E_{\text{transportation}} + E_{\text{application}}$$

##### 4.2 CO<sub>2</sub> storage (20 years)

The proportion of Product carbon that is left in the soil after 20 years is estimated with Yasso-modelling tool forecasting litter decomposition and soil carbon pool accumulation (Yasso).

Therefore, the amount of CO<sub>2</sub> removed from the atmosphere by each Product is calculated according to the following formula:

$$\text{CO}_2 \text{ storage} = Q_{\text{product}} * C_{\text{product}} * SC_{\text{product}} * CF$$

Where:

*CO<sub>2</sub> storage* = amount of CO<sub>2</sub> removed from the atmosphere (t CO<sub>2</sub>)

*Q<sub>product</sub>* = Quantity of Product that has been delivered to farms for soil amendment use (in tons)

*C<sub>product</sub>* = Average organic carbon content of the delivered Product batch (%)

*SC<sub>product</sub>* = Stored Carbon Proportion, Yasso-modelled Proportion of Product organic carbon that is stored in the soil after 20 years (%)

CF = Conversion factor from carbon to carbon dioxide (3,67)

### 4.3 Emissions from the Activity

Emissions from the Activity consist of emissions from processing, transportation, and field application of the Products within the Activity Boundary.

$$Emissions_{activity} = E_{processing} + E_{transportation} + E_{application}$$

$E_{processing}$  = Emissions from the processing of the Products and emissions from the use of possible additives

$E_{transportation}$  = Emissions from all transportations within Activity boundary

$E_{application}$  = Emissions from field application of the Products in the farmland and soils

#### 4.3.1 Emissions from processing pulp and paper mill sludges into Products

Emissions from processing occur from fossil fuel use of the machinery used for processing, and from the production and transportation of possible additives used in processing (for example lime if Product is lime stabilized). If used additives are also sourced as side streams, no production emission is considered to occur for them.

#### 4.3.2 Emissions from transportation

The side stream and Product transportation emissions are calculated for all transportations occurring within the Activity boundary. These include transportations from side stream source to the Product processing site, from Product processing site to Product storage facility, from the Product storage facility to the farms, and all other occurring transportations.

#### 4.3.3 Emission from field application

Emissions from the field application of the Products are estimated for the total Product quantity delivered by the CO<sub>2</sub> removal Supplier. Emissions from the application are included regardless of if the application is performed by the farmer or by the CO<sub>2</sub> removal supplier.

## 5. Proofs and evidence needed from the CO<sub>2</sub> Removal Supplier

### 5.1. Principle

5.1.1 Output from Activity is determined as eligible for issue of CO<sub>2</sub> removal certificates once the Activity and CO<sub>2</sub> removal supplier have undergone a process of third-party verification by an auditor against the specific methodology for the Pulp and Paper mill sludge. The verification ensures that the corresponding CO<sub>2</sub> removal has taken place and that the CO<sub>2</sub> removal is considered stored for the long term as defined in the methodology.

5.1.2 For the Activity to be eligible for soil amendment use of pulp and paper mill sludges for which CO<sub>2</sub> removal certificates can be issued, the following proofs (5.2- 5.5) need to be presented by the CO<sub>2</sub> Removal Supplier (in this case, the seller of the Product).

## 5.2 Product source, quality & quantity

5.2.1 Proof that Products that are used as part of the Activity are manufactured from fiber-, primary-, secondary-, tertiary-, or mixed sludge that is generated as a side stream in pulp, paper, or cardboard production. This is demonstrated by presenting that the starting point of transportation for each side stream is an eligible source, and by presenting the product information papers that show the ingredients of the Product.

5.2.2 Proof that Products fulfill the requirements of fertilizer and soil amendment legislation, and proof of all the additives used in Products. Proof to be presented for these are the product information papers that follow the requirements of local fertilizer and soil amendment legislation and show the ingredients of the Product.

5.2.3 Proof that shows the organic carbon content of the Products. Proof to be presented is laboratory results that show the content of organic carbon in the Products. (  $C_{product}$  )

5.2.4 CO<sub>2</sub> removal supplier provides data and documentation on the quantity of Products delivered to the farms for soil amendment use. Proof to be presented is data on Product deliveries, for example, invoices or record keeping for the transportation, which include transportation destinations and quantity of delivered Product(s). (  $Q_{product}$  )

## 5.3 Storage of the Activity ( $SC_{product}$ )

5.3.1 CO<sub>2</sub> removal supplier provides a Yasso-model results for the Proportion of Product organic carbon that is retained and stored in the soil after 20 years (%).

5.3.2 The input parameters needed for determining the decomposition rate in the Yasso-model. Proof to be presented is laboratory results for the Product's Carbon content as acid (A), water (W) and ethanol (E) soluble, non-soluble (N) and humus (H) fractions.

5.3.3 The climate zone of the farms informs the Yasso-model for weather conditions impacting the decomposition rate like rainfall and temperature.

## 5.4 Emissions from the Activity

Proof that allows quantifying all the emissions occurring from the Activity. CO<sub>2</sub> removal supplier needs to present LCA/carbon footprint results for the processing (  $E_{processing}$  ), logistics (  $E_{transportation}$  ), and application (  $E_{application}$  ) of the Products.

## 5.5. Proof of the end use of Product

5.5.1 CO<sub>2</sub> removal supplier will present proof that the Products have been sold and delivered to farms (data on deliveries showing end destinations)

5.5.2 CO<sub>2</sub> removal supplier will present proof that use of Products does not take place on Histosols. Proof to be presented is confirmation from the farmer.

## 5.6. Proof of no double counting or double claiming

5.6.1. A statement is needed from the CO<sub>2</sub> Removal Supplier that the Product or Activity in which the CO<sub>2</sub> is stored will not be sold or marketed as “carbon positive” if the CO<sub>2</sub> removal certificate associated with the use of Product (soil improvement fibers) is removed from the Product and sold to another stakeholder not associated with the Product.

5.6.2 No carbon accounting claims can be made by the end-user (user of Product; farms that use Product for soil amendment) that the Product is a carbon sink or carbon removal, if the decoupled CO<sub>2</sub> Removal certificate has been sold to and cancelled by another stakeholder not associated with the Product.

## 6. References

(Alakangas et al. 2016) Alakangas, E., Hurskainen, M., Laatikainen-Luntama, J. & Korhonen, J. 2016. Suomessa käytettävien polttoaineiden ominaisuuksia. VTT Technology 258. Downloaded on 27.1.2021: <https://www.vttresearch.com/sites/default/files/pdf/technology/2016/T258.pdf>

(EU Reg) Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilizers , Downloaded 13.4.2021 <https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32003R2003>

(Yasso) Soil carbon model Yasso07, Yasso15 - worldwide litter decomposition and carbon stock mathematical modelling tool based on a global database containing 18 500 measurements of litter decomposition and soil organic carbon. Downloaded 26.4.2021 <https://en.ilmatieteenlaitos.fi/yasso-description#Yasso15>