THE ROLE OF FEEDSTOCK FOR BIOCHAR & ENERGY IN REDUCING THE CARBON FOOTPRINT OF BIOENERGY PROJECTS — A CASE STUDY IN NORTH EUROPE

Lydia Fryda, TNO, Netherlands
Lydia.fryda@tno.nl
Rian Visser, TNO, Netherlands

Key Words: Biochar, peat, substrate, CCS.

The study evaluates the GHG emissions of biochar & bioenergy production in a low temperature gasifier based on various feedstocks. A LCA approach is used to assess the environmental impact of the production and use of biochar for selected applications including the whole feedstock supply chain. Three kinds of feedstock were evaluated, namely (1) agro-residues and municipal forest residues (2) clean wood from sustainable forestry (e.g. pine) and (3) fast growing energy crops (short rotation coppice) Miscanthus and/or willow.

The scenarios considered are:
(1) Co-production of bioenergy (syngas) and biochar in a low temperature gasification unit, feedstock used agro-residues and park residues. The biochar is used as soil improver due to its high nutrient content. Syngas is used for heat production in a gas boiler, replacing NG boilers, while biochar is considered a CCS option (BECCS = BioEnergy Carbon Capture & Storage). The reasoning is, residual feedstock streams (agro-waste and park residues) are abundant, and need to be treated anyway. The option of gasification as a treatment process offers the possibility to return part of the carbon to the soil and sequester it (negative CO2 flow = CCS) and also replace part of fossil energy demand by producing energy from waste material (neutral CO2 flow).

(2) Dedicated production of biochar in a pyrolysis unit (PyroCCS_1). Feedstocks used agro-residues and park residues, same as in Case 1. The product is used as soil improver, for example in poor degraded soils. In contrast to option (1, BECCS), no fossil energy is replaced because no surplus energy is co-produced.

(3) Dedicated production of biochar in a pyrolysis unit, feedstock used is pine and miscanthus from sustainable forestry. The product, due to its high quality, is entirely used in sustainable growing media replacing peat (PyroCCS_2), and at the end of life it is disposed in the soil. The reason is, high quality biochar should be used for high value end products, such as substrates for high market price products (strawberry, tomato, horticulture).

The functional unit is the use of 1 kg feedstock. All results on GHG emission reduction and other impact categories refer to 1 kg input feedstock. The choice of this functional unit allows the comparison of the scenarios that may have a different purpose, namely producing only biochar or co-producing biochar and bioenergy. In the case of co-produced bioenergy (in the form if syngas) and biochar, the bioenergy part replaces fossil energy from natural gas. Tradeoffs are identified, which influence the final GHG emission mitigation potential per case; biochar is always disposed of in the soil and thus is considered a CCS option.