Life cycle assessment of energy biomass from rewetted peatlands

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1. Introduction

Agriculture and forestry on drained peatlands are connected to numerous negative impacts on the environment, including greenhouse gas emissions, nutrient leaching and loss of biodiversity [1]. Restoration can reduce these impacts [2].

Rewetting does not exclude further land-use. Biomass can be used with adapted techniques. The cultivation of biomass on wet and rewetted peatlands, so-called paludiculture (latin 'palus' = swamp), is a sustainable alternative to drainage based peatland agri- and silviculture as well as to peat mining. Biomass can e.g. be used to substitute fossil fuels [3].

Is the energetic use of biomass from rewetted peatlands a reasonable alternative to fossil fuels?

This poster presents the results of a screening life cycle assessment (LCA) for gramineous energy biomass from rewetted peatlands focusing on energy and greenhouse gas balances for Reed Canary Grass (*Phalaris arundicea*) and Common Reed (*Phragmites australis*) from harvest to combustion.

Fig. 1: Harvest of gramineous biomass on a rewetted peatland with a tracked vehicle.

2. Materials and Methods

The life cycle assessment largely follows the guidelines of the ISO standards 14040 and 14044. It considers harvesting of round bales by using adapted grassland machinery and chopped biomass by a tracked vehicle. For Reed Canary Grass a yield of 5 t dm (ha a)$^{-1}$ is assumed and 10 t dm (ha a)$^{-1}$ for Common Reed. The Biomass is used as co-fuel in a 600 MW hard-coal-fired power plant (see Fig. 2).

The study uses data from GEMIS database [4] which includes direct emissions and energy consumption of products and processes as well as their upstream chains. Modelling of machines and processes follows Borken et al. [5]. Yields and biomass properties as well as aspects of the product system are taken from Wichmann and Wichtmann [6]. All calculations refer to the amount of fuel providing 1 GJ energy.

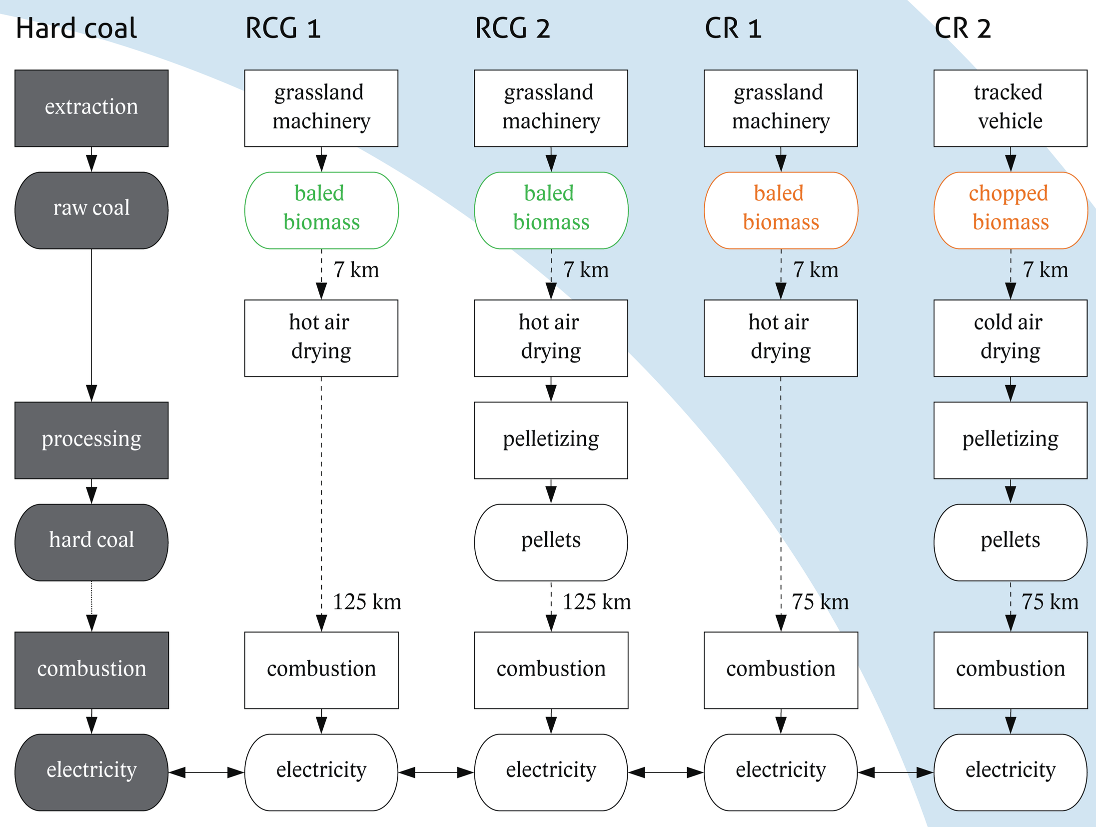

Fig. 2: Setup of the life cycle comparisons between hard coal and gramineous biomass from rewetted peatlands. Common Reed Reed Canary Grass

transport comparison product process reference

3. Results

If hard coal is substituted by biomass from rewetted peatlands, between 82 % and 92 % of greenhouse gas emissions and between 70 % and 83 % of primary energy depletion can be avoided.

If drying is not considered, baling the biomass is superior to pelletizing. The reduced primary energy demand and greenhouse gas emissions during transport of pelletized biomass cannot compensate for the efforts of pellet production.
However, drying is the crucial factor determining the life-cycle comparison. Hot air drying causes the highest expenses during the life cycle path: 15 % of the energy content of the biomass is needed for hot air drying. Pelletizing consumes about 10 % of the biomass energy. Expenses for harvest and transport of the biomass are relatively small.

The significantly lower demands of cold air drying in scenario CR 2 result in the highest savings of all scenarios despite pellet production (see Fig. 3.).

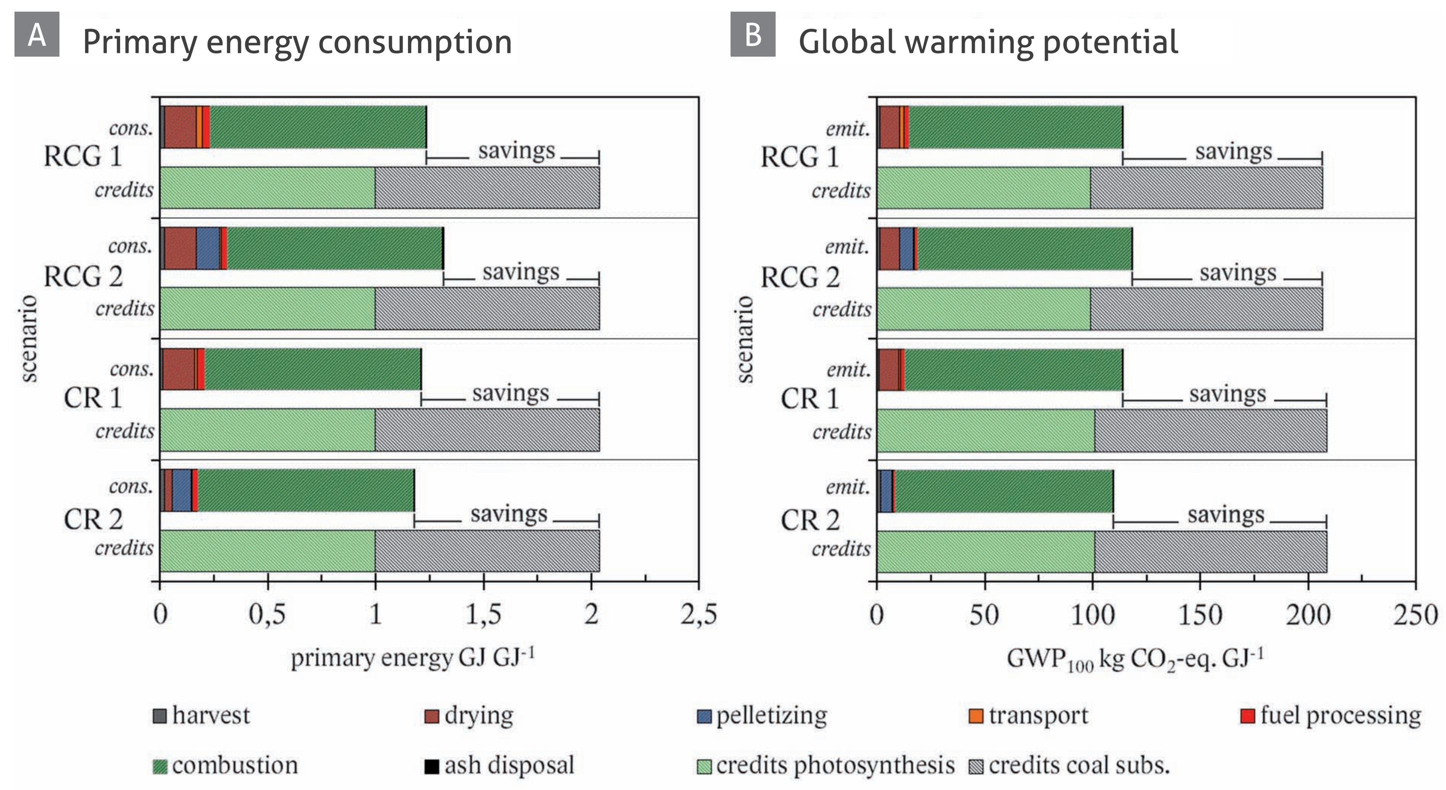

Fig. 3: Primary energy consumption (A) and global warming potential (B) differentiated by scenarios and life cycle stages. Expenses (upper bar) and credits (lower bar) referring to environmental burden or relief. The difference between total expenses (consumption/emissions) and credits indicates the savings compared to hard coal firing. RCG - Reed Canary Grass, CR - Common Reed, cons. - consumption, emit. - emissions.

4. Conclusion

The substitution of hard coal by biomass from rewetted peatlands leads to a significant reduction of primary energy depletion and greenhouse gas emissions. These savings are additional to and in the same order of magnitude as possible emission reductions achieved by rewetting drained peatlands [7].

Biomass can be used as co-fuel in peat fired power plants as well leading to even higher reductions of greenhouse gas emissions, considering that the combustion of peat leads to even higher greenhouse gas emissions per GJ than hard-coal.

Highest savings are realised if energy intensive hot air drying is avoided and if the biomass is harvested and transported as bales. Pelletizing is associated with high energy consumption and is only reasonable in combination with cold-air drying of chopped biomass.
As far as greenhouse gas and energy balance are concerned, energy biomass from rewetted peatlands is a good alternative to fossil fuels.

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