

BIOGRACE II

Harmonised Greenhouse Gas Calculations
for Electricity, Heating and Cooling from Biomass

Methodological background and rules for GHG calculations

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23 October 2012, Heidelberg

Biograce I and Biograce II

- Biograce I for biofuels
 - Renewable energy directive 2009/28/EC
 - Communications
 - Decisions
 - Default values
- Biograce II for solid biomass
 - Report COM(2010)11 from EC
 - Impact assessment
 - Default values
 - Renewable energy directive 2009/28/EC
 - Coming report from EC

Calculation rules

- Purpose
 - Set up rules for actual calculations
- Examples from Biograce I
 - How to choose a standard value (emission factor for nitrogen)
 - How to make allocation of emissions between co-products

Biomass combustion plant

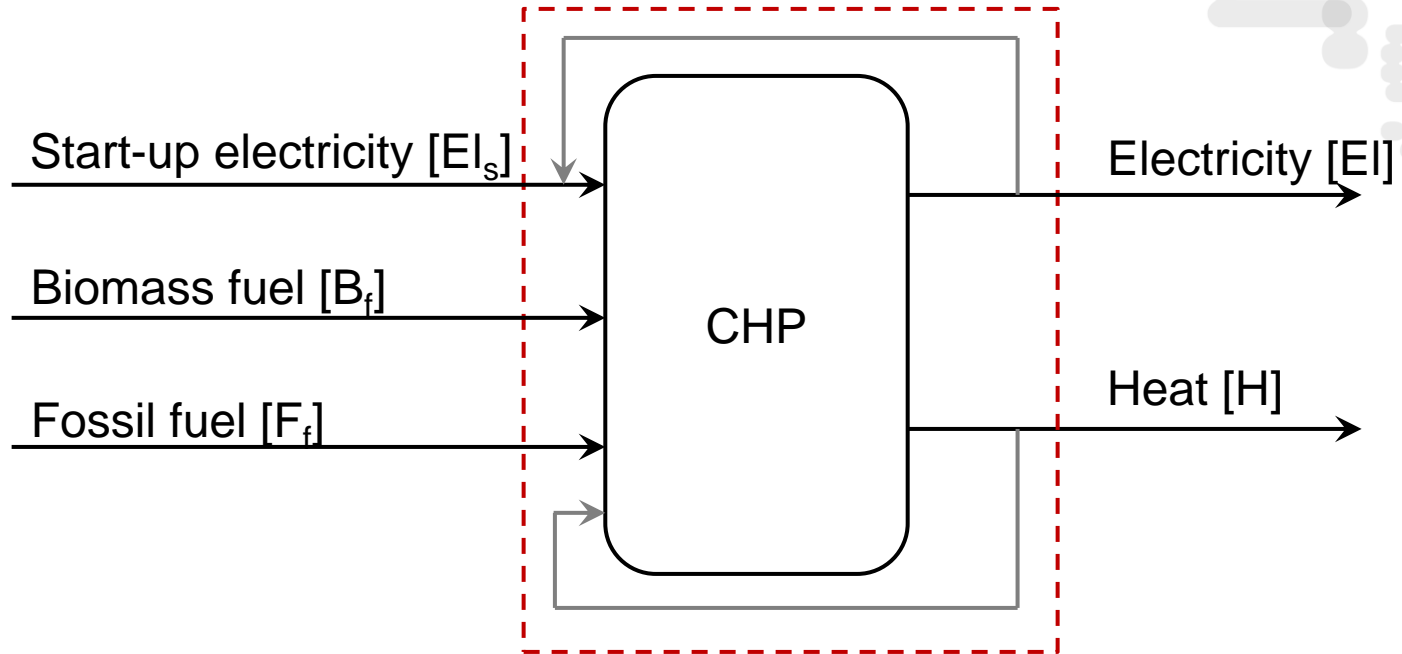
- Start-up fuel or co-combustion fuel
 - Fossil fuel
- Electricity
 - Start-up electricity
 - Help systems (oil pumps, pumps for the feedwater, ventilation pumps)
- Heat
 - Preheating of air or fuel

Guidance from RED

- **RED Article 5(3)**

- In multi-fuel plants using renewable and conventional sources, only the part of electricity produced from renewable energy sources shall be taken into account. For the purposes of this calculation, the contribution of each energy source shall be calculated on the basis of its energy content.

Rule for determining efficiency



$$El_{eff} = \frac{El - El_s}{F_f + B_f}$$

$$H_{eff} = \frac{H}{F_f + B_f}$$

Methodological background document

- Purpose

- Explain difficult parts of the method
- Explain unclear parts of the method

Allocation of emissions

- Biofuels and bioliquids
 - Energy allocation based on lower heating value
- Heat, electricity and cooling solid biomass
 - Exergy and energy allocation combined
 - Energy allocation based on lower heating value

Exergy

- Not commonly used within GHG-calculations
- A measurement for the amount of work which can be produced
- For heat physical formula
- For bioenergy there is no simple way

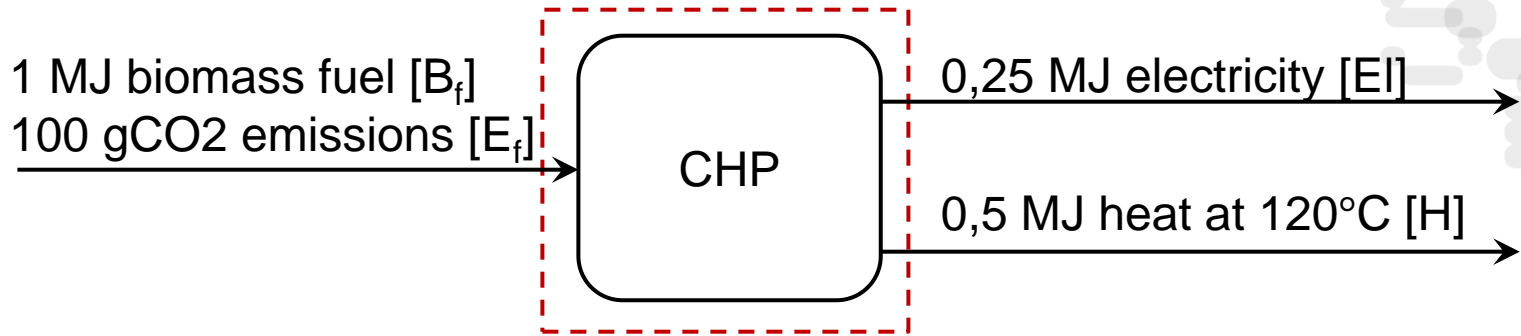
Simplifications

- All other products than heat, exergy value of 1
- Heat below 150°C constant exergy value
- Ambient temperature 0°C in all of Europe when calculating exergy value for heat > 150°C

$$\eta = \frac{T_h - T_{env}}{T_h} = \frac{423 - 273}{423} = 0.3546 \quad \text{Carnot efficiency}$$

Example

E_f = total GHG emissions for the biomass fuel [gCO₂]
 E_{el} = the allocated emissions to electricity [gCO₂]
 C_{el} = Carnot value for electricity
 C_h = Carnot value for heat
 EC_{el} = Total GHG emissions for electricity [gCO₂]



$$E_{el} = E \left(\frac{C_{el}\eta_{el}}{C_{el}\eta_{el} + C_h\eta_h} \right) = 100 \left(\frac{1 \cdot 0,25}{1 \cdot 0,25 + 0,3546 \cdot 0,5} \right) = 58,5 gCO_2$$

$$EC_{el} = \frac{E_{el}}{\eta_{el}} = \frac{58,5}{0,25} = 234 gCO_2/MJ_{el}$$

Thank you for your attention



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