IEA Bioenergy

Task 38

Greenhouse Gas Balances of Biomass and Bioenergy Systems

B. Schlamadinger

R. Edwards

K. Byrne

A. Cowie

A. Faaij

C. Green

S. Fijan-Parlov

L. Gustavsson

T. Hatton

N. Heding

K. Kwant

K. Pingoud

M. Ringer

K. Robertson

B. Solberg

S. Soimakallio

S. Woess-Gallasch

Optimizing the Greenhouse Gas Benefits of Bioenergy Systems

Energy decisions are optimization problems among multiple objectives such as job creation, energy security, environmental benefits including GreenHouse Gas (GHG) mitigation. This poster specifically focuses on ways to optimize GHG benefits from policy measures at the macro level.

Approach often used in energy analysis

When assessing the efficiency of energy systems in terms of GHG mitigation, many analysts to date have used measures such as

- input-output ratios (Figure 1)
- emissions per unit output (Figure 2).

This type of assessment can be misleading if the energy system uses its own product as an input, thus reducing external energy inputs and associated emissions (Figure 3).

Our recommendation

Thus, the system boundary needs to be set wide enough to include emission reductions (e.g., in fossil fuel reference systems) from using the energy and non-energy products of the bioenergy system (Figure 4).

The analysis also needs to consider the limiting resource that will define the extent to which forest and land management and biomass fuels can limit net GHG emissions:

Several different limitations are conceivable, each requiring a different measure of GHG efficiency:

1. available biomass
2. bioenergy market share
3. available land for biomass production
4. available funds for GHG mitigation

Figure 1

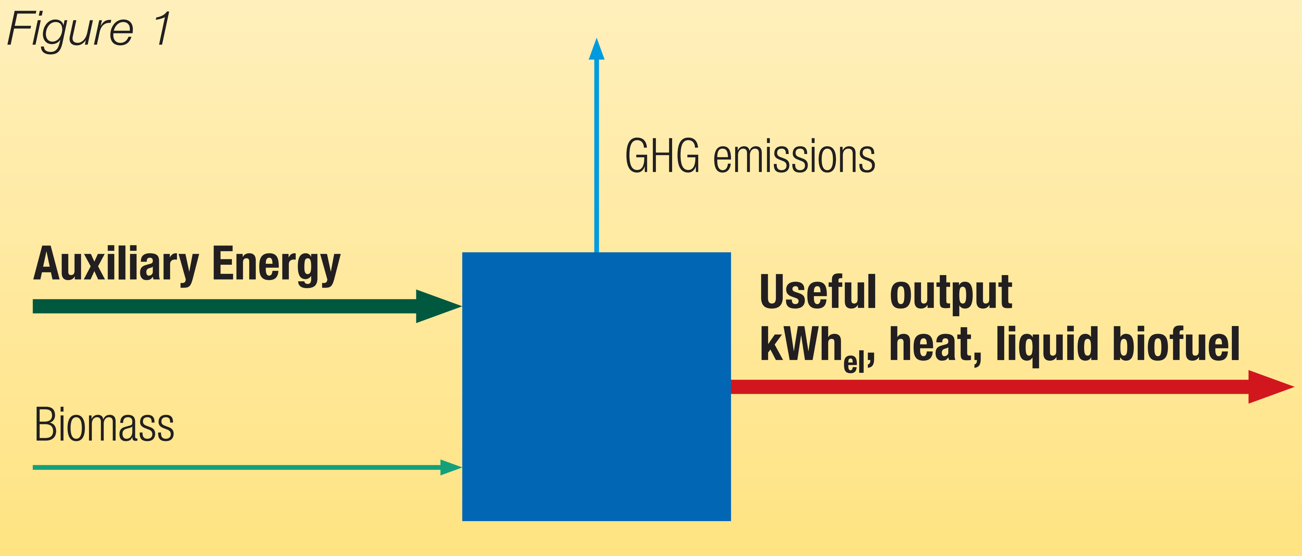

Figure 2

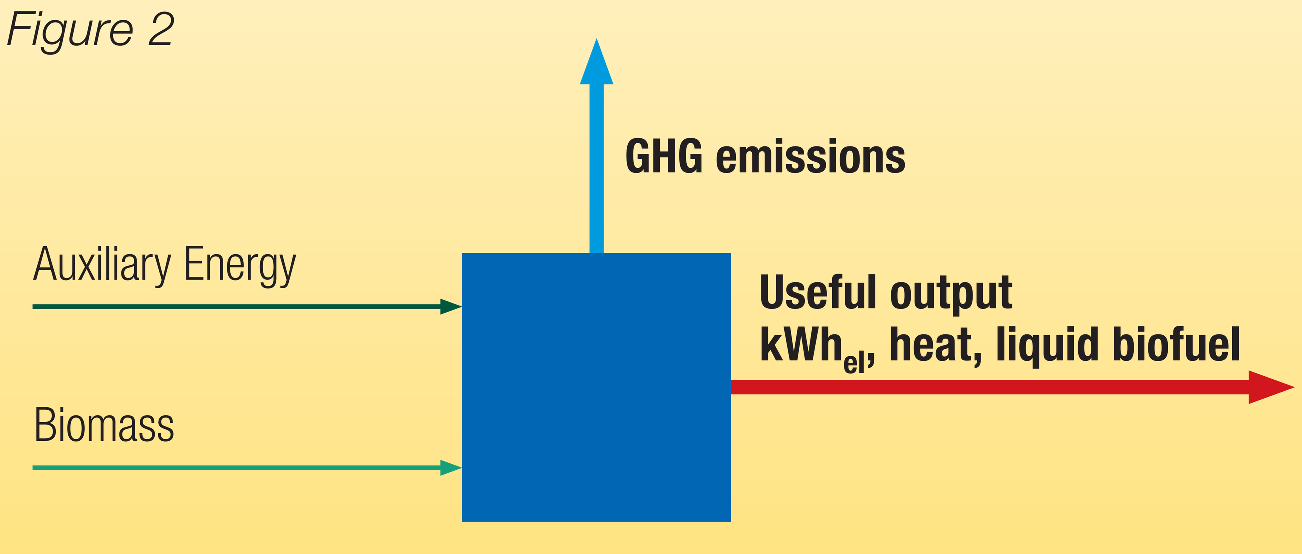

Figure 3

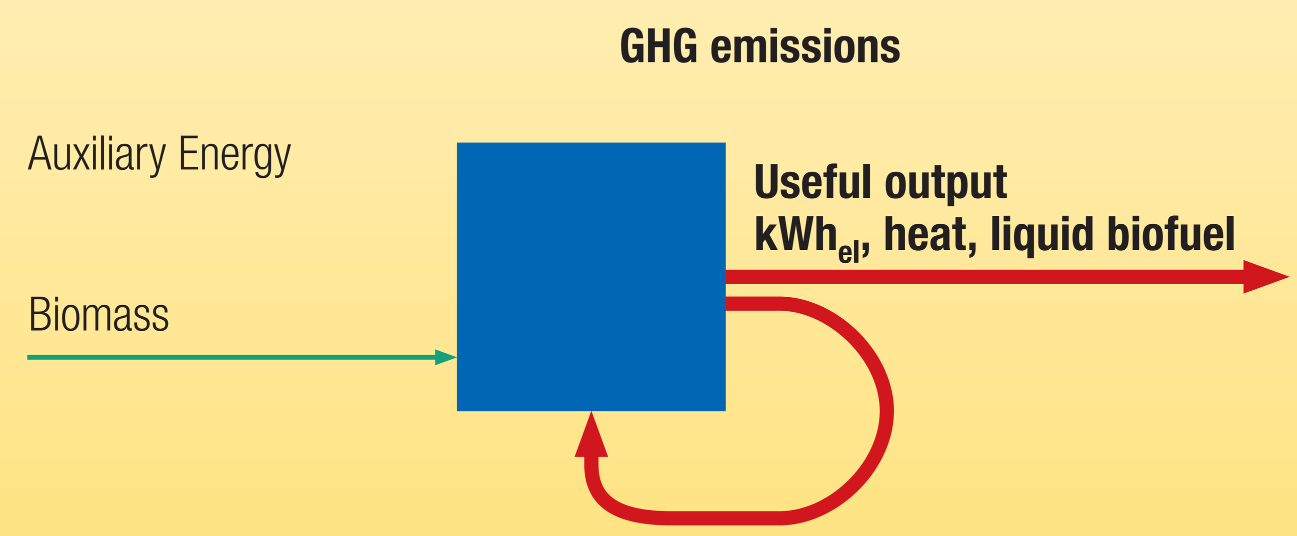

Figure 4

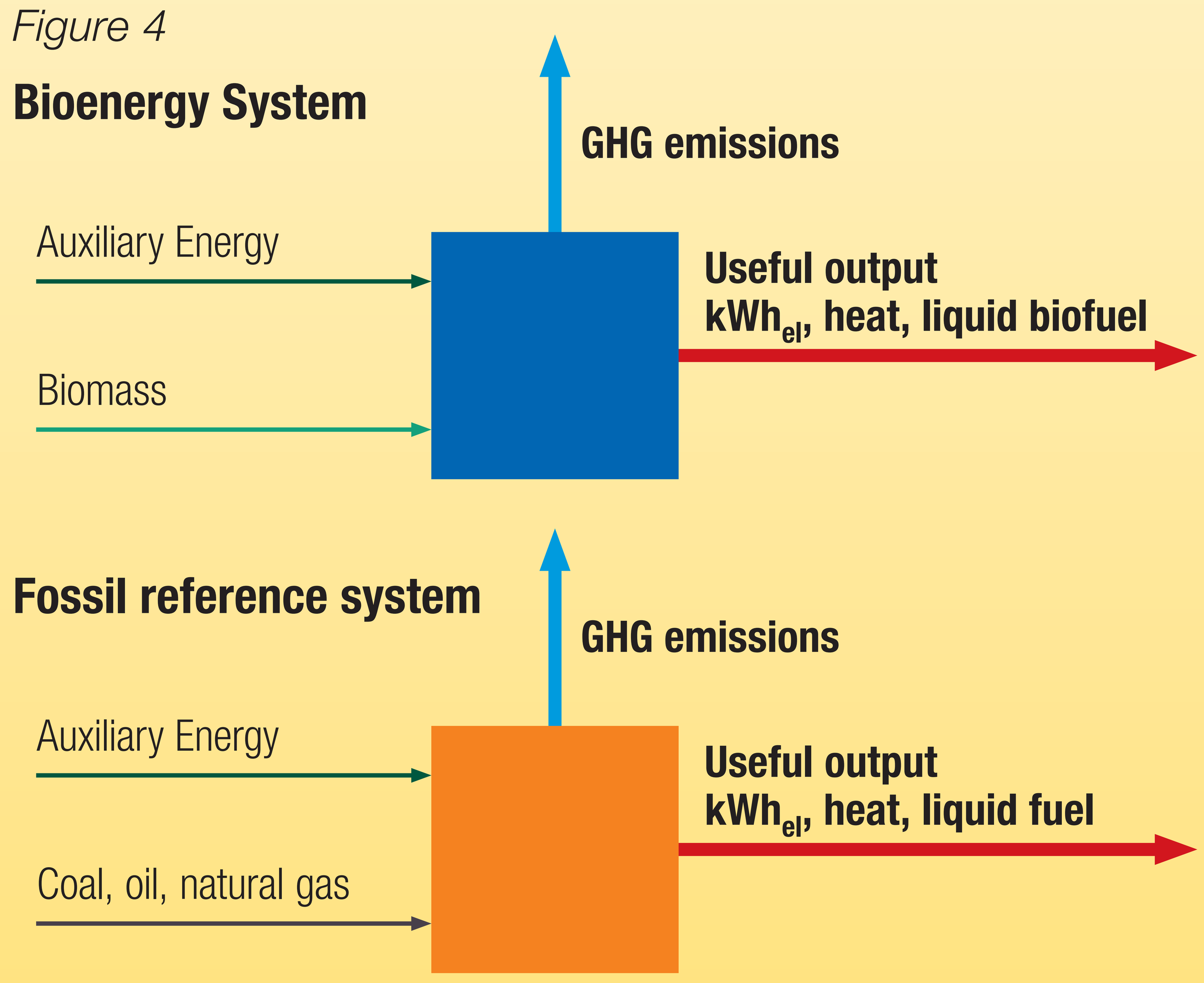

Table: Maximizing Greenhouse Gas Reduction using Biomass

Case	Limitation	Figure of Merit	Cons equence
1	Available biomass (e.g. wastes)	GHG savings per tonne feedstock	■ Favours most efficient use of biomass, even if at greater cost ■ Allows external fossil inputs if they enhance biomass use efficiency ■ Can compare between different outputs (electricity, heat, fuel)
2	Reaching policy targets for bioenergy or biofuels in terms of market share	GHG savings per unit output (electricity, heat, road-fuel)	■ Favours biomass conversion processes with low GHG emissions, even if inefficient or costly ■ Ignores the amount of biomass, land or money required ■ Easy to distort ■ Cannot compare between different outputs
3	Available land for biomass production	GHG savings by biomass production per ha of available land	■ Biomass yield and conversion efficiency are paramount ■ Greater GHG emissions from production (e. g., fertilizers) may be acceptable if that increases the biomass yield ■ Costs not considered ■ Can compare between different outputs (electricity, heat, fuel)
4	Available funds for GHG mitigation	GHG savings per €	■ Will favour "close to economic" biomass options over more efficient but more expensive ones ■ Can compare between different outputs (electricity, heat, fuel)

- In all cases the "GHG saved" (and the denominator of the figure of merit) calculated by comparing to a reference fossil-fuel scenario.
- These figures-of-merit are only ONE input to policy evaluation, other environmental and societal effects also need to be considered.
- Enhancing benefits in one part of the system can reduce benefits in another. Appropriate choice of system boundary, service unit, and the parameter for optimization is critical.

IEA Bioenergy (www.ieabioenergy.com) is an international collaborative agreement, set up in 1978 by the International Energy Agency (IEA) to improve international cooperation and information exchange between national bioenergy research, development and demonstration (RD&D) programs.

The objective of Task 38 is to assess GHG balances of bioenergy and land use strategies.

JOANNEUM RESEARCH

oefpos05049

www.joanneum.at/iea-bioenergy-task38