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Comparison of different methods in the supply of biofuels

In the planning of projects considering the use of energy from biomass, costs involved in the supply of the fuel have to be identified, along with those for capital investment. To arrive at realistic prices for biofuels it is necessary to regard the whole technical-processing production chain. Often, only simplified production chains are involved, or standard values utilised, in possibility-studies. For the planning program HORTEB reference data for numerous work operations were investigated and finally simplified for comparison and then applied to comprehensive production chains.

Biofuel	Work operations in the supply chain
Round bales	Mowing, baling, transport, burning
Rectangular bales	Mowing, baling, transport, burning
Chopped straw and grain pellets	Harvesting with self-propelled silage chopper, pelleting in stationary plant, transport, burning
Pellets from whole-crop bales	Mowing, baling in round bales, opening bales in intermediate plant and stationary pelleting, transport, burning
Biotruck-pellets	Harvesting with Biotruck, transport, burning

Table 1: Explanation of variations of simple production chains for the supply of wholecrop cereals in different biofuel forms

In order to simplify planning in the sector of energy production through biomass, the planning program HORTEB (Horticultural Energy Supply with Biomass) was developed with financial support from the BML at the Institute for Technology in Horticulture and Landscaping. The program identified as reference data the costs of heat production, CO_2 emissions and the energy balance in comparison with the use of heating oil and natural gas for each single step in heat production. In the development of the program the question was posed as to what extent the production chain should be divided into single work operations. Often production chains are extremely simplified in the literature and presented in a non-uniform way so that values, for instance for the costs of fuel supply, cannot be compared with one another, nor adopted for one's own planning situation. The reference data from more than 200 work operations were integrated in the HORTEB program.

Comparison of simplified and complete production chains

A detailed description of the individual work operations and the applicable costs is contained in [1]. The costs were calculated according to [2, 3, 4 and 5].

Simplified chain with wholecrop cereals

In this case examples of simplified chains (partial production chains) for wholecrop cereals were compared with one another. These covered systems with round bales, rectangular bales, pellets from chopped material, pellets from material baled and then opened and pellets produced by the Biotruck 2000 system. The production chains used here are described in *table 1*.

The single inconsistent factor is represented by the transport distance. For the transport of the pellets, trucks with a load volume of 80 m^3 were chosen, the bales were transported with trucks and trailers. The results of these comparisons are shown in *fig. 1*.

Complete production chain

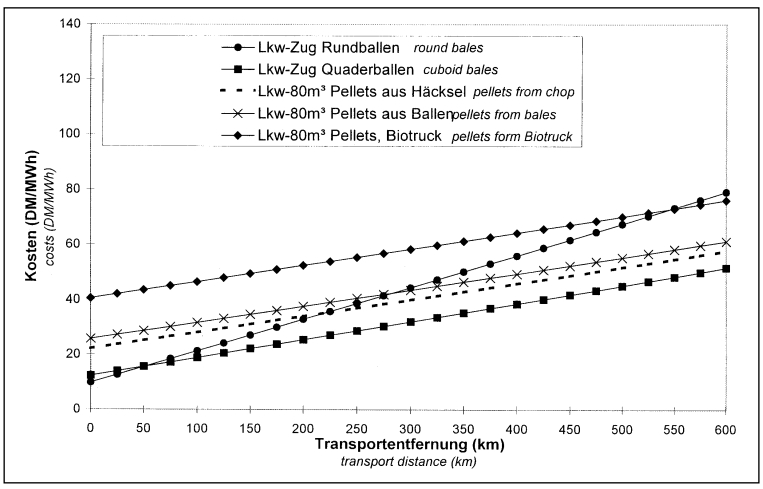

Fig. 1: Comparison of different procedures in the production of bales and pellets from wholecrop cereals (simple production chains from harvest to combustion)

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A refereed paper produced for LANDTECHNIK, the long version of which is available under LANDTECHNIK-NET.com

Keywords

Renewable energies, biofuels, culmiferous goods, engineering process chains

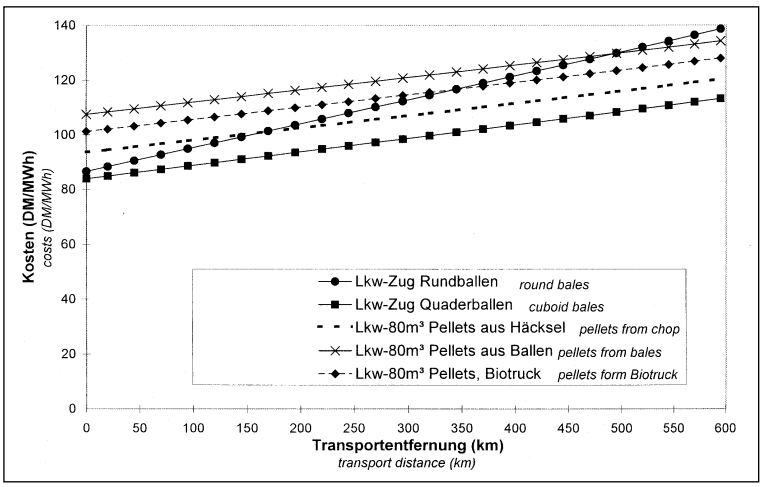

Fig. 2: Comparison of different procedures concerning production costs of bales and pellets from wholecrop cereals (complete production chains from cultivation of biomass to disposal of ashes)

with wholecrop cereals

In that further work operations take place before the harvest, after the transport and also during the production processes, complete production chains were considered for the same fuel and the same forms of fuel as featured in the simplified production chains. In the former cases all work operations such as loading operations, crop turning in the field, transport to intermediate treatment plant and the storage in intermediate and final stores were taken into account.

Results and discussion

Fig. 1 plainly shows that, first of all, the round bale line and then, after a transport distance of 50 km, the rectangular bale line, have the least cost demand right through the operation. Against this, harvesting and pelleting with the Biotruck shows itself as by far the most expensive process and also the pelleting from opened bales caused much higher costs than, for instance, the simple baling and burning procedures. The use of pellets from chopped material (produced by silage harvester) would not be more economical than the round bale process until transport distance was 220 km, pellets from opened bales would need a transport distance of at least 280 km and Biotruck pellets could not compete with round bales until the transport distance topped 550 km. Further, the graphic shows that there is a clear cost difference of around 15 DM/MWh between the Biotruck pellets and the pellets from opened bales.

The results, as illustrated graphically in *fig. 2*, show firstly that , in total, the cost level presented for the fully detailed production chain is clearly higher than the results from the simplified chain. The variant consistently most economic is now the rectangular bale line, and that right up to and over the transport distance of 600 km. With correspondingly higher costs, the pellet lines run transposed almost parallel to this. The round bale line showed the strongest rise in costs, although this remained more economical than the pelleting from chopped straw up to a transport distance of 170 km. Not until from 340 km onwards was this less economical that the pellets from the Biotruck system and from 600 km compared with the pellets from opened bales. The cost difference between Biotruck pellets and the pellets made from opened bales were reduced by around 7 DM/MWh compared with those calculated from simple chains. The positions were, however, exchanged – with pellets from opened bales now showing themselves as the most expensive process. The ground for the exchange in positions lay in the consideration of the complete processing chain. Especially where pellets are produced from opened bales, there are more loading operations, transport to intermediate store and the intermediate storage of the bales, as well as of the pellets, all come together so that the preparation of the fuel is higher in costs compared with the Biotruck pellets.

Conclusions

In order to determine realistic biofuel prices and thus avoid the reproach of „enhanced calculations" for projects featuring energy production from biomass, an as comprehensive as possible determination of the production chain in the supply of fuel is necessary. The comparison presented from observation of a simplified production chain and of a complete production chain makes clear that the simplified, or limited, point of view here can lead to false conclusions.

Despite higher costs involved in the use of pelleted biofuels their use should be checked in every individual case because when compared with the burning of whole bales or of chopped material, for example, the pellets can give lower emissions. This advantage can lead to a favouring of pellets particularly in the case of increased emission restrictions.

In total, the costs for the supply of biofuel have less influence on the economics of heat production than those of the capital investments in the appropriate burning equipment. These can be two to three times as expensive as equivalent size oil or gas burning equipment. Despite this, the fuel costs should not be ignored as long as there is still no market for biofuel and therefore no associated development of a market price.

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