Bio-mass for energetic: Chance or regression?

Biomasa pro energetiku: šance nebo návrat zpět?

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Abstract: Authors summarise historical aspects of the renewable energy resources usage in the Czech countries, mainly of bio-mass. They are interested in the economic evaluation of the investment efficiency of usage or transformation of bio-mass. They supply facts of the approaching fossil fuels reserves exhausting and therefore an interest of growing trees and plants for energy usage. They indicate the possible utilisation of fallow land and of reclaimed land after the surface lignite mining for the purpose.

Key words: bio-mass usage, renewable energy resources, economic evaluation of efficiency investment

Abstrakt: Autoři shrnují historické souvislosti využívání obnovitelných zdrojů energie v českých zemích, zvláště pak biomasy. Zajímají se o ekonomické posouzení efektivnosti investic při využití či přepracování biomasy. Uvádějí skutečnost blízkého vyčerpání zásob fosilních paliv a s tím související zájem o pěstování dřevin a bylin pro energetické využití. Upozorňují na možný způsob využití ladem ležící zemědělské půdy a využití rekultivovaných ploch po povrchové těžbě hnědého uhlí.

Klíčová slova: využití biomasy, obnovitelné zdroje energie, ekonomické zhodnocení efektivnosti investic

Wood biomass was the first primary energy source utilised by man, and for long time, it was determined by the civilization development. Charcoal made the first manufacturing metallurgical and chemical production possible. Not before the beginning of the 19th century, wood as fuel began to be edged out by coal, and 20th century is labeled as the 'period of fossil fuels' (coal, oil, natural gas – and the products of their processing). Only in some developing countries like Asia, Africa and South America, wood stays an important part of the fuel-energy balance till now.

During the 21st and 22nd century, state economics will have to cope with the fact, that fossil fuels mining will enter more complicated geology-mining conditions, that will much increase mining costs, and finally fossil fuels supply will be in a practical way exhausted. At the same time, it is obvious, that rationalization of fossil fuels consumption as primary energy inputs and rationalization of the consumption (or use) of the energy media for final consumption (electricity, steam, heating gas) has its own limits, given by thermo-dynamical and stochio-metric regularity, which cannot be exceeded. It is therefore necessary to look for possibilities of higher use of resources other than fossil fuels and to look for and use resources relatively new, respectively 'well forgotten'.

Therefore in the last 20–30 years, there increased the interest in use of solar radiation in collectors (heat accumulators) and in photocells. In many regions with favorable geographical, geological and climatic conditions, there are investments to devices, which use up water energy, ebb and flow energy, wind energy, geothermal energy – as it is in detail discussed in monographs by authors Kaltschmitt et al. (1997) and Loske et al. (1997). Higher and more distributed use of enumerate renewable energy sources prevents the fact that these sources provide energy flow with low density (as it is physically quantified by Poynlinger vector) which means, that they are demanding for soil occupation.

Disputable is the further development of nuclear energy on the base of uranium fuel elements. Futurologists put big hope in hydrogen, respectively its isotopes deuterium and tritium, as energy source of so-called thermonuclear fusion. It seems that technological and structural problems are so complicated and difficult, that in practice using technological solution is more a question for the 22nd century.

Research interest, development, but also economic practice has therefore focused to energy biomass use in the last twenty years, and to the use waste biomass, biomass deliberately produced for energy purposes, so called energy plants (for example African fast-growing so-called elephant grass Miscanthus, hemp, sorghum) and fast-growing trees (poplar, birch). Except the above mentioned balance motivation, there are also ecological reasons: Burning fossil fuels brings CO_2, to atmosphere which in the long term – through the so-called greenhouse effect – unfavorably influences climatic conditions. In biomass burning, only the CO_2, which has been taken from the atmosphere in the saccharide photosynthesis before, returns back to the atmosphere. Ecological motivation has also the utilization of livestock excrements to biogas, which can be used further as heat-

ing gas – the so far obtained knowledge is summarized in the publication written by Šoch and Vráblíková (1999).

During the last years, the interest in growing the so-called energy plants is increasing also because it presents economically interesting possibilities how to use the fallow farming land and how to contribute to using reclaimed areas after the lignite surface mining. For the Northwest Bohemian region, this possibility is discussed mainly by Vráblíková and Vráblík (1999), Vráblíková et al. (1999).

RESULTS AND DISCUSSION

From an economist point of view, the alternative fuels using is mainly evaluated by the high costs of machinery, which uses the alternative fuel (mainly to heat or electricity production). Only once invested investments are in these running production costs projected by the form of depreciation, or interests for the accepted credit, if an investor does not finance the construction from his own resources.

While water amount in fossil fuels is negligible or stays at a constant level, water amount in biomass can fluctuate in fairly wide limits, in dependence on the origin and period and weather in the harvest or dispatch, or even if biomass is modified by supplier (pre-dry, finish drying). Variable water and other burden substances amount then becomes evident in the variable weight of the final fuel, and then it is not without influence on the storage space and the boiler economy, transport costs and storage expenses. The problem of sufficient storage space and transport costs is more important for the biomass fuel than for fossil fuels, which are seasonally marketed sources. (It does not mean, that to make a reserve of fossil fuels is without problems. For example, coal can spontaneously combust, there are problems with transport in frost etc. As a matter of principle, the level of reserve fossil fuels is significantly lower, however.) Therefore, for a detailed economic calculation we always have to have information about cost and heating value of fuel shown in relation to the volume unit (for example 1 liter), from which it should be simply evident, that the question is costs and heating value material fuel 't.q.', not information about dry matter. In this context, there is evident, how essential meaning for the economy of energy biomass usage has the choice of a suitable type of starting plant or tree. For detailed analysis of this factor, we refer to the article Součková, Vráblíková (1999).

High energy amount of ethyl alcohol (heating value 6 kWh/liter), which can be obtained by fermentative technology from biomass (waste biomass) made for, already in 1920s, an idea to 'dilute' petrol with it. In the Czechoslovakia in 1930s, the contemporary label 'national fuel' DYNAKOL has been sold and promoted, which was the mixture of 30% petrol, 20% benzene and 50% ethyl alcohol. Benzene was made from the home source-bituminous coal tar, ethyl alcohol from biomass (potatoes, grains, but also sugar and molasses) in distilleries, which had, as a consequence of the Austrian-Hungarian common market breakdown, a redundant install capacity.

In 1990s, there came another, environment motivation: Products made from biomass are well biologically decomposable (problems of handling losses and accidents) and also the low amount of polycyclic aromatics in their combustion gasses is favorable. It led to starting production of the rape oil (heating value 9.5 kWh/liter) methyl ester acids rape oil (heating value 9 kWh/liter), used as the so called bio-diesel fuel (or 'green diesel fuel') for diesel engine, or to dilution of the classical diesel fuel.

A consumer, which has to choose between methyl ester acids rape oil and normal diesel fuel, only exceptionally decides according to the environmental point of view, but it is the price that matters to him. (Only if he has to use bio-diesel fuel in order to fulfil a special regulation, what can be the situation of forest workers in some water-management important and risk areas.) The demand for bio-diesel fuel in the market is confronted with the offer of its producers. Offer cost is the fuel price for consumer at the petrol station. It is influenced by taxation, which is paid by the final consumer: the consumer tax and the general value – added tax. Therefore, usually the tax allowances for environmental-friendly products are the important partial precaution of the state environmental protection policy. (For the detailed study of situation in tax privilege of bio-diesel fuel and the use of taxation as economic implementation of environmental protection in the European Union and Germany, see publications Böhringer et al. 1998; Farnung 1998; Niehörster 1999; Schmitt 1999 and Weisheimer 1999).

Investment efficiency observing biomass using or transformation

From company point of view in evaluation of the investment plan observing the usage not only of biomass, but also of other renewable sources, we proceed in a standard way: we count all positive and negative influences of realization and operation of investment to cash flow and gain time series balance cash flow we analyse alternatively: a) discount b) calculation inner earning per cent (IRR).

The negative influence on cash flow is exerted by investment and operating costs evaluating investment. Positive influence on cash flow: depreciation from new buying facilities, appropriately falling costs and penalties for emissions, appropriately falling operating and investment costs connected with deposit or renovation of wastes and credit notes or incomes for energy sources (electricity, steam, biogas) sold outside the evaluated circle.

At the present time and practically all over the world, the production costs of electricity and steam gained from renewable sources are mostly much higher than costs offered by firms using fossil fuels.

This reality can be explained by the low level of internalisation of externalities to producers costs.

For summing, these three components should be used:
– costs implemented by company
– positive externalities in company benefit
– for negative externalities caused by company, there is used the term 'social costs'.

Knowledge of the structure and volume of social costs is very useful for the state economic evaluation using alternative fuel – energy sources. For example, if we mark the data of the electricity production from conventional sources '*k*' and the data of production from alternative source '*r*', production costs as *VN* and social costs high-defined components *B, C* as SN_{B+C}, then the identity:

$$VN_k + SN_{k,\ B+C} = VN_r + SN_{r,\ B+C}$$

determines when, from the state economic point of view, the alternative energy source is equivalent to the conventional source.

In the former Czechoslovakia, a work on calculation of negative externalities connected with coal mining has begun in early 1970s by Voráček (1971) and in 1980's, it received high attention in consequence of the deliberation about increasing wholesale and retail price fuel – energy products sum (Černá et al. 1987). After November 1989, this problem was first outside the interest of economic research, but now it is followed again in the Czech economic institutions (authors of internal materials Seják, Zeman, Kovář), and it is in the context of the study of direct and indirect grants to fuels and energy and thoughts about their development (Zeman 1998).

In Germany, they take systematic heed of the identification, quantification and monetary assessment of the fuel – energy externalities by the Society of German Engineers (VDI) and the technical journal Energiewirtschaftliche Tagesfragen. This topic is the issue of interest in the European Union and the multi-stage research project 'ExternE' (Friedrich and Krewitt 1998).

If we restrict ourselves only to negative externalities connected with the pollutant emission to air, we can use for the evaluation of substitution of conventional energy sources by alternative sources the externality values, ascribed to 1 ton of emission of different pollutants in the GEMIS model (Gesamt Emission Modell Integrierte Systeme), which was developed by the Öko-Institut in Darmstadt (Germany) by order of the Hessen Government. In the Czech Republic, the firm CityPlan in Prague works on the application of this model and extends its database. Model GEMIS is used by Diviš (1999) in his paper about bio-energy in small and medium heat sources.

CONCLUSIONS

At present we may say, that all the European Union states governments, as well as some post-communist countries governments, try – with different approaches and with different power – a maximum incorporation of externalities to production costs of fuel sources. This implies the increase of the wholesale and retail sources, and also the increase of taxation connected with final consumption of fuel and power resources. National economy evaluation of this trend is not yet unanimous. Thus, this creates a price margin favourable mainly for the local business activities in the energy biomass use.

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