PLANTATION FORESTRY: A ROLE FOR ENERGY FARMING?

T. FRASER*

The rapid escalation of energy prices since 1973 has sparked off a world-wide search for alternatives to non-renewable fossil fuels. One possibility that has received considerable attention in New Zealand, as well as overseas, is the growing of forests for the provision of energy. While this may seem a radical idea, it is in fact not new at all. In fact, only 100 years ago wood was still the major source of energy for industrial development in the U.S.A. Even today wood accounts for most of the energy consumption in the non-industrialised nations which make up the bulk of the world's population.

There are two ways in which wood can be used as an energy resource.

(1) Burned as a fuel for heating, or for the generation of electricity.

(2) As a feed stock for the manufacture of compounds which could substitute for the liquid and gaseous fuels at present provided by the oil industry. Ethanol, for example, can be used in mixture with petroleum; and methanol can be used as a petroleum substitute.

For energy farming to be economically viable, high yields and short rotations are essential in order to minimise costs. Thus, if there is a future for energy farming it could lie in the growing of hardwoods such as red alder or eucalypts. The fast growth rate of these and other hardwoods, combined with the ability to coppice, raises the possibility of higher yields than are possible from conifers. It is true that eucalypts are site-sensitive and that their establishment in New Zealand has faced problems. Nevertheless, the apparent success of N.Z. Forest Products Ltd in overcoming many of these problems indicates that it would be wrong to dismiss eucalypts and other species out of hand without a thorough investigation.

While many extravagant yield claims have been made, one that may be realistic suggests that a yield of 37 tonnes of dry

*Scientist, Forest Research Institute, P.B., Rotorua.

biomass/ha/yr could be obtained in a managed stand of red alder on the West Coast of North America (Evans, 1974). Similar, and in some cases more extravagant, claims have been made for eucalypts (Anon., 1973; Alich and Inman, 1974).

The first problem in looking at the potential of energy farming in New Zealand is the lack of information on dry matter production for hardwoods. I know of only one yield estimate for eucalypts — made at the Forest Research Institute (D. Revell, pers. comm.) — which indicated a yield of 22 tonnes/ha/yr for a young *E. saligna* stand. Such a yield is considerably higher than one would expect from close-spaced radiata pine which might produce 12 to 16 tonnes/ha/yr of oven-dry biomass for a 13-year rotation.

Assuming a figure of 20 tonnes oven-dry weight/ha/yr for eucalypts, and allowing for non-productive land in firebreaks and roads, a 100 MW power station at 60% load (total output higher than the Waitaki hydro scheme) would require a gross forest area of about 17 000 ha, an area about two-thirds the size of Golden Downs State Forest.

Area figures then appear possible, but it must be borne in mind that, given the limitations of present-day technology, large-scale energy farming based on short rotations would have to be on easy topography in order to facilitate whole-tree harvesting and to minimise harvesting costs. This would mean the diversion to energy farming of land currently under agriculture and commercial forests. So not only does energy farming have to produce an energy source that is competitive with alternative fuels, but it also has to compete for land with agriculture and commercial forestry. An economic assessment of energy farming should therefore include due allowance for the loss in production resulting from the diversion of land from other productive uses.

At the moment it is impossible to draw firm conclusions on the economics of energy farming because of lack of data, both on growing and harvesting of hardwods, and on the technology and economics of conversion plants. However, we can derive indicative figures on the economics of electricity generation and the production of liquid fuels.

First, electric power generation — and I stress that the figures I shall use are tentative. One way of deriving the value of wood as a fuel for electric power generation is to evaluate it in terms of the return forgone by diverting wood from another end-use, such as chip exports. The cost of chips at a power station is found by deducting port and transport costs from the f.o.b. price. Starting with the average 1975-6 price of $20.39 per tonne, and deducting port and transport costs, the price of green chips at a power station is found to be about $14.80 per tonne or $34.41 per tonne oven-dry. Assuming a calorific value of 19.66 × 10^9 Joules per oven-dry tonne, the cost of wood is equivalent to $1.75 per 10^9 Joules. By comparison, the cost of oil in November 1976 was $2.15 per 10^9 Joules and coal about $0.77 per 10^9 Joules. (Ministry of Energy Resources, pers. comm.). The prices of oil and coal have increased since that time.

Combining these figures with United States data (Moody, 1976), and assuming that the relativity of capital and operating costs for wood, oil and coal-fired power stations is the same in New Zealand as in the United States, the following costs are derived for a 20 MW power station:

	Fuel Cost (cents/10^6 Joules)	*Heat Rate (10^6 Joules/kWh)*	*Costs (cents/kWh)* Fuel	*Owning Cost*	*Labour*	*Total*
Coal steam	0.0767	9.71	0.7	2.4	0.3	3.4
Oil steam	0.215	9.61	2.1	2.1	0.2	4.4
Wood steam	0.175	13.30	2.3	2.5	0.3	5.1
Wood gas-turbine	0.175	18.16	3.2	1.2	0.3	4.7

On the basis of these figures it appears that exotic pine wood, at a price derived from its value as export chips, is not at present competitive with oil or coal. But, according to the Ministry of Energy Resources, the price of coal to power stations after Huntly could rise to almost three times the present price of coal derived from opencast mining. This could push the price of coal-generated power close to the price of wood gas-turbine power. Viewed in this light, the generation of electricity from low-value wood seems a distinct possibility. In fact, one North Island mill is able to generate electric power from mill residues at a cost of 3.2 cents/kWh. Although this is higher than the cost to the mill of electricity from the national grid, on the basis of the figures quoted above it is cheaper than the cost of oil- or coal-generated power. In general, if sufficient low-value mill waste is available on site, it is probably more economic to utilise it in producing electricity than to dispose of it in other ways.

Secondly, liquid fuels. Based on estimates from Lincoln College (Ross, 1975), 1 million hectares diverted from agricultural production to energy farming could have reduced the 1974-5 petroleum import bill by $177 million. Taking the highest estimate for lost farm production, the loss in overseas earnings was found to be some $73 million. There is then a positive foreign exchange balance of $104 million to methanol production.

While the export-import balance appears to favour energy farming, we would need to know a great deal more about the economics and environmental impact of energy farming and wood conversion to methanol before we could say that this scheme would result in a net benefit to the nation.

Should we take the concept of energy farming seriously, or should we dismiss it out of hand? At present opinion is sharply divided. My own view is that we simply do not have enough information either on the environmental impact, silviculture, technology, or economics of energy production from tree crops to make a decision. On the basis of the preliminary results I have quoted, though (particularly the large foreign exchange balance), the concept of energy farming appears to offer a possible partial solution to New Zealand's liquid fuel supply problem, and a possible alternative to increasingly costly coal resources. In conclusion, therefore, I believe that research is required into technical and economic aspects of growing and harvesting energy crops, and of the conversion plants needed to utilise them.

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