reach the Academy's target.

A large part of the difference between the two estimates arises from the fact that Dr. Gartside based his calculations on the amount of ethanol needed on its own to reach the target. The starting point for Mr Siemon's calculations, which effectively reduced the target by two-fifths, was described earlier. Other factors are involved too.

The scientists looked at different wood-to-ethanol processes, but arrived at similar figures for the proportion of the energy content of the wood made available in ethanol. Mr Siemon's figure is about 20% and Dr Gartside's a somewhat lower 13%. They assumed different productivity figures for the eucalypt plantations. Mr Siemon used a stem yield of 12·5 tonnes per hectare per year, giving a whole-tree yield of 19 tonnes, while Dr Gartside worked from a more modest total yield figure of 10 tonnes per hectare per year.

As plantations on the scale envisaged are quite unprecedented, only rough estimates of their potential productivity are possible. But undoubtedly a very large amount of land would be needed.

Alternatives

Keeping the area that has to be planted as small as possible is obviously vital, so high yields are essential. Dr Gartside looked at cassava, a high-yielding tropical crop, as another possible source of ethanol. But he found that harvesting and processing the crop required more energy than was available in the ethanol produced. His calculations for ethanol production from sugar molasses gave a similarly disappointing result.

An alternative way to obtain fuel from plant material is to break it down by pyrolysis—heating in the absence of air. This produces a liquid similar to heavy fuel oil, an inflammable gas, and char. Calculations by Dr Gartside indicate that, if the gas and some of the char are burnt to provide heat for the process, considerably more energy comes out in the liquid product than has to be supplied from other sources to produce it. His calculations—done for elephant grass, cereal straw, and domestic garbage as the feedstock—suggest that further studies of cost and yield would be worth while. Pyrolysis may prove decidedly more productive than the ethanol process.

Liquid fuel can also be produced by hydrogenating plant material—building up its hydrogen content in reactions at high temperatures and pressures. This again produces a form of oil. Laboratory

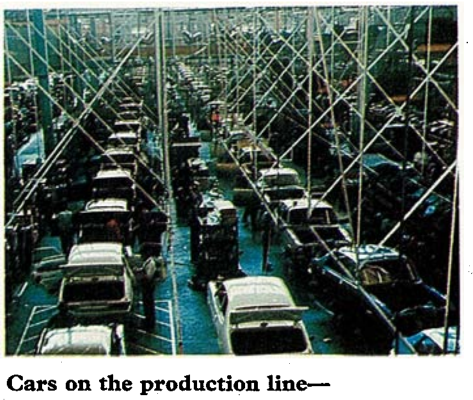
tests overseas indicate that hydrogenation gives a greater fuel yield than pyrolysis, but consumes more energy. Even less research has been done on this process.

A well-known way to make fuel from organic matter is to ferment it in the absence of air, producing methane (the principal ingredient of natural gas). Garbage and sewage can be fermented this way, and so can crop material. Dr Gartside's calculations indicate that a given amount of plant material can yield three times more energy through this process than as ethanol. But the product is a gas, and the need to find substitutes for natural gas is not as urgent as the need for oil substitutes.

Wastes converted into liquid or gaseous fuels could supply part of our energy need, but only a very small part. Dr Gartside estimates that the straw left over when Australia's wheat crops are harvested could provide a net energy yield equivalent to 3% of the Academy's liquid fuels target and that forestry wastes could supply a similar amount. But the energy used to collect and transport the wastes has to be deducted from those figures, and we haven't any other waste products that could make comparable contributions.

With coal

While he is pessimistic about the prospects for producing liquid and gaseous fuels just



Cars on the production line—substitutes for petrol will be needed quite soon.

from plant material in quantities matching existing or expected use rates, Dr Gartside believes plants could play a valuable role in extending the life of fossil fuel reserves.

For example, if coal was used to supply the energy needed for the wood-to-ethanol process, this could be regarded as a way of converting coal to liquid fuel. The ethanol energy output would be about 60% of the coal energy input, a conversion rate similar to that achieved by turning coal directly into liquid fuels. Processing costs and product quality would probably determine which coal-to-liquid route was more desirable.

Cassava, and other starch crops, would give still better conversion rates. The plantation areas needed for these processes would be less than half those required if coal was left out of the equations.

Methane production by this indirect method seems quite a good prospect. If coal supplied the energy needed to process the plant material, the methane produced would contain twice as much energy as the coal used. That's more than three times the energy output from the direct conversion of coal to methane. The extra energy comes, of course, from the plant material.

Dr Gartside calculates that a million hectares of a high-yielding tropical crop such as elephant grass would yield enough methane to meet the much-mentioned Academy target. That may be worth remembering when natural gas supplies begin to falter, although the target is for liquid rather than gaseous fuels. When coal starts to run short, another set of answers will be needed.

More about the topic

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