

COMMENTARY

by Bernard Dixon

BRAZIL'S STAGGERING PROGRESS IN BIOFUELS

One would hardly expect to find our planet's most grandiose biotechnology project in a nation whose inflation rate is 120 percent, whose massive debts threaten the fabric of international banking, and whose social discontent is such as to suggest violent upheavals, if not worse, in the near future. Maybe this is why Brazil's astonishing progress towards an ethanol-based economy is not more widely discussed. While formidable problems surround that country's Programa Nacional do Alcool (PNA), it is a remarkable achievement for biocrats in the developing, rather than developed, world to have pioneered the use of alcohol as a source of power. To have done so on a scale unmatched elsewhere, while leading the way in exploiting fermentation as a centerpiece for the chemical industry, too, is truly amazing.

The plain facts are staggering. Brazil is currently spending over a billion dollars per annum on technology designed to produce 5 billion liters of alcohol this year and 10 billion by 1987. All Brazilian cars now run on the sugar-cane based fuel—three quarters of a million of them on pure (95 percent) alcohol, the remainder on alcohol blended with petrol. Some 390 new distilleries are being built or planned to meet future demand. And in Alagoas the country's first full scale ethanol-to-ethylene plant is now on stream, marking a decisive move away from reliance on hydrocarbons as the principal feedstock for chemical synthesis.

The speed with which Brazil's scientists and politicians have reached this position is the most surprising aspect of their success. What we are witnessing is a sprint version of a trend seen in less frenetic guise elsewhere throughout the world. It originated, of course, with the 1973 oil crisis and subsequent hikes in the price of crude, which have triggered global retreat from petro-dependence. For the Third World country most vulnerable in this regard, with the highest external debt plus a need to import 45 percent of its energy, those events have been unusually traumatic. Yet, as Harry Rothman, Rod Greenshields, and Francisco Rosillo Calle underline in their excellent new book *The Alcohol Economy* (Frances Pinter, 1983), Brazil was also uniquely positioned to forestall calamity.

From the standpoint of energy potential, the most significant advantages were "sheer territorial size; an extremely long coast-line; favorable geological composition; a voluminous hydrographic basin; an enormous arable land area with an advantageous tropical geographic location plus intense sunlight for maximum plant growth; and a large agricultural labour supply." No terraforming technocrat, contemplating the

solar energy, water, soil, and personnel required to generate astronomical quantities of fermentable biomass, could have done better than this. Given Brazil's historical experience in ethanol fermentation, the opportunities were even greater.

But political will, at the highest government level, was required, too. Symbolized by the PNA's creation in 1975, this singleminded determination has reaped handsome rewards over the ensuing years—as well as spawning both expected and unexpected difficulties. Although alcohol manufacture had been increasing previously, establishment of the PNA led to a dramatic spurt, with production rising from 555.6 million liters in 1975/6 to 4200 million liters by 1981. Recession has since hit the country, sales of alcohol-powered motors have fallen, and industrial output has generally plummeted. Nevertheless, Brazil's long-term objectives remain steadfast, with an unchanged target of 10,700 million liters of ethanol by 1984.

World slump aside, it is inevitable that any venture on which a government spent a massive billion dollars a year would encounter some problems and create others. The Brazilian program has been criticized for taking land and labor away from conventional agriculture (though given such lush resources, it seems entirely feasible that energy crops can be grown in addition to food crops). It has been attacked on environmental grounds because every liter of alcohol is accompanied by 12–14 liters of high-BOD (Biological Oxygen Demand) effluent (though the government is making vigorous efforts to combat this pollution). And perhaps the most pressing dilemma of all is how to prevent adverse consequences for land tenure. By increasing, rather than decreasing, concentrations of rural wealth, the program could even be considered a form of state aid for the car-owning middle classes. In view of Brazil's current social and political unrest, this is a danger somewhat more important than the purely technical problems that have received attention in the Western press.

True, there have been more mundane, more predictable troubles. A rush to meet demand for alcohol-powered cars during 1980, for example, meant that

manufacturers spent insufficient time perfecting the requisite engine modifications. Consequently many new vehicles used too much fuel, corroded quickly, and proved to be unreliable starters. Only over the last year or so have these drawbacks been overcome. Ford Brazil, in particular, has conquered corrosion by resolving to design an alcoholic engine from scratch rather than tinker with one evolved for the significantly different purpose of burning petrol. Corresponding technical challenges remain to be met as Brazil moves towards an ethanol-based chemical industry. With an intrinsically wasteful process (2 tons of sugar for every ton of alcohol), the need to boost yields by



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tactics such as higher cell density and lower product inhibition is even greater than would be the case for an extremely efficient conversion.

Between 1940 and 1978, the percentage of the world's organic chemicals derived from coal fell from 95 to 3. The figures for petroleum boomed accordingly. Such are the possible dimensions of the *next* revolution, with all its unsolved problems, now being spearheaded by a resource-favored land in Latin America. ■

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whatsoever. The Commission considers developments in genetic engineering and provides advice, in the form of written reports, to the President, the Congress, and appropriate federal agencies. These reports will present the Commission's conclusions, as well as any recommendations for regulatory or legislative action. Because it is a purely advisory body, the impact of the Commission's conclusions and recommendations will depend upon the force and quality of the reasoning behind them.

It is a primary responsibility of government not only to promote science but to attempt to foresee the future of technology and any problems it might present. As the new genetic technology develops, it will be essential for our nation to be informed about both the positive and negative implications of it. Particularly for those of us in Congress, it will be important that we base our reactions to and decisions about the technology on objective, reasoned consideration of the issues and not on misunderstandings or exaggerations of the technology's potential for either good or evil. Biotechnology will unquestionably have a tremendous effect on our society in the years ahead. The challenge we face is how to ensure that those benefits are realized and any misuses are avoided. Accomplishment of these objectives will require public education and thoughtful debate about the complex issues that will confront us. The Commission that I have proposed is a first step in that process. ■

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the conventionally-derived version . . ." and "[T]he effect of the new policy seems to be to require full clinical testing of all rDNA drugs . . . [T]he obvious effect of this policy is to increase the cost of marketing rDNA products." The term "full clinical tests" is a buzz-word intended to be pejorative; in fact, full clinical tests may consist of brief trials on five patients or lengthy trials on five thousand, depending on the particular circumstances. The record time in which human insulin moved through the regulatory review process demonstrates that regulation by FDA of recombinant DNA-derived products need not be debilitating nor Draconian.

We reiterate that the FDA will regulate each product according to the relevant statutes and regulations, and, as important, will attempt to do so intelligently and responsibly.

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