A CARBON-NEGATIVE MODEL FOR PRODUCTION OF FEED AND FUEL FROM BIOMASS

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"Today, the extrasomatic energy used by people around the world is equal to the work of some 280 billion men. It is as if every man, woman, and child in the world had 50 slaves. In a technological society such as the United States, every person has more than 200 such "ghost slaves."

Keywords: bio-fuel, electricity, electric cars, ethanol, forage trees, goats, rural development, sugar cane, fractionation

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1. Introduction

There has been, and continues to be, a heated debate about the wisdom underlying the policies being promoted in rich countries to replace imported petroleum products with bio-fuels derived from forms of biomass that are also the primary source of food for humans and feed for animals. Ethanol is promoted as the replacement for gasoline, and is derived mainly from maize and sugar cane [see also – *Biorefineries – Concept for Sustainability and Human Development*],. Hundreds of ethanol distilleries are in operation and under construction. Distilleries that will use wheat and cassava are also in the pipeline. The main source of bio-fuel that can be used in diesel engines is the oil from the African oil palm, oilseed rape, soybeans and other oilseeds [see also – *Biodiesel*].

Indicative of the concern being felt in many quarters concerning development of fuel

from crops that are the staple of the human diet, was the decision made recently by the President of Mexico when he vetoed the growing of maize and sugar cane for conversion into biofuels.

One of the most vehement critics of the ethanol program is Professor Tad W. Patzek of the Department of Civil and Environmental Engineering, University of California. The conclusions he made at the recent Round Table on Sustainable Development of Biofuels, in Paris were: "to decrease all automotive fuel use …. by up to 6 percent per year ….., while switching to rechargeable hybrid and all-electric cars".

Professor Patzek recommended that the electricity should be generated from direct use of solar energy in photovoltaic panels. However, this technology is still extremely expensive. A 5 KWe power supply requires an investment of over USD 30,000 or USD 6,000 per KWe. A related issue is that such systems offer few opportunities of employment, especially in rural areas.

The alternative approach that is the subject of this presentation is the generation of electricity as a by-product, or associated product, of food/feed production. The concept underlying this approach is that biomass consists of cell walls and cell contents, the former acting as physical support structures for the plant while the latter are composed of compounds that are mostly edible by humans and or animals.

Inedible cell wall biomass is easily converted to an inflammable gas by the process of gasification, the gas in turn being the source of fuel for internal combustion engines driving electrical generators [see – *Thermochemical Conversion*]. The cell contents and related structures, such as tree leaves, are used as animal feed.

The model being implemented in Colombia is based around sugar cane and forage trees. Sugar cane is separated into soluble sugars (for animal feed or human food) and residual fibrous biomass (feedstock for gasification), by passing the cane stalks through a crushing machine. In the case of the forage trees, the crushing machine is replaced by goats which are naturally adapted to consume the most nutritious parts of the tree (the leaves and bark) leaving as residue the highly lignified stems and branches which, like the sugar cane bagasse, serve as feed stock for gasification.

This model is highly appropriate for decentralized, small-scale production of electricity in rural areas. It also offers opportunities for sequestration of carbon in the form of biochar – the solid residue remaining after gasification of the biomass. Long distance transport of biomass (as to a conventional distillery or power plant) is avoided, rural employment opportunities are promoted for growing the biomass, and availability of low-cost sources of electricity will facilitate development of rural industry, including access points for charging the batteries of electric vehicles..

It is estimated that the investment in a 5 KW gasifier-motor-generator, linked to a "UPS" (Uninterruptible Power Supply) and backup batteries will be of the order of USD 7,500 (USD 1,500/KWe), less than 25% of the cost of a comparable solar-voltaic system.

2. Biomass as a source of food or fuel? What are the issues?

There are three major issues:

- Should crops normally grown as sources of food / feed be used to make biofuel?
- Is it feasible to produce enough biofuel (as ethanol or biodiesel) to replace existing sources of fossil fuel?
- What is the way forward for livestock-based farming systems in a world faced with declining fossil fuel supplies and climate change

To be able to make a reasoned judgment on these issues, it is necessary to understand what are the sources of biofuels, what are the rates of conversion of these raw materials into final products, the economics of these processes, especially the ERI (Energy Return on Investment), and more importantly the implications for agriculture - and hence food production - of replacing fossil fuels with biofuels.

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Biographical Sketch

Dr Reg Preston received his PhD in Animal Production from Newcastle University, UK in 1955 and was awarded his DSc by the same University in 1970 for published work related to the thesis: "Development of Intensive Methods of Animal Production".

As a researcher at the Rowett Research Institute, Aberdeen, Scotland he developed the “Barley Beef” system in which Holstein calves were fattened to 400 kg live weight in 10 to 12 months on a diet of barley grain and protein supplement.

In 1965 he was employed by the Cuban Government to establish a research institute in animal science (Instituto de Ciencia Animal), serving as its Technical Director until 1971. Major achievements were the development of intensive systems of animal production using the by-products of sugar cane as replacement for cereal grains, and post-graduate training of over 100 Cuban scientists.

From 1972 he has been a freelance consultant advising Governments, Research Institutions, Universities and NGOs in tropical countries on research and training strategies for sustainable agricultural development.

Most recently, from 1988 to the present time he has been consultant to research and training projects in Vietnam, Cambodia and Laos, financed by SidaSAREC of Sweden.

He founded and was Chief Editor of bilingual research journals in Cuba (Cuban Journal of Agricultural Science, 1967 to 1971) and Latin-America (Tropical Animal Production, 1976 to 1983). With Dr Andrew Speedy he founded the first electronic journal in agriculture in 1989 (Livestock Research for Rural Development) of which he is Chief Editor. He has published 3 books and more than 500 articles in international scientific journals.