Fiji's biofuel industry: perched for a soaring take-off?

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“A review of Fiji's National Energy is currently in the process of completion. One can only hope that its architects have taken on board the lessons that are being learnt about the efficacy of energy policies made in boardrooms.”

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While the energy supply issues of the Pacific Island countries is well understood [1], there is potential within the region to reduce at least some of its imported fuel dependency through utilizing indigenous renewable energy resources. Fiji is in a position to provide at least a partial solution to the transportation fuel needs of the country and its neighbors through its biofuel resources.

Not too long ago, the prospects for this happening had been shrouded in skepticism. The potential for ethanol production existed in the form of sugarcane and starchy root crops such as cassava [2–4], but the lack of leadership, and perhaps more importantly the absence of vision, prevented the development of these resources. Biodiesel production from coconut oil (CNO) was also developed, but the collection of the nuts from the field and delivery to the mill was proving to be the biggest issue. There was also a question as to whether enough CNO could be produced to meet the diesel engine fuel needs of the country.

Recent developments on two fronts have changed the picture significantly. The commercial production of ethanol is now considered a more feasible possibility thanks to the concerted efforts of the new sugar industry leadership, which has realized that for the industry to survive it must undergo a mandatory metamorphosis from a mere sugar-producing food industry to one that includes energy as well (in the form of both ethanol for transportation and bagasse for power generation). Towards these ends, the new leaders have sought expert help from Brazil to provide advice on the way forward with their ethanol program [101,102]. The fresh enthusiasm that has been injected can only auger well for an industry that had been ailing under the burden of expiring sugarcane farm land leases, poor mill management, and low and variable sugar prices on the international market. The new vigor in the leadership has helped to broaden the commercial vision of the industry and encourage it to seriously contemplate a strategy for development that is realistic and achievable.

Biodiesel & beyond

The story of biofuels as a diesel substitute for marine- and land-based vehicles has taken an interesting turn. There are two factors that are promising to pump new life into this venture: the arrival of new players on the industrial scene and the continuing evolution of recent technologies that promise a new beginning for biofuels for diesel engines.

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The present biofuel technology for diesel (i.e., compression ignition) engines is centered around the use of biodiesel and its blends [5]. However, the production of these alkyl esters from vegetable oils, used cooking oil and animal fat is confronted with several issues. Among them are the costs of the transesterification process required for their production [6,7].

The main advantage of biodiesel over unmodified vegetable oils (that can also be used as diesel engine fuel) was the viscosity [8]. Vegetable oils are triglycerides, which are essentially three carbon chains bonded to a glycerol backbone. A triglyceride is a large molecule and leads to a high fuel viscosity – an undesirable property of diesel engine fuels. In the production of biodiesel, this molecule is effectively broken up into smaller units each containing one carbon chain only. These smaller molecules have smaller molecular weights and lead to the desired lower viscosities of the fuel. However, the chemical and various physical extraction processes involved in the production of biodiesel are time consuming and expensive.

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Recent advances in the chemical processing of biooils (liquids produced from the high temperature treatment of organic matter) and first-generation biofuels hold the possibility of producing new fuels for diesel engines that will be cheaper and easier to produce. Chief amongst these are the products of the hydrodeoxygenation (HDO) of bio-oils and vegetable oils [8–11]. The HDO process essentially converts oxygen-rich components of these feedstocks to those that are richer in hydrogen (products such as straight-chain alkanes and cycloalkanes). When perfected, the new fuels will be cheaper, easier to produce and may completely displace biodiesel as a transportation fuel alternative.

What is especially significant is the manner in which these new fuels will satisfy the requirements of international fuel standards. The number 2 grade diesel used in land transportation consists of a mixture of hydrocarbons with varying carbon chain lengths, centered around C16 [12]. To economically produce a biofuel (by the HDO process) that is close in composition to transportation-grade petroleum diesel, one must start with a feedstock that has a similar composition. It is thus fortuitous that the most appropriate feedstocks are abundantly available in the poorer countries of the world, and significantly in the Pacific Island countries. The development of this new class of biofuel thus holds promise to radically change the financial fortunes of many of these island nations.

Challenges

But hurdles still remain. The success rate of Fiji’s biofuel projects is a matter of some concern. Fiji’s outer island biofuels implementation project does not seem to be working as well as it could [103]. The Department of Energy has already set up three coconut oil extraction/blending mills in the outer islands for the production of renewable diesel for power generation needs, and six are planned to be commissioned soon. However, reports on the general acceptability of the scheme by the outer island communities are mixed. Not all the mills are producing up to expectations. The reasons tendered are varied, and include dissatisfaction with the purpose-defeating choice of 20–80% CNO diesel blends currently being produced by the scheme.

There are strong indications that socioeconomic factors are also at play. The present projects seem to be going the same way as the earlier pilot projects at Lomaloma and Welagi in the outer islands of Vanuabalavu and Taveuni [13]. These well-intentioned, well-planned projects started in 2000 by a grand consortium among the Secretariat of the Pacific Community, the French Government and Fiji’s Department of Energy for a similar coconut oil-based electrification scheme had failed to deliver. The reasons have been scientifically elaborated by Woods *et al.* in their paper [13], but more recent repetitions of the same results add weight to the contention that the failures were in all probability due to an arrogant disregard to the all-importance of the socioeconomic factor. It is easy to plan biofuels projects that look good on paper, to pass them through the usual channels of vetting and approval, and to proceed to implement them; the proof of the pudding lies in the results of the implementation and these have usually fallen far short of expectation.

It is clear that the mixed performance of the Biofuels Implementation Project is evidence that the relevant policies are not working. This example provides a small but important test of the policy strategies for Fiji and the region, which have been progressively evolved over the last two decades [14]. A review of Fiji’s National Energy is currently in the process of completion. One can only hope that its architects have taken on board the lessons that are being learnt about the efficacy of energy policies made in boardrooms.

But all is not doom and gloom. There is a large market for renewable diesel satisfying the quality standards of number 4 grade fuel. This fuel is suitable for both power generation and marine transportation. The ability to produce this from indigenous feedstock such as CNO has been boosted with the recent infusion into the country's biofuel industry of more qualified expertise and knowledge. As a result, this lower grade fuel is already making inroads into the marine market.

The ethanol thrust

But the real thrust in the development of the biofuels industry will come from the sugar sector, and will be driven by the very significant impact ethanol from molasses in Fiji can have on the national, as well as regional, transportation fuel economy. Fiji produces some 1.8 million tonnes of sugarcane annually, from which it extracts 130,000 tonnes of sugar and produces approximately 110,000 tonnes of molasses as a byproduct [15]. It is this byproduct that holds the most promise, with the possibility of producing ethanol well in excess of the country's needs for E10 transportation fuel. The estimated volume of 23 million l of ethanol that can be produced will mean a potential for producing E10 that will meet all local demands with at least the same amount left over for export [1].

So is the industry set to soar?

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