`Assessment of a Potential Coconut-based Bio-Diesel Refinery Initiative in Fiji, and Establishment of New Rural Enterprises[1]

Purpose

The purpose of this short mission to Fij is to explore the opportunities for the development of a bio-diesel refinery in Fiji, with use of cocodiesel fuels for large diesel gensets on Fiji's two main islands. A project to develop such a refinery would be conducted under the auspices of the Global Sustainable Energy Islands Initiative (GSEII), which is receiving support from the United Nations Foundation (UNF) and other donors for work in the Small Island Developing States (SIDs) nations where the current focus has been in the Caribbean. Caterpillar is a strategic partner for this effort, supporting test and evaluation of coco-diesel powered diesel power plants. This project would serve as a pilot for a larger bio-diesel initiative in Small Island Developing States (SIDS) to be conducted under GSEII, in partnership with Caterpillar and others, including the private sector and foundations.

An associated objective is to assess the potential for wider use of coconut-derived products for economically productive and environmental management in the rural environment. Cocodiesel can be used for both small engine/generator minigrids (and there are two such pilot projects operating in Fiji now), and for transport (as well as for construction equipment such as earth movers). A potentially important product of coconut husks is "geotextiles", mats that are woven from fibers drawn from the coconut husk. Such geotextile mats are excellent media for restoration of eroded hillsides and riverbanks, and are also being used for mangrove restoration. [See attached paper by J. Weingart]. The success and expansion of a program that empowers rural Philippine women by providing them regular income from the weaving of these mats may provide a model for similar rural enterprise development in Fiji. This is very important to the Government of Fiji, because of the high level of rural unemployment, the increasing emphasis on empowering rural women, and expanding both decentralized energy services and enterprise to rural areas.

Background

A number of factors are coming together that make this a very timely and highly beneficial project:

- Fiji relies on imported petroleum for meeting a substantial portion of its energy needs and is particularly hard hit by rising fuel costs.
- The Government of Fiji is strongly committed to development of renewables on the island, striving for 100% use of renewable energy for in-country use (excludes jet fuel) by 2015. This can only be accomplished if liquid fuels are produced from local biomass.
- The Fiji Electricity Authority (FEA) is also committed to transitioning to renewable energy technologies to the extent technically and economically practical, and supports the development of a bio-diesel refinery on the island. The utility would require technical assistance in the design, development, and financing of the facility.
- The country has substantial coconut groves; however the market for coconuts and coconut oil is in decline. Many small farmers have had to leave the industry, crop yields have

[1] This is the preliminary working version, and is subject to modification as feedback and suggestions are received from key stakeholders in Fiji and elsewhere.

decreased and most coconut husks and shells are either burned or left to rot, creating air pollution problems.

- The technology exists to convert coconut shells to electricity shaft horsepower, and heat. Coconut oil can be used in combination with diesel fuel to produce a clean-burning "coco-diesel" fuel (minimum 5% coconut oil). Plants are operational today in industrialized and developing countries.
- Caterpillar is active in Fiji and several other small island nations and is interested in shifting to increased use of bio-fuels in its operations. There are four 7.5 MWe diesel gensets (8,000 HP engines) providing power on the main island of Viti Levu. This represents almost 20% of the entire national installed generating capacity of 160 MWe (hydro plus diesel). The 80 MWe Monasavu hydro facility provides much of Fiji's power, but fluctuations in annual rainfall have limited the energy production from this facility. Three more large Caterpillar diesel gensets are scheduled for introduction on the other principal island, Vanua Levu, in 2005+.
- Caterpillar is committed to provide the technical support that will allow the FEA to become a major purchaser of the fuel output of a Fiji bio-diesel refinery, primarily coco-diesel. Caterpillar has equipped one of FEA's four large diesel gensets with two fuel tanks to permit operation from either pure diesel fuel or from biodiesel fuel
- Other local economic development opportunities exist for creation of productive rural enterprises based on the coconut crops. These enterprises will help to motivate farmers to maintain the trees, enhance their yields, and generate incomes. Additionally, opportunities exist for developing enterprises to employ women and stimulate business ownership. A good example is the Productive Rural Enterprises (PRE) program in the Philippines that has created a local industry to produce and sell high value coconut coir-based soil erosion control mats for domestic use and export to Asian markets.
- Significant opportunities exist for replicating this effort in other SIDS nations in cooperation with Caterpillar. Palau, Mauritius and several Caribbean nations have already expressed interest in this area.

Coco-Diesel Fuel for Diesel Engines

"Biodiesel" refers to fuels derived from plant or vegetable oils that can be used as a blend with diesel fuel or a complete substitute for diesel fuel. It can be used in diesel engines without any engine modifications. Biodiesel has important environmental benefits relative to other transport fuels. It is sustainable and renewable with very positive energy balances. It is safely biodegradable and has far lower greenhouse gas emissions than do fossil fuels. It offers scope for recycling waste oils and produces far less local air pollutants than fossil diesel. On balance, biodiesel also offers environmental advantages over the road gas fuels (LPG, CNG, and LNG).

For many years vegetable oils and their derivatives have been used as a fuel source for diesel engines. Applications range from North America and Europe (Caterpillar has operated diesel gensets on 100% rapeseed oil in Germany) and in tropical countries. Recently, local interest in using refined coconut oil as a fuel has increased in some coconut producing countries due to several factors. The coconut coir industry is suffering from low prices of coir based products; therefore growers have looked to diversify, and find alternative coconut-based products to generate. In the Philippines, President Arroyo has issued a memorandum mandating that all government depart-

ments use one percent Coco Methyl Esters (CME) by volume as a blend in petroleum diesel fuel. Biodiesel from coconut oil is often referred to as cocodiesel or CME (coco methyl ester).

Activities

Under this initial effort, the Energy and Security Group, working in conjunction with Caterpillar, the Fiji Electricity Authority, the Government of Fiji, local communities and others will conduct a pre-feasibility study for development of a bio-refinery on the island of Viti Levu and possibly a second refinery on the island of Vanua Levu, where the country's largest copra processing plant is located (at Savusavu). The study would involve performing an initial preliminary assessment of the engineering, economic, financial, environment, management and institutional aspects of developing a facility on the island, as well as identifying key stakeholders, possible configurations for such an industry, and potential suppliers. The study will also involve identification of rural economic development opportunities related to coconut processing.

Expected Benefits

This project is expected to yield a number of favorable impacts through subsequent development of a coco-diesel fuel production and distribution capacity:

- Reduced reliance by Fiji on imported petroleum, including enhanced balance of trade impacts and displacement of environmentally polluting diesel fuel with cleaner bio-fuel alternatives.
- Use of locally available biomass residues for energy generation.
- Alleviating an environmental problem in coconut shell/husk disposal.
- New markets for coconuts as current sales to China have dried up.
- Increased jobs and incomes on the island from the bio-refinery plant.
- Development of associated local enterprises.
- Replication of the bio-diesel refinery and development model to other SIDs nations in the Pacific and Caribbean.

Schedule and Deliverable

The primary deliverable will be the pre-feasibility study. This will be completed within 3 months of work initiation. The work began in early January, with the field mission to be completed on March 2, 2005, with the draft report submitted by March 20.

Personnel and Corporate Experience

The Energy and Security Group has extensive experience in renewable energy and SIDS nations. ESG President Judy Siegel has been working in the international renewable energy field for over 25 years, including the design, development and promotion of renewable energy projects and programs throughout the Caribbean and Pacific, Latin America, Asia and Africa. ESG consultant Jerome Weingart will serve as the principal investigator, with Ms. Perla Manapol as technical expert on production and applications of coconut products and coconut oil, and also on the use of coconut products for supporting sustainable rural employment especially among women. Mr.

Weingart is a physicist with over 30 years experience in renewable energy in developing countries, including the Pacific islands. Recently, he has supported UNF in organizing a workshop in association with the Bonn Renewable Energy Meeting (*Renewables2004*), and has provided technical assistance on the Philippines Productive Rural Enterprise project that involved a similar effort to develop distributed biomass energy systems linked to economic development activities in rural areas and remote islands.

Relationship with Caterpillar

For this effort Caterpillar is interested in collaborating with ESG/GSEII on the Fiji project and in exploring a broader collaborative initiative in other SIDs nation. With UNF, Caterpillar is committed to participating in the UNF Energy Future Coalition (EFC) Energy and Development Council and becoming an advocate for bio-diesel in the EFC.

Personnel

Sponsored by the Energy and Security Group, Mr. Jerome Weingart and Ms. Perla Manapol will conduct the study, in close communication and coordination with stakeholders in Fiji (government -- especially DOE and FEA, the private sector, NGOs, and international organizations such as the Pacific Power Association.)

Schedule

Ms. Manapol and Mr. Weingart arrive[2] in Suva on Tuesday, February 15 and depart on Thursday, March 3, for 11 full weekdays and two weekends. They will need to coordinate and work closely with DOE and FEA, as well as with PPA and key members of the coconut industry in Fiji. They have the support of the DOE through the offices of Ms. Makareta Sauturaga and through Mr. Tony Neill, President of PPA. Mr. Randy Etheridge, a Pacific Islands representative for Caterpillar Corporation, will be in Fiji on February 8th in meetings with FEA, and will help arrange an introduction and set up an initial meeting between the visiting team and FEA.

Through the good offices of the Climate Institute, the Fiji Department of Energy, the Fiji Electricity Authority, the Pacific Power Association, and the coconut industry, a series of meetings will be scheduled. A preliminary schedule will be distributed on or before 7 February, and it is expected to evolve once the team is in Fiji.

Sustainable Rural Enterprise (SRE) of the Philippines

Sustainable Rural Enterprise (SRE) is a registered Philippine non-government organization based in the province of Aklan. Its mission is to promote the productive uses of renewable energy, specifically, biomass. SRE has considerable knowledge of and experience with the coconut industry, including industrial scale production of highly refined cocodiesel fuel. SRE staff are interested in collaboration with Fiji, to further promote sustainable biomass-based energy and enterprise in the Asia-Pacific region.

[2] All travel and lodging arrangements have been completed as of 28 January, 2005. The team will be staying at the Tanoa Plaza Hotel in Suva. Mr. Weingart's Fiji cell phone is +679 931-6238 (operational as of 15 February, 2005).

SRE operates and manages the Center for Productive Uses of Renewable Energy (C-PURE) in partnership with the Aklan State University, and the Ibajay Coconut Coir Processing Plant in partnership with the Ibajay Small Coconut Farmers Development Cooperative. At C-PURE, SRE carries out applied research and development on the use of agricultural waste such as rice hulls, wood chips, and coconut husks/shells as fuel for drying various crops, as well as the production of coconut biodiesel and its use in operating stationary engines. At the Ibajay coir facility, tons of waste coconut husks are processed into fiber and dust by a machine (decorticator) that is fuelled by a blend of regular diesel and coconut methyl ester (CME). The fiber is distributed to households for processing into twines and ropes; the ropes are then woven into nets which are used for soil erosion control. The dust is used as fertilizer and soil enhancer. Coir processing is labor-intensive, and SRE's Ibajay activities currently employ more than 100 households, the majority of whom are women.

SRE won awards in 2002 and 2003 from the World Bank Development/Innovative Marketplace competitions, and has also received a citation from the Philippine Coconut Authority for its "commitment to a community-based enterprise that benefits small coconut farmers and the coconut industry in general." It has also received additional orders for its nets which will guarantee employment for its workers for two more years. Indeed, SRE has received invitations from various local government units in Mindanao and the Visayas to replicate the "Aklan model."

Ms. Perla Manapol is President of Sustainable Rural Enterprise (SRE), a Philippine NGO based in the province of Aklan that promotes the productive uses of renewable energy, specifically, biomass. SRE operates and manages the Center for Productive Uses of Renewable Energy (C-PURE), where it carries out applied R&D, and the Ibajay Coconut Coir Processing Plant, a thriving SME that produces geotextiles (coconut fiber nets used for soil erosion control) out of waste coconut husks. The enterprise currently employs more than 100 families of small coconut farmers, most of them women. In 2003, SRE expanded its activities to include the production of virgin coconut oil (VCO) and coconut methyl ester (CME). Initial marketing of VCO has been successful; a larger production facility will soon be constructed.

SRE’s production of CME at the C-PURE – in partnership with the Aklan State University R&D Department - has likewise been successful. Of significance is that this accomplishment has allowed SRE to become the first small enterprise in the country to use CME as a blend (1%) with commercial diesel fuel in a stationary engine, a 50HP diesel decorticator (a machine that grinds coconut husks into fiber and dust) at the Ibajay plant. To enhance its CME development and application in stationary engines, SRE is now working closely with the Philippine Coconut Authority’s Biodiesel Program Division, the Department of Energy’s Alternative Energy Division, and the Philippine National Oil Company’s Biodiesel Energy R&D Center. With the assistance of the latter, SRE is poised to establish a first-ever commercial small-scale CME plant.

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