REToolKit Case Study

Biomass Gasifier–Based Community Productive Uses

1. Introduction

Small, modular biomass gasifiers are an emerging technology for enhancing the economic productivity of small agricultural-based communities, especially when combined with the "multi-function platform" concept.

A multi-function platform (MFP) is an engineering and technological approach to using local available biomass residues to produce shaft horsepower, electricity, and heat to support economically productive activities in rural communities. Two design concepts have been pursued to date through commercial demonstration projects. One MFP is a very simple diesel engine-based unit developed and being used in Mali (West Africa) with UNDP support. The other, discussed in this case study[1], is operational in the United States and the Philippines. It is an advanced biomass gasification-based system that produces combustible clean-burning gas, heat, shaft energy, and electricity. Both platforms are renewable energy-driven "Swiss army knives" that provide useful energy for socially and economically productive activities.

2. Modular Bio-Energy-Based Multi-Function Platform

An advanced bio-energy-based MFP has been developed by US-based Community Power Corporation (CPC) for markets worldwide. The system produces thermal energy, shaft power, and electricity. One of the commercial prototypes is operating in the Philippines at a coconut cooperative, providing energy and power for production of commercial products from coconuts.

The MFP is powered by modular trailer-mounted systems that convert local biomass into useful mechanical, electrical and thermal power that can be applied to a myriad of productive use applications. The Gas Production Module (GPM) converts coconut shells (and other dry woody biomass) to a combustible gas for delivery to a spark-ignited engine mounted on a power distribution platform. The platform can allocate shaft power as needed to various mechanical and electrical loads. The peak electrical output of the system in the Philippines is 15 kWe from the conversion of about 23 kg of coconut shells per hour. In addition, about 20 kW of thermal energy is available in the form of clean, hot air for drying crops and fish.

This type of biopower system is well suited for many rural enterprises. Sustainable supplies of biomass residues are available in many parts of the world, and they can be converted to high-quality power to drive complex electrical and mechanical loads. Unlike renewable energy equipment such as photovoltaic systems and wind turbines, biomass energy systems also produce thermal energy, which can be used for drying and

[1] Multi-Function Platforms for Enhancing Economic Productivity of Small-Scale Agriculture, prepared by Jerome Weingart for Winrock International, using published and non-published information from Community Power Corporation, October 2003.

processing food and fiber, for driving refrigeration units, and for institutional cooking (e.g., at schools).

3. Productive Loads Supported by Small Biopower Units

Small biopower / productive use platforms can support a wide variety of productive loads. These include the following:

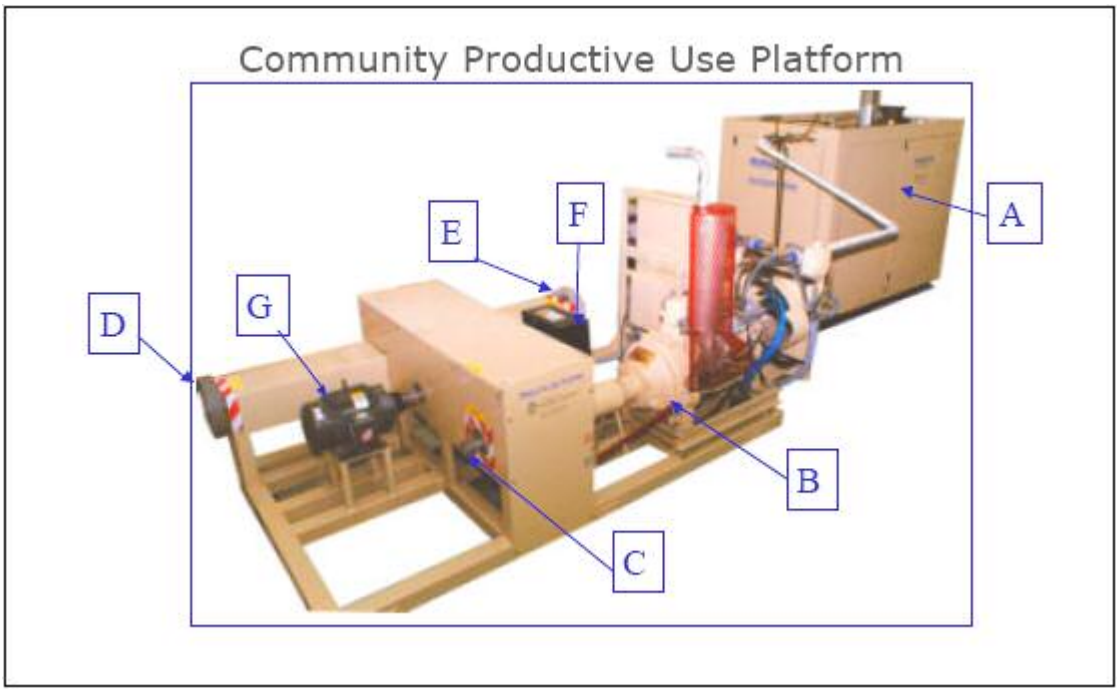
Thermal	Mechanical	Electrical
Dryers	Grinders	Motors
Cold Rooms	Saws	Compressors
Freezers	Mills	Pumps
Boilers	Lathes	Heaters
Purifiers	Pumps	Air conditioners
Distillers	Fans	Computers
Cookers	Generators	Telephones/ telecommunications
		Rechargeable power tools
		Rechargeable batteries: cell phones
		Charging auto batteries

4. Technical Overview of the MFP System

The biomass-powered MFP can provide up to 15 kW of shaft power or three-phase electrical power, and up to 20 kW of thermal power to operate a wide variety of implements of production. Some aspects of the systems are the following:

- ③ Fuel sources: A variety of biomass materials can be used as fuel. These include wood chips from hard and soft wood, sawdust pellets, coconut shells, pecan shells, and corncobs.
- ③ Electricity production: The units have gasifiers that convert wood chips, chipped coconut shells, etc., to a mixture of fuel gases such as hydrogen, carbon monoxide and methane. This producer gas is then combusted or mixed in internal combustion engines, Stirling engines, microturbines, or fuel cells.
- ③ Waste products: The units use a drying system to cool and clean the producer gas, eliminating the need to process large quantities of contaminated water, as is the case with in wet scrubbers. Ash and char are stored and periodically combusted to ash that can be dispersed in the soil. Tars and soot are recycled through the gasifier.

A picture of the MFP system is shown below. The Gas Production Module (A) converts woody biomass to a fuel gas that is ignited in an engine (B) to turn a shaft. The shaft power is distributed to output (C) to run a small biomass fuel grinder (not shown); to outputs (D) and (E) for powering a variety of larger implements such as flour mills, rice mills, decorticators, composters, water pumps, etc. (not shown). Any combination of these mechanical outputs can be engaged, or disengaged simultaneously. If electrical power is needed, a 15 kW generator (F) can be engaged. If the Gas Production Module or engine are not available, motor (G) can be connected to a backup electrical power source to drive any combination of mechanical outputs (C, D and E). All rotating shafts, belts, pulleys, and heated surfaces are covered for worker safety.



5. Commercial Applications in the Philippines

At a small coconut processing facility in the Philippines, CPC and colleagues at Aklan State University Center for Productive Uses of Renewable Energy (C-PURE) have demonstrated the ability to simultaneously grind husks and shells, sort fiber, pump water, light the facility, and dry agricultural products. This system is at the cusp of commercialization, and is potentially a practical and affordable source of modern energy services. The successful test and ongoing operation of this new Community Productive Use Platform (C-PUP) are being conducted at the Productive Rural Enterprise (PRE) coconut fiber processing facility in Aklan Province, Philippines, at the Ibajay Coconut Cooperative. This system produces sufficient electricity to power the motors, lights, fans, and other components of the SRE production facilities.

Productive Rural Enterprise (PRE) is a for profit joint venture company that was formed in 2002 by CPC and local Philippine partners to employ rural people to operate and maintain the C-PUP, and to make geo-textiles and other high-value products from coconut byproducts, for sale to domestic and export customers. PRE is also offering manufactured systems. The PRE business model, using the C-PUP to support sustainable enterprise development and growth, appears replicable in rural areas of many developing countries if there is sustainable availability of suitable biomass residues. As of October 2003 several large orders have been placed with PRE for geo-textile soil stabilization / erosion control mats.

Sustainable Rural Enterprise (SRE) is a registered Non-Governmental Organization (NGO) based in Kalibo, in Aklan Province (Philippines). It operates the Center for Productive Uses of Renewable Energy (C-PURE) at Aklan State University. SRE staff members conduct applied research and development in productive uses of renewable

energy resources, especially for rural enterprises. It also operates the Ibajay coconut processing facility, and manages and operates PRE under an agreement with CPC.
The capital investment for these systems is very sensitive to the specific site conditions and types of products being produced. The ideal product is one which is energy intensive, in the form of either electricity or heat, can be made from locally available resources, and has both domestic and export markets. In new applications, enterprise like the PRE would own and operate the system, and revenues from sale of products would provide the funds to recover the initial investment.

7. Empowering Rural Women and Children

At the Ibajay Coconut Cooperative in Aklan Province (Philippines), women who previously were unemployed now earn money on a regular basis by weaving geo-textile mats from coconut coir. The mats are very valuable for enhancing soil stability, especially for sloping areas where there have been fires and where the soil has to be stabilized and fast-growing vegetation can be planted and take root. One of the social consequences of this work, which is done only by local women, is that these women have gained new social power through their new regular source of income. Their children, many of whom had inadequate clothes for school and lacked the money even for simple notebooks, now have the clothes, notebooks, and umbrellas that their wealthier rural classmates have.
Children like to work with their mothers in preparing the coconut coir ropes that are then woven into the geo-textile mats. Children are able to earn a bit of money and participate in the family income generation. However, they are allowed to do this *only during non-school periods.* There is anecdotal evidence that this after-school opportunity has resulted in decreased after-school vandalism and other problems by school children.
Other products created from coconuts at the SRE facility in Aklan include premium cooking oil and high-quality soaps, as well as potting media for houseplants. Coconut coir dust can hold ten times its weight in water, and is well suited for transport and storage of premium houseplants.