Small Modular Biopower Systems

Small modular biopower systems can help supply electrical power to the more than 2.5 billion people who live without electricity. The potential is great because most of these people live where large amounts of biomass are available for fuel. Small systems (with rated capacities of 5 megawatts [MW] and smaller) can provide power to villages, and have a great potential market for distributed applications in industrialized regions of the world. These applications consist of power generation attached to the transmission and distribution grid close to where the consumers use electricity. Some of these units might be owned by the consumers and would be connected to the power grid on the customer side of the electric meter. Both applications have large potential markets in the United States and abroad.

Small modular power systems powered by fossil fuels predominate in today's markets, but biomass provides an alternative that is more environmentally acceptable. Furthermore, successful commercialization of small modular biopower systems completes the development of a biopower industry that covers all ranges of expected power applications:

- Small systems for village power or distributed applications
- Combined heat and power systems for industrial applications
- Cofiring, gasification, and advanced combustion for utility-scale power generation

The U.S. Department of Energy's Small Modular Biopower Systems Project works with industry to develop small modular biopower systems that are efficient and clean. The project consists of feasibility studies, prototype demonstrations, and system integration based on a business strategy for commercialization. In 1998, the National Renewable Energy Laboratory in Golden, Colorado, and Sandia National Laboratories in Albuquerque, New Mexico, began 10 projects to develop small modular biomass power systems. These projects, which constituted the first phase of the Small Modular Biopower Initiative, were aimed at determining the feasibility of developing systems that are fuel-flexible, efficient, simple to operate, and whose operation will have minimum negative impacts on the environment.

Ralph Overend/NREL

STM's gasification/Stirling engine system

Small Modular Biopower Systems Project Objectives

- Bring to market readiness biomass-based generation systems smaller than 5 MW.
- Develop flexible, efficient, and simple-to-install and operate systems that offer minimal environmental impact.
- Accelerate the process that comprises feasibility studies, prototype demonstration, system integration, and development of mature business strategies.

Phase 1 of the three-phase project focused on the feasibility of developing cost-effective technologies and identifying the potential markets for each of the systems. The feasibility studies addressed the following technical issues:

- System capacity (as large as 5 MW)
- Load following ability
- System fuel consumption
- Fuel flexibility
- Number of operators and required training
- Life cycle costs
- Environmental impacts (feedstock-related issues; air, water, and solid emissions)
- Safety
- Load profile (proposed hours of operation, etc.)
- Proposed fuel (including availability)
- Fuel handling/feeding system and method
- System transportability
- Maintenance schedule and costs
- Water consumption
- Capability for remote monitoring (unit performance and maintenance intervals)

Phases 2 and 3 (which will be awarded competitively) will require the companies to participate at a higher level.

A synopsis of the projects and their participants appears on the reverse side.

Initiative Goal

To develop systems that are:

- Fuel flexible
- Efficient
- Simple to operate
- Environmentally friendly
- 1 kW to 5 MW

Multi-Phase Initiative

Phase 1: Feasibility studies
Phase 2: Prototype systems
Phase 3: Integrated systems

Status

Phase 1: Complete
Phase 2: RFP: June 1999
Phase 3: Selection in progress

Courtesy of Community Power Corporation

Community Power Corporation's 7.5 kW prototype system

Phase 1 Studies

Residential, Institutional, Villages <100 kW

- CPC—Gasification/Stirling engine
- Reflective Energies—Microturbine for biogas
- STM—Gasification/Stirling engine
- Sunpower—Combustion/Stirling engine

Villages and Industries 100-500 kW

- Bechtel—Gasification/IC engines/gas turbines
- Reflective Energies—Gasification/gas turbine

Mini-Grids, Industries >100 kW

- Agrilectric—Combustion/steam turbine
- BIOTEN—Direct-fired combustion turbine
- Carbona Group—Gasification/steam turbine
- EERC—Combustion/heat exchange/steam turbine
- Niagara Mohawk—gasification/gas turbine

Phase 2 Project Awards

Community Power Corporation, Colorado

- Downdraft gasifier, dry gas cleanup, IC engine/generator
- 5-25 kW
- Test systems—Philippines, Alaska, Denver

External Power, Indiana

- Combustor—Stirling engine
  36 preproduction systems
  72 production prototypes
- North America, Europe

Flex Energy, California

- FlexMicroturbine™
- 30 kW
- Landfill gas, digester gas, producer gas

For More Information

Visit the Biopower Web Site:

http://www.eren.doe.gov/biopower

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