PROJECT SUMMARY

CENTRALIZED ANIMAL MANURE ANAEROBIC DIGESTER AND CHP PROJECT FEASIBILITY STUDY AND BUSINESS PLAN PREPARATION

PROJECT SUMMARY

With Federal regulations governing concentrated animal feed operations (CAFO's) and the management and disposal of animal manure from CAFOs, and the growing concern about nutrient runoff into water sheds from animal manure disposal, Bridgestone Associates prepared a detailed feasibility study and business plan to develop, own and operate a centralized 450 ton per day animal manure and food waste anaerobic digester plant. The proposed project would be located at or adjacent to one or more existing CAFOs and other dairy farms. The study focused on dairy farms in New York State.

The proposed business and plant design included de-watering and collection of animal manure and food waste from multiple locations, transportation to a central digester location, anaerobic digestion of the material and the production of biogas, and the generation and sale of electricity in a combined heat and power (CHP) plant. Various technology enhancements were included to reduce transportation costs, to increase biogas production, and to reduce digestion time.

A detailed report and business plan was prepared and presented to various interested parties. Due to a lack of serious pressure at the time on the CAFOs and farmers to prevent nutrient runoff and the environmental damage this was causing, their interest in such a solution was tepid at best. As a result the project was put on hold until such time this pressure resulted in greater interest and action.

PROJECT STATISTICS

Client:	Confidential
Project Date:	2003
Project Scope:	Detailed Feasibility Study and Preliminary Business Plan Preparation
Project Type:	Centralized Animal Manure and Food Waste Anaerobic Digester and CHP Plant
Size:	450 tons per day 3 MW electrical generation
Estimated Project Cost:	US$11.8 million
Plant Location:	New York State
Plant Elevation:	TBD

Interconnection Voltage:	TBD
Plant Feedstock:	Dairy manure, mixed food waste
Technology Enhancements:	Membrane filter press de-watering equipment to reduce transportation costs High power ultrasonic cellular destruction to enhance anaerobic digestion. Patented process nutrient removal from liquid digestate
CHP Plant Primary Fuel:	Biogas
Back-up Fuel:	Natural gas
CHP Plant Technology:	Biogas fired reciprocating engine(s)

PROJECT DESCRIPTION

With the increasing concern of nutrient runoff and environmental damage from disposal of animal manure, Bridgestone Associates identified the issue of animal manure management as a significant problem facing the agricultural industry and therefore development of a suitable solution a potential business opportunity. The research and the work undertaken to prepare the feasibility study and business plan showed that there were solutions already available, but that they had not yet been commercialized to any great extent in the US. Farmers had attacked the issue on a farm-by-farm basis, attempting to solve nutrient management, runoff, odor control and a number of other issues in all manner of different ways. Some solutions had been successful, many had not. Many university agricultural extensions, State agencies, Federal agencies and a number of industry groups had participated in alternative solutions. Again some had been successful, many had not.

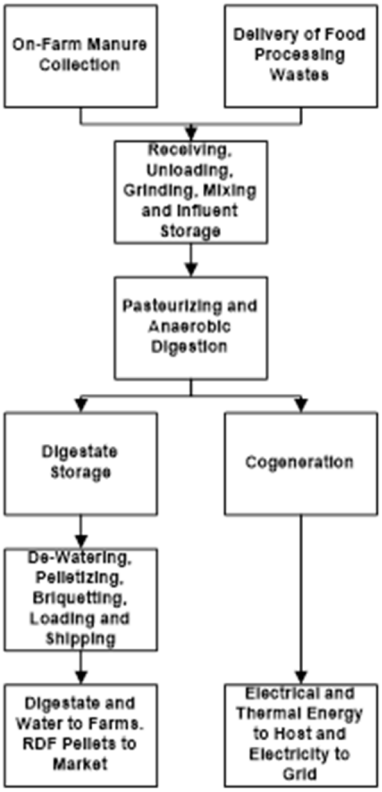
In Europe, European farmers had attacked similar problems in a different way. Centralized processing plants had been built where animal manures and food wastes are processed, gas produced from digestion is used to generate electricity and thermal energy, and digested manure is returned with minimal odor for land-spreading. It is fair to say that European governments and their regulations have supported the move towards centralized processing plants and that without such regulations and support, they may not have been built. However, Bridgestone believed that this European approach is a solution here and that it is translatable to the US and to New York State in particular.

The analysis undertaken validated Bridgestone's supposition that one or more centralized plants in New York State could be both technically and economically viable. These centralized plants

would process animal manure, animal wastes and food wastes. They would be located in a suitable catchment area where sufficient quantities of manure and wastes can be delivered without undue trucking costs. Ideally the plants would be located adjacent to a suitable user of thermal and electrical energy.

The plant design assumed in the analysis was based on existing plants in operation in Europe. Bridgestone modified the design to accommodate changes for US operations. Bridgestone also included new technologies that enhance the plant's performance and economic viability. These included new membrane filter press de-watering equipment and the use of high power ultrasonics to enhance anaerobic digestion.

The project design assumed collection of manure from multiple farms and transportation to the central digester location. To reduce transportation costs, the amount of water in the manure must be minimized before transportation. This can be accomplished inexpensively and simply using membrane filter press de-watering equipment developed by one of Bridgestone Associates team members. Once the water is removed at the farm and the manure transported to the digester plant, water can be added back to allow full operation of the digester and its associated pumping equipment.



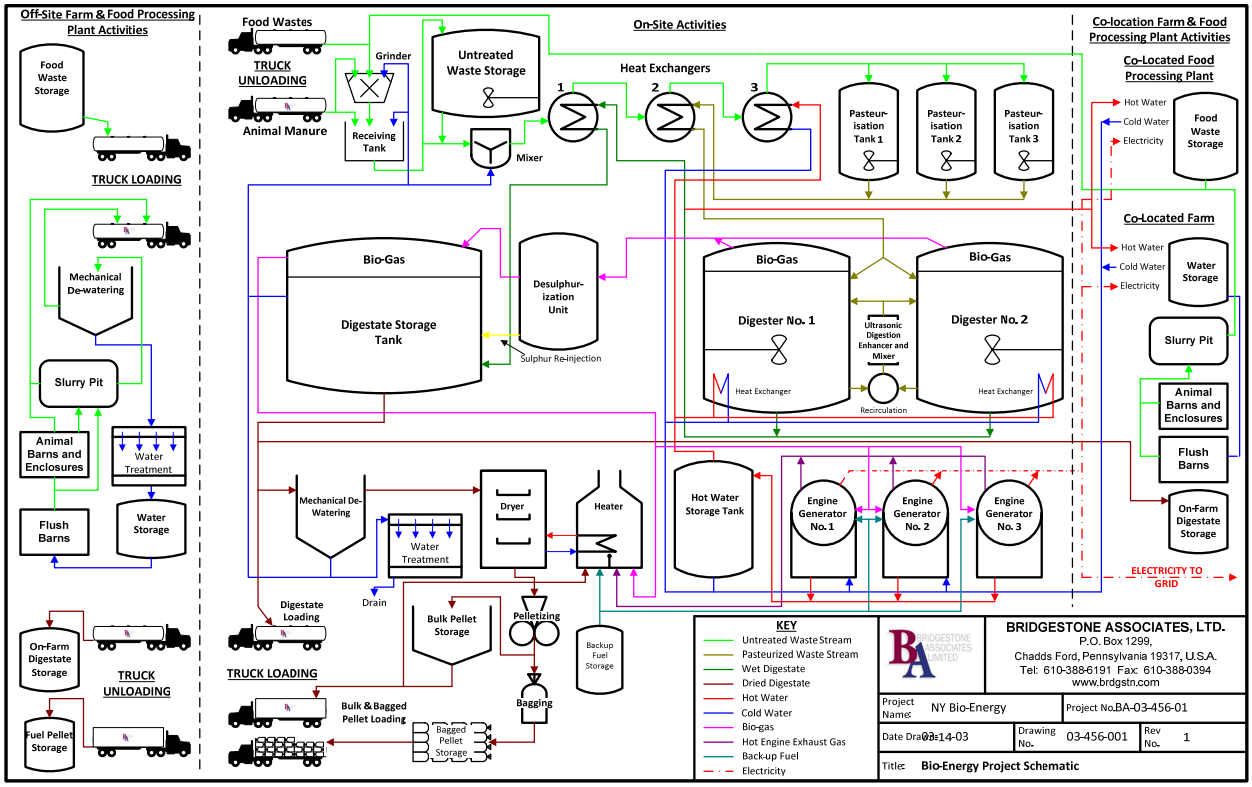
To enhance biogas production and reduce digester retention time, Bridgestone identified a high power ultrasonic disrupter technology being developed and used for wastewater treatment applications. The high power ultrasound breaks the cell walls of the material in the manure, allowing the microbes in the digester to consume the material much faster, increasing biogas production and significantly reducing retention time requirements.

The solids in the digestate from the digester can be pelletized and used for a number of useful purposes (e.g. animal bedding, soil stabilization, etc.). The liquid digestate, which contains the bulk of the nutrients, can be treated to remove the nutrients and then may be returned to the farm for disposal or disposed of at site. One of the Bridgestone Associates team members has developed and patented technology for this nutrient removal that allows the farmer to manage the exact nutrient balance in this liquid digestate.

The capital cost for a 450 ton per day plant was estimated to be approximately $11.8 million. This included on-farm slurry tanks, trucks to collect animal manure from the farms, the complete anaerobic digestion plant, a cogeneration plant, and a de-watering and pelletizing operation.

This cost compared closely with the reported costs of the Holsworthy Plant in Devon, England, and with the 20 centralized plants built in Denmark.

An economic analysis model developed specifically for the project was used to analyze the project's economic viability. Similar economic models have been developed and used by Bridgestone for the analysis of many major energy related projects throughout the US and worldwide.



Using a conservative approach to the assumptions included in the economic model, based on a 20%/80% equity/debt ratio and assuming a composite debt interest rate of 7.0% (made up from a combination of commercial and low interest loans), the project had a pro-forma simple payback of approximately five years and a pro-forma 15 year Pre-tax Internal Rate of Return of over 20%. These results were based on an input ratio of 80% dairy manure and 20% food wastes. Increases in the percentage of food wastes will increase revenues through increases in processing (tipping) fees and increased electrical generation from the additional biogas produced by food wastes.