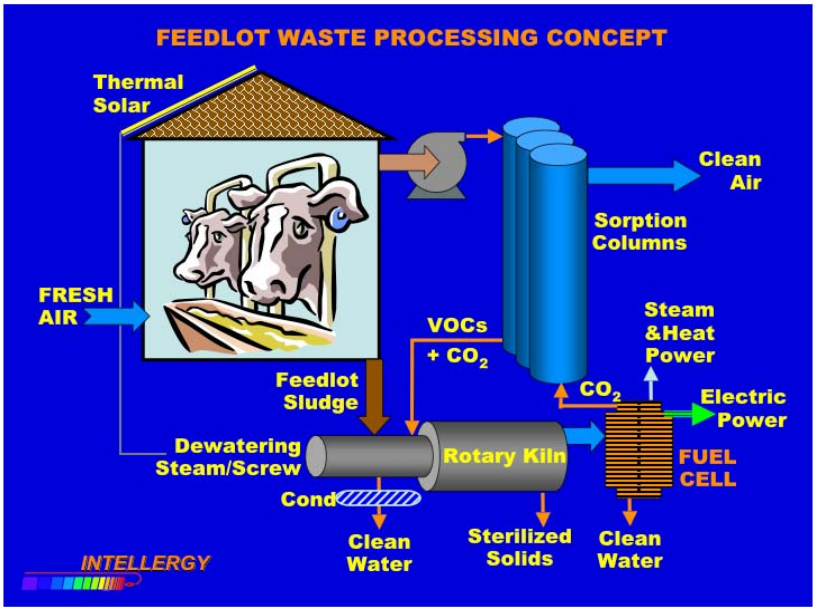
Feedlot Waste to Energy

The Challenge

Milk cows and beef cattle are critically important in modern society. However, although precise figures are hard to agree on, a single cow emits roughly between five to twenty pounds of volatile organic compounds annually, (including propyl acetate, hydrogen sulfide, methane, and ammonia). These compounds combine with nitrogen oxides to form ozone, which can reduce lung function and trigger asthma attacks. In reality, dairies in the San Joaquin Valley Air Pollution Control District are the largest source of smog, surpassing even the pollution from trucks and cars. Add to this the amount of manure and liquids daily (estimates vary, but 120 lbs per day would be conservative) from a single cow, and the 2.5 million cattle currently residing in the central valley produce a prodigious amount of dangerous and frequently toxic waste. When the waste is spread in fields and dries, 17 tons per 1,000 head per year of bio-hazardous fugitive dust (incl. Bacillus Subtilus, Bacillus Cereus, Corynebacterium Aquaticum, and Corynebacterium renale group) blows into the air, causing other hazardous products to be breathed in by folks in the Central Valley. Lagoons worsten the situation, and when it rains, waste is washed into the groundwater, polluting wells and the entire aquifer system in the valley. The situation is critical, and agencies and private sector industry organizations mandated to serve the community in a manner that is environmentally, socially, and economically sound have been meeting to address the problems. Currently there is controversy amongst cattle ranchers, organizations, agencies, and the communities that surround the feedlots, largely regarding environmental and health impacts of large operations. Present disposal practices are costly, create their own hazards, and can be avoided.

The Strategy

Turn the liability into an asset. Use the waste as a resource before it can become a pollutant. Direct the waste to process equipment that converts it into hydrogen gas and CO. Use this syngas in a fuel cell to produce electricity, heat, steam, and other saleable products, with virtually no CO_2 emissions, or other forms of pollution. Destroy harmful viruses and bacteria in the process, and render toxic metals inert. Capture and destroy VOC's, reduce odors from the feedlots, and avoid the need to store waste on site or to transport it.



The Technology

Steam reformation is a technology that has been used for years to convert various forms of waste to gas. The technology has been used for about a decade to steam reform 85% of the pharmacological waste in the US. It has been used to steam reform nuclear waste, and tests have been performed on medical waste, municipal solid waste, and human waste (for NASA). The technology is the only one that is California-DHS-approved to destroy the top 10 most harmful bacteria and viruses list (ref).

Indicator Test Organism	Initial Inoculum Level (CFUÕs)
Staphylococcus aureus	8.3×10^{8}
Pseudomonas aeruginosa	1.6×10^{9}
Candida albicans	3.8×10^{7}
Mycobacterium laticola	2.3×10^{8}
Bacillus subtilis Spores	1.8×10^{8}
Bacillus stearothermophilus Spores	1.7×10^{9}
Enterococcus faecalis	1.6×10^{7}
Aspergillus Fumigatus	8.8×10^{6}
Polio type-2 Virus (oral vaccine strain)	1.0×10^{10}

Sources: Final Report - Northview Pacific Laboratories, Inc., Dec. 7, 1994
BioVir Laboratories, March 2, 1994 for polio virus only.

The Project

Intellergy proposes a pilot steam/CO_2 reformation system at a cattle feedlot, taking 10 tons a day of wet slurry and converting it to syngas. The syngas produced would be fed to a fuel cell that would provide 30 kW of electricity, and roughly the same amount of heat to the facility. As part of the system, we would capture the VOC's released in the feeding buildings, separating the air and the VOC's in a zeolite bed with a pressure swing adsorption process, and then destroying the VOC's in the steam reformer. The system footprint for the steam/CO_2 reformer would be roughly 20 x 40 feet, and the adsorption column system would occupy roughly 20 x 20 feet. The system would cost in the vicinity of $2M, and would pay back in about 5 years. A full scale system could take up to 150 wet tons a day (sized for a 1600 head ranch), and the proforma is presented as 15 dry tons per day, and demonstrates a 4.34 year payback. [1] (Preliminary figures).

Project Economics, Proforma

Intellergy estimates the cost of a 150 wet tons per day (15 dry tons) system to be $8.7M, with a payback of 4.34 years and an IRR of 23%. Here is how we built the proforma. We assumed avoided operating costs of disposal and handling (sludge spreadlot disposal) $197K annual, avoided cost of environmental testing and compliance ($70K/yr), avoided cost of electricity at 12 cents/kWh, avoided cost of heat at $6.25 per million Btu. Avoided cost of water is $2 per thousand gallons, and health cost might be estimated at $150K/yr (from recently published articles), for a total of $797K/yr of avoided cost. This all averages to an avoided cost daily of $2,200.

Revenue streams include electricity at 12 cents/kWh, heat and steam at $6.25 per million Btu, and co-products (at 0 right now), federal tax credits (new), and California fuel cell credit, for a total of $3.067M annual benefits/ year (electricity, steam, heat, Federal Tax credit, fuel cell credit). The proforma takes all costs into account and assumes operating cost of $876.00 per head of cattle per year, or $1.4M for 1600 head. When combined, preliminary calculations indicate a ROI of 23 percent and the project has a simple payback of 4.34 years. The technology is all commercially available, there is no R&D involved, and there may be patentable technology derived through this effort. Bonding will be through Shaw Environmental or Caterpillar.

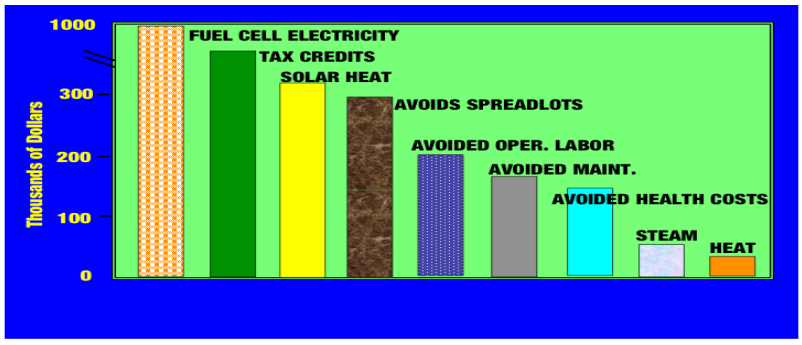


Figure 1 Relative Values of the Benefits from a Typical Project

(See Appendix 1 for detailed Proforma economics spreadsheet.)

The Partners

Intellergy: Started in 1981, Intellergy did the R&D, developed the technology and holds the patents worldwide for the steam/CO_2 reforming chemistry which produces clean syngas that is used in a fuel cell to generate electricity, steam and heat; and is used to synthesize saleable co-products.

Shaw Environmental: The Shaw Group operates one of the largest full-service integrated environmental laboratories in the world, with over 19,500 employees and 132 major locations worldwide. They are committed to delivering services in the area of municipal sewage, sludge, and feedlot waste. They are a partner with Intellergy in this proposal.

Caterpillar: Is one of the world's leading heavy equipment manufacturers/operators. They are also a partner with Intellergy in this proposal.

Timing:
Project start-up could occur in October. The project would take two years to complete.

Tasks: The following is a preliminary listing of tasks

[1] Feasibility Analysis
- Gather data
- Seek consensus on plant requirements
- Costing
- Analysis
- Reporting

[2] Lab. Gas Tests
[3] Pilot Design
[4] Procurement
[5] Assembly and Testing
[6] Demonstrate Pilot
[7] Reporting
[8] Media Releases and Events
[9] Presentation of Conference Paper

APPENDIX 1: ECONOMIC PROFORMA ANALYSIS

The detailed proprietary economic analysis requires an NDA, however, Bottom line conclusion:

Dairy Farm Feedlot: Payback in 4.34 years with a 23% return on investment.

Beef Cattle Ranch Feedlot: Payback in 6.35 years with a 16% return on investment.

APPENDIX 2 : Analysis of Features, Advantages, and Benefits:

The following is a listing of features, advantages, and benefits derived from steam CO_2 reforming of feedlot waste. The onsite conversion of this waste produces steam, hot water, electricity and recyclable by-products

Features	**Advantages**	**Benefits**
Sustainable waste stream	Easy availability/predictable quantities	Reduced handling cost
Uses nasty waste as fuel	Reduces use of other fuels	Solves multiple problems with one solution
Removes feedlot waste from fields	Reduces health/environmental hazards	Cleaner healthier environment
Remove VOC's from buildings	Reduces health/environmental hazards	Reduced compliance cost
Removes transportation of waste	Reduces use of transportation fuels	Healthier neighborhoods/less stress, cost
Reduces cost of handling	Reduced feedlot cost	Good economics
Creates green electricity/steam/heat	Electricity, steam, and heat to hospital	Good economics
Creates co-products	Sale of co-products	Good economics
Advances use of hydrogen	Positioning as renewable fuel supplier	Very good economics
Advances uses of fuel cells	Adds to momentum of fuel cell development	Quickens route to market for consumers
Fuel cell electricity as premium power	Premium Power is uninterruptible power	Relative immunity from blackouts
Scalable to all feedlots	Space is available	Low cost of land
California approved technology	Easy permitting, with fuel cells exempt from air regulations.	Technology highly favored by environmental groups