Making Integrated Food - Energy Systems Work for People and Climate

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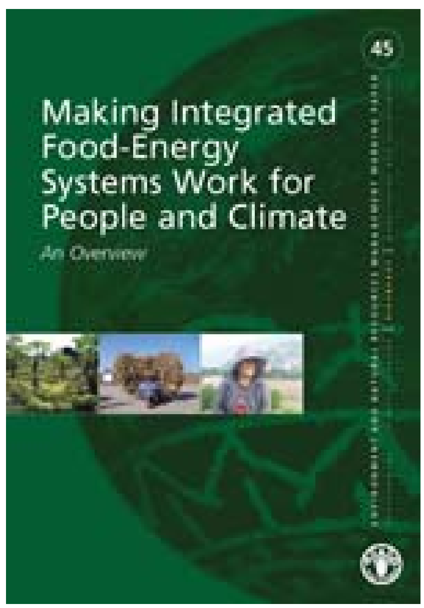


Excerpted by Farmers' Ethanol LLC

The FAO report refers to Farmers' Ethanol as an integrated 'closed loop' bioethanol plant that could be a solution for safely integrating food and energy production (see page 22). The report also includes Farmers' unique process triangle on page 23.

great challenges for adding correspondingly large livestock units to make use of the feed co-products. One solution may be to feed a portion directly to livestock and export the rest. Some have opted for smaller-scale ethanol plants with livestock integrated from the outset, seeking to add value to all the co-products rather than export them. A good example of this is the Canadian company, 'Poundland,' which has been raising cattle next to an ethanol plant since 1970. The cattle feedlots have benefited from the distillers' grains from the corn ethanol plant, which are high in protein. This saves on costs of drying and transporting the product to feedlots further away, which is the standard practice. More than a third of distillers' grains in the USA are fed wet to livestock (Renewable Fuels Association 2008), which signifies that the animals are kept in the vicinity of the ethanol plants.

Whilst there are many examples of the systems outlined above, a small handful of companies have gone further and brought the two together. Biofuel crops are grown with the co-products used for animal feed. The livestock by-products are themselves used for energy (usually AD of manure). In such integrated systems it can be quite difficult to distinguish a main product, as all the processes are intertwined with multiple outputs and recycling. This approach is sometimes called a 'closed loop' system. The following table (Table 1) provides a summary of 'closed loop' bioethanol plants in North America, which typify this approach. The systems are all broadly similar, resulting in the co-production of ethanol and beef or dairy products.

TABLE 1

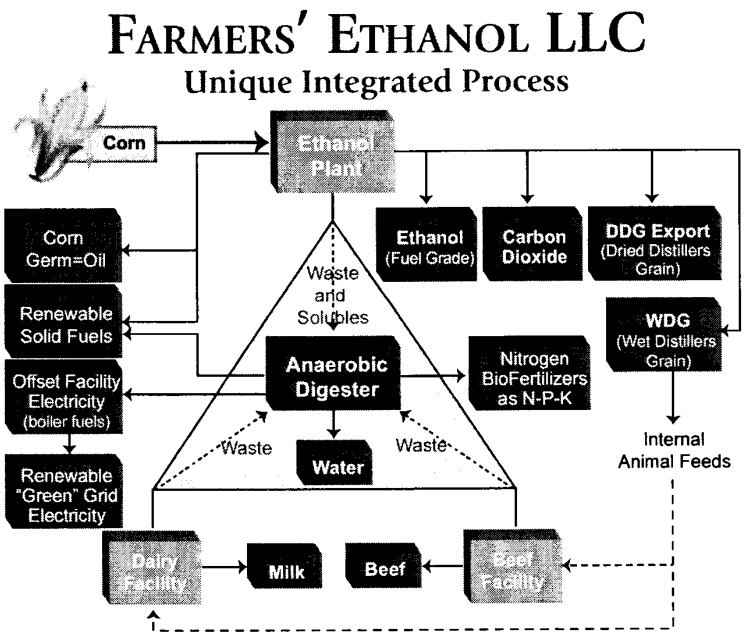
Summary of 'closed loop' bioethanol plants in North America

Name	Location	Litres Ethanol/yr	Head/Livestock	Status
E3 BioFuels	Mead, Nebraska	114 million	30,000 (dairy)	Closed 2007
Panda Ethanol	Hereford, Texas	435 million	Unspecified (beef)	Closed 2009
Bion	New York State	225 million	70,000 (beef)	Planning
Poundmaker	Saskatchewan, Canada	13 million	28,500 (beef)	Operating since 1970
Farmers' Ethanol	Cadiz, Ohio	Unspecified	10,000 (beef) 2,000 (dairy)	Planning / Construction

Each of the companies above has integrated – or plans to integrate – cattle with ethanol production, to make use of the high protein co-product as livestock feed. The two that closed were reported to have struggled mainly with issues not directly related to the 'closed loop' element, but rather engineering or construction problems with the 'standard' part of the plant. With any system, the manure from the cattle can be used in various ways. Some have opted for anaerobic digestion, which is particularly appropriate for dairy slurry, because of its high moisture content. Panda chose gasification and Bion has developed a proprietary wastewater treatment technology to extract energy and nutrients from the manure. In each case, the energy is used in the ethanol plant to process heat, strengthening the synergies between the two operations. Farmers' Ethanol (Figure 1) is a company planning to open several plants utilizing this principle, starting in Cadiz, Ohio. The schematic below gives an overview of their multi-product approach, with anaerobic digestion making up a key element.

FIGURE 1

Farmers' Ethanol, Ohio



Source: Farmer's Ethanol LLC (no date)

Although most plants seek to extract energy from the livestock manure, the exception among our examples is Poundmaker, who simply return the manure to the local farmers' fields and consider the low-cost animal feed alone as sufficient incentive to co-locate the livestock. Although this may appear to be a missed opportunity, the carbon in the manure is not wasted as it replenishes the soil carbon levels. A recent report from Michigan State University illustrates how livestock manure is more effective in this regard than returning crop residues to the soil. Therefore, by integrating livestock with arable cropping, more crop residues can be harvested for bioenergy if desired, rather than ploughing back into the soil to maintain organic matter (Thelen *et al.* 2010).

Anaerobic digestion of manure can be a stand-alone technology, as can any other element of the 'closed loop' systems described: they do not have to all be integrated in one system. However, there are numerous benefits from doing so, both economically and environmentally. A recent study of the potential for Type 2 IFES in the UK listed some of the economic benefits as economies of scale (in livestock production, AD and biogas use), reduced costs of biomass drying and transport, and lower livestock feed costs (Jamieson *et al.* 2010). Environmentally, the energy balance (energy out compared with energy in) has been estimated to be as high as 7.6 to 1 for corn ethanol in a Type 2 IFES, as illustrated in the right hand bar of Figure 2 below, which is approaching that of sugar cane ethanol at 9 and a drastic improvement on 'conventional' corn ethanol of around 1.3 to 1.7.