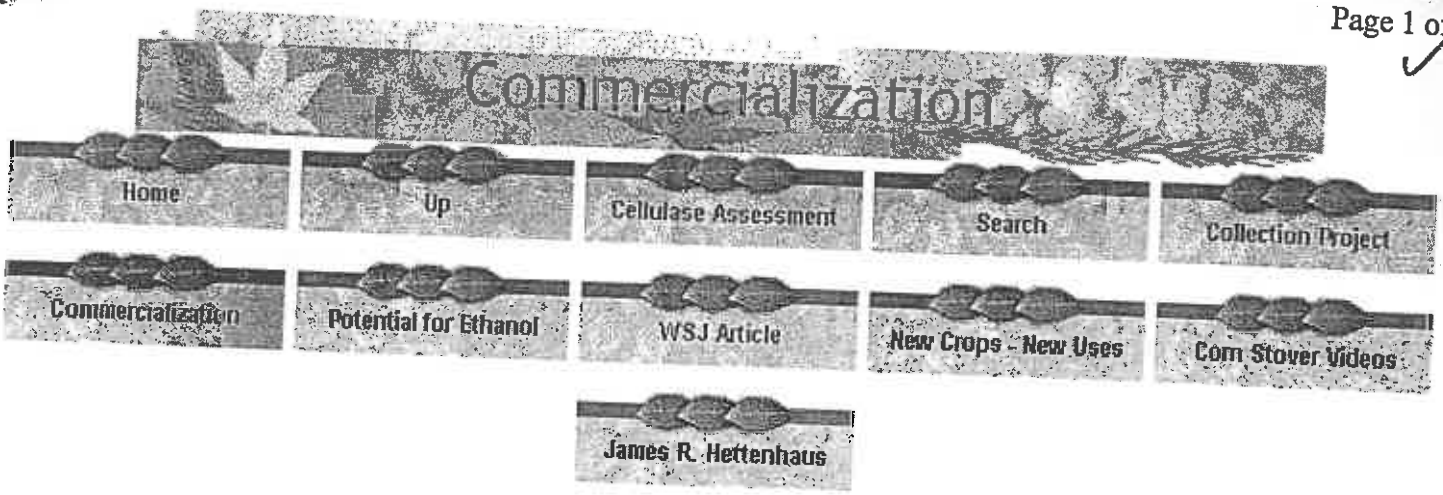

Abstract
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CORN STOVER COMMERCIALIZATION
A Potential Winner.

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Converting corn stover to fiber, sugars and other value added products can be a win-win-win. The farmer can win from sale of the excess stover. The paper, food and chemical processing industries win by expanding the market for fiber, low cost sugars used in fermentation and refined to sweeteners and ethanol. The environment wins from less greenhouse gas (GHG) emissions and improved agricultural practices.

Corn stover consists of the stalks, leaves and cobs remaining after the corn kernels are harvested. About one pound of stover is produced per pound of corn. In addition, its lignocellulosic composition can provide the same amount of sugar as an equivalent amount of corn. The fiber has similar properties as the fiber from hardwood, offering a replacement for paper production. Its lignin contains enough energy to meet the steam and electrical needs of the process. It is by far the largest biomass feedstock in the US. More than 250 million dry tons were produced in the 1997/1998 crop year.

Innovative corn stover harvesting, collection and transportation practices have reduced the cost to $32/dry ton delivered in Western Iowa where collection occurred over a 50 mile radius in the '97 and '98 crop year. Further reductions to less than $30/dry ton are projected.

What is "excess" corn stover varies by region, dependent on soil type, crop rotation, topography and other factors, often including value judgements. In "Powering the Midwest," published by the Union of Concerned Scientists, leaving one ton per acre was estimated to be adequate for erosion control.

If 50% of this "excess" is collected from the Corn Belt -- where the food processing and ethanol industry infrastructure is largely in place – 77 million dry tons results, providing the industry with 30 million tons of cellulose feedstock to produce these products along with an additional 2 to 4 billion gallons of ethanol from the hemicellulose without using any additional cropland. Just 30% of the total stover is used, adding more than $2 billion to

rural farm income at $30/dry ton delivered to the processor.

Collecting the excess stover can be environmentally beneficial. Today, the excess decomposes on the surface with most of the carbon content going to the atmosphere. The National Soil Tilth Lab reports most of the surface material is lost as CO_2. Just 11 to 19% of the carbon in the surface stover contributes to the formation of soil organic matter while roots contribute 32 to 44 % of their carbon to the soil matter.

Excess stover on the surface can cause a major reduction in crop yields, especially on poorly-drained soils and in cooler-than-normal growing seasons due to lower soil temperature in the spring: a detriment to plant germination and emergence. Cold soil temperatures associated with residue coverage are often given as the primary reason for tillage operations. More than 80% of the stover is tilled under to remove surface material.

The benefits of reduced tillage on increasing soil organic matter and reducing erosion have been widely reported. Because of plowing, a carbon deficit can occur in the soil. The plowing activity exposes soil carbon to oxidation, increasing organic carbon loss with the release of CO_2. For example, a recent study reported by the USDA ARS showed no difference in soil carbon when silage and corn were harvested over a 30-year period using identical cultivation practices. Both soils contained the same soil carbon although all the stover was tilled under in the plot where the corn was harvested.

Recent advances in research supported by the DOE are moving the use of stover closer to commercialization, lowering the cost of sugars processed to sweeteners and used in fermentation to less than $4/cwt. The low cost can open new market possibilities.

Previous attempts to pulp corn stover fiber have proven paper quality. Low yields, however, have prevented commercialization. With recombinant fermentation strains now able to ferment the hemicellulose fraction of the stover, a high value co-product opportunity is emerging for the corn fiber to replace a portion of the hardwood pulp.

While not expected in Y2000, many envision this scenario to occur within the next three to five years. For all to win depends on accomplishing the sustainable harvest of corn stover in sufficient quantities and attainment of corn stover conversion technology targets.

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