Model Economic Analyses:[*]
An Economic Impact Assessment of an Ethanol Production Facility in Iowa

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This report assesses the regional economic effects that should accrue to Hoover County, Iowa, from the construction and operation of an ethanol processing plant located on the edge of Herbert, the largest city in the county. This project is a joint venture involving a local cooperative, the local rural electricity utility company, local financial institutions, a group of area investors, and an unspecified number of investors from outside of the region.

Ethanol Basics

Ethanol production in Iowa and in the United States has grown markedly in recent years. Ethanol (grain alcohol or ethyl alcohol) can be made from a variety of grains and biomass materials, but a very large fraction is made from corn. Ethanol was first considered as a fuel additive after lead-based additives were banned in the 1970s. This led to the mixing of a 10 percent solution of ethanol per gallon of automobile fuel as, primarily, an octane booster to help engines run better. In 1990, amendments to the Clean Air Act mandated the sale of additives to fuels that helped them to burn more cleanly, especially in areas that had poor air quality. Ethanol was one of the additives that was approved for use, and this new legislation gave the industry a major production boost. As most corn is produced in the Midwest, ethanol production is also centered in the Midwest states. The preponderance of existing ethanol plants in the U.S. are found in Minnesota, Iowa, Nebraska, and Illinois. Illinois, by virtue of housing a very large facility in Decatur, historically led production in the U.S. Most of the new plants coming on line in recent years are found in Iowa, South Dakota, and Nebraska.

There is a major factor contributing to most of the recent growth in ethanol production facilities in the Midwest. The U.S. EPA has banned the use of MTBE, a popular fuel additive derived from petroleum refining, because it was found in groundwater and it is carcinogenic. This was the major fuel additive used in places in the U.S. that did not have ready access to the ethanol production markets. Notably California and the populous New England states will have to blend other smog-reducing additives. The general consensus, is that Midwest states producers are in a good position to meet west-coast demand for oxygenated fuel additives. Accordingly, Iowa, the largest producer of corn is a logical place for more ethanol facility production.

There are other incentives to invest in ethanol production, as well. In many Midwestern states there are state programs and tax incentives to stimulate

[*] These are real assessments using real, firm level data and hypothetical Iowa non-metropolitan county.

production, distribution, and the demand for blended fuels. There are also substantial federal credits that accrue to both the producers and the blenders of ethanol fuels. Farmers believe that continued demand for ethanol helps to boost corn prices. Regional economic developers believe that ethanol production helps locally two ways, as a direct producer of jobs, and as a locally produced substitute for, primarily, foreign fuel imports.

The Facility

The new facility will be located in the city of Herbert, the Hoover County seat. The facility will cost $52.25 million to construct, and it will be in operation by the end of 2003. This is a wet milling processing plant capable of producing either ethanol or, if the market demands, high fructose corn sweetener. Its nameplate capacity is 41 million gallons annually. The joint venture has received a number of local and state incentives to stimulate construction and production, to include a $1.5 million tax abatement on local property taxes, assistance for access roadways and approaches under the R.I.S.E. (Revise Iowa's Sound Economy) program administered by the Iowa Department of Transportation, a forgivable loan from the Iowa Department of Economic Development under the Economic Development Set-Aside Program, along with an extension of water lines and waste water sewerage by the city of Herbert. At the outset it is clear that there is considerable specifically-dedicated state and local investment in this facility.

Table 1 describes the direct characteristics of the new plant. The expected gross sales in the first full year of operation are $57.05 million. Ethanol production will account for $47.05 million of the sales, and byproducts (mostly feed gluten) will make up the other $10.0 million. The facility will need 15.25 million bushels of corn annually. Hoover County farmers already produce 17.8 million bushels of corn, so this facility has the capacity to consume a majority of all corn production in the county.

Table 1. Direct Data for the Ethanol Plant

Industrial Output (Gross Sales)	57,050,000
Ethanol (@ $1.13 a gallon)	47,050,000
Byproducts	10,000,000
Bushels of Corn Used	15,250,000
Major Expenditures	
Corn	34,312,500
Natural Gas	5,312,500
Electricity	1,237,500
Payroll	1,493,750
Total Jobs	35
Earnings Per Job	42,679

The plant also has some major expenses. At current prices, it will buy $34.3 million in corn, $5.3 million in natural gas, and $1.24 million in electricity. It's payroll

costs, including all cash like benefits, will be $1.494 million, which averages to $42,679 per each of the 35 workers that the plant is expected to require.

There are no other plants of this sort in Hoover County. There are already very well established grain transportation and grain warehousing infrastructure capacities upon which the plant can rely. The plant has been placed adjacent to an existing rail line, and the regional trucking capacity is adequate to meet the needs of the plant. The regional capacity for grain storage is extensive, both on farm and off farm. Though the region produces 17.4 million bushels of corn annually, the total corn production capacity within a 45 mile radius of the plant is 87 million bushels. This level of annual production capacity plus the amount of stored grain in the region leads us to conclude that though the plant will be a major purchaser of regional grain, it will have competition from other purchasers for other uses. Nearly all of the grain produced in the region is either fed to animals or exported. This plant will likely cause some short-term price increases in corn regionally (due nearly solely to lowered transport costs), which may have a negative effect on those feeding corn to animals. That impact will be offset somewhat, however, by the availability of production byproducts, the feed gluten that can be blended and substituted for traditional feeds. Higher prices for corn might also lead to an increase in corn production and lower soybean production, thereby increasing the corn supply and, over time, reducing the prices received by corn producers locally.

Interpreting Economic Impact Information

This is a new plant that will bring a new level of manufacturing productivity to the region. Iowa is a large consumer of ethanol fuel blends, but we are assuming that this productivity will yield net exports of ethanol from the region and from the state. In a case like this, where new productivity is generating export activity, we are safe in concluding that the plant will have an *economic impact* in the region. We need to limit the overall economic impact, however, to the productivity of the plant and any nominal effects it might have on regional corn supply. As the region is already in full and efficient production of agricultural products, we cannot assume that there will be significant change in the corn supply regionally – those critical inputs are simply being diverted to this particular market. We can assume, however, that the new plant may lead to greater efficiencies in existing transportation, grain storage, and in utilities as these are capital-intensive industries whose average cists decrease as capacity utilization is approached.

Economic impact estimates are compiled with the aid of an Input-Output (I-O) model of the Hoover County economy. An I-O model is a sophisticated accounting of inter-industrial transactions in a region of scrutiny that tracks the flow of commodities and services into industrial inputs, into household consumption, or as exports to domestic and foreign purchasers.

There are several important pieces of economic information that are produced by our I-O modeling process. The first is *industrial output,* which is simply the gross sales of the new plant. The second is *employment or jobs*. The modeling system looks at the number of jobs or positions in an industry, not the number of employed persons. As people can hold more than one job, there are necessarily more jobs in an economy than employed persons. The third important piece of data

is *value added*. Value added is the sum of all wage and salary payments that are made to workers, plus the normal profits accruing to sole proprietors, plus payments made to investors in the forms of dividends, interests, or rents, and indirect excise, and, finally, the sales and excise tax payments made by individuals to governments. The fourth piece of data is *labor income*. Labor income is a subset of value added and consists of all payments to workers and profits to sole proprietors. Labor income is particularly important because it represents the amount of value added that is highly likely to be retained in the regional economy.

When we produce our tables of findings, they will also display three important dimensions of the economic activity just listed. The data discerned are the *direct values*. These are the economic attributes attributable just to the firm that we are measuring – the ethanol plant. The next are the *indirect values*. Indirect values are the inputs to production that the direct firm, the ethanol plant, purchases from the regional economy. We listed some of the major inputs (corn, natural gas, and electricity) in Table 1. This is just a small fraction of the inputs that are required. The plant will make transportation, maintenance, accounting and financial, business services, legal, wholesale, and other purchases from regional suppliers. The more purchases that the plant makes locally, the higher the potential economic impact the firm might have on the local economy. The last set of data are the *induced values*. Induced effects are also called the household effects. They happen when the workers in the direct industry, the ethanol plant, and the firms that are supplying goods and services to the plant, the indirect industries, take their labor income and spend it on household goods and services locally. When we add the direct, indirect, and the induced effects together, we get a count of the *total economic values* in the county that are potentially attributable to the firm in question.

The Economic Impacts

This analysis differs significantly from many input-output analyses of ethanol in Iowa and in the Midwest. Agricultural value added examples require us to modify our input-output modeling approach to reflect the fact that the industry, in this case an ethanol plant, does not cause a change in the regional supply of corn production. Stated differently, the plant does not stimulate "up-stream" inputs – those inputs were already being produced. The plant merely processes those already produced inputs into a more valuable product.

There are economic impact summaries of ethanol plants that allow the plant to *cause* corn production, and in iterative fashion, to further stimulate inputs into corn production, as well. This results in tremendously bloated economic impact conclusions that are highly misleading.[*] This analysis removes the corn production

[*] One notable example occasionally cited by industry proponents was produced by John Urbanchuck, AUS Consultants, and Jeff Kapell, SJH & Company in their report "Ethanol and the Local Community." June 21, 2002. In that report they indicated that the ethanol plant that they were studying would create 41 jobs. They went on to note, "as the dollars expended for goods and services in the local economy are spent and respent thereby creating new final demand for local business, an estimated 694 additional new permanent jobs will be created in all other sectors of the economy as a result of the ethanol plant (p 4)."

This implies that there is an effective jobs multiplier of 17, meaning every job in an ethanol plant produces 16 other jobs in the regional economy. The economy does not produce results like that in any instance in any industry.

that was already being produced from the assessment in order to arrive at a more realistic assessment of the net increment to regional economic activity caused by the plant.[**]

A summary of the economic impacts is found in Table 2. As was already demonstrated in Table 1, the plant's direct data consist of $57.05 million in sales or industrial output, $1.5 million in labor income, and 35 jobs. This plant is expected to generate $7.3 million in total value added. As labor income is a subset of value added, a very large fraction of the value added that is generated in this plant will accrue to investors. In producing $57.05 million in direct output, the plant will require $7.72 million in locally supplied (non-corn) inputs, which will in turn require 77 workers earning $2.3 million. When the direct and the indirect workers convert their labor income into household spending, they will induce an additional $1.4 million in additional sales in the county. This will require 23.5 jobs earning $398,565. In all, when we add all of the impacts together, the ethanol plant will directly or indirectly contribute to $66.2 million in total regional industrial output, $11.84 million in value added, $4.2 million in labor income, and 135 jobs.

Table 2. Summary of Economic Impacts

Totals	Direct	Indirect	Induced	Total	Total Multiplier
Industrial Output	57,050,000	7,716,938	1,401,509	66,168,449	1.16
Value Added	7,279,280	3,701,104	860,010	11,840,394	1.63
Labor Income	1,493,750	2,295,047	398,565	4,187,362	2.80
Jobs	35.0	76.9	23.5	135.4	3.87

The last column in Table 2 contains the total multipliers for each category. A total multiplier is merely the ratio obtained by dividing the total value by the direct value. It tells how much the whole economy reacts to a unit change in the direct value. The multiplier of 1.16 for industrial output says that for every $1 of direct industrial output, $.16 in additional industrial output has been generated in the remaining (non-agricultural) economy. The multiplier of 1.63 for value added means that for every $1 of value added generated in the plant, $.63 in value added is sustained in the rest of the economy. In contrast, the labor income and the jobs multipliers are quite high. The labor income multiplier is 2.80. That means that for every dollar's worth of labor income paid in the ethanol plant, $1.80 in labor income is generated in the rest of the economy. The key to interpreting this high statistic is found in the indirect labor income. That value is $800,000 greater than the direct value. This plant, our analysis indicated, requires inputs that pay significantly higher labor incomes in the aggregate than the plant itself. This is an example of where we would look to the value of inputs supplied as a measure of the worth of a new firm, perhaps more so than the direct values. The jobs multiplier is even higher at 3.87.

[**] The same problem accrues to input-output analysts when assessing the localized economic impacts of a new beef or swine processing facility. The facility in and of itself is probably locating in a region because there already exists an efficient and adequate supply of inputs (hogs or cattle). The plant, per se, does not cause cattle or swine production, and, iteratively, it does not in turn cause the growth of corn and other feed-stocks for those animals. In assessing a packing plant, prudent analysts "disconnect" the linkage to the animal production sectors so as to not distort the findings and mislead policymakers and citizens.

That means that for every job in the ethanol plant 2.87 jobs are sustained in the rest of the economy. This multiplier is comparatively high because the labor needs of the plant are so sparse. Plants of this kind are very capital intensive, so they require comparatively few workers. As was the case with the labor income explanation, we see that there are over twice as many indirect jobs as direct jobs. Both the indirect and the direct jobs pay comparatively high salaries, so the induced job numbers, those caused by household spending, are also robust.

Additional Interpretation and Cautions

The reader will recall that this plant will annually purchase $34.3 million in corn from regional suppliers. In this exercise, as the region was already producing as much corn as it could, we did not let the plant *cause* additional corn production. We allowed for only a small increase in corn production and the total value of corn output regionally. Stated differently, from just corn production, we only allowed gross industrial output in the corn production sector to increase by $1.88 million as a direct result of the plant locating in the area. We offset nominal feed grain price increases by an increase in feed substitutes (ethanol byproducts), and we did not let any other portion of the agricultural sector be indirectly influenced by the plant. As we originally declared an economic impact for this assessment, we had to be wary of overstating the effects that might accrue to commodity suppliers in the region. Prior to the plant locating in the region, nearly 80 percent of grain produced in Hoover county was exported, the remainder was fed to animals. Area farmers will realize only a small price differential by diverting their sales to the plant versus other uses.

The reader will also have noticed that the amount of value added that is generated in the plant is $7.3 million, according to the model. After payments to workers are made in the amount of $1.5 million, the vast majority of the remaining $5.8 million represents payments to investors of all kinds. These payments will accrue to equity investors. Because this is a cooperatively owned enterprise that has also allowed regional “stakeholders” like local banks, utilities, and others to invest in the plant, then comparatively large fractions of the value added that is generated will remain in the local community. Some of these payments will be converted to household income and some will be made available for additional investment, although there is no assurance that retained value added is reinvested locally.

The 35 jobs that are required to run this plant are skilled professions. There will be engineer-grade workers that will necessarily relocate to operate this facility. All other workers will be highly skilled, a significant portion of whom will likely relocate from other facilities in the. In all, it is not likely a majority of the workers at this plant will by hired from the local labor supply, as local workers are highly unlikely to possess the skills necessary to run the plant. Accordingly, the direct job impacts should yield population growth for the community of Herbert and the county of Hoover.

There are additional considerations. If the regional economy has surplus capacity or slack in its input-supplying and its household-supplying sectors, then we would not expect to realize the full indirect and induced values in either labor income or in jobs. Consequently, the multipliers may be too robust. Were that the case, we

would expect the value added (discounting for the difference in real labor income gains) to be smaller also.

The last risk to this estimation involves factors beyond the control of the local economy. This plant has been constructed with the supposition that there will be predictable and persistent increases in the demand for oxygenated fuel blends like ethanol. This plant has hedged its bet by building in the capacity to produce corn sweeteners, though the capacity for growth in that area is limited.

There are emerging technologies that may hinder growth in the demand for ethanol from corn in the longer run. The first is that less-expensive dry milling operations are beginning to realize margins that meet or exceed traditional wet-milling or distilling operations. The second is that there have been strong advances in research that foretell the production of ethanol from other kinds of biomass including field waste, wood pulp, and from commercial grass operations. As the cost differences converge, it could be the case that Western states may invest in indigenous ethanol production plants rather than relying on ethanol produced in the Midwest. The final risk to this enterprise is political: Exemptions, exceptions, and compliance with EPA rules for air quality and for the use of oxygenated fuels are still being hammered out, and are always subject to change.

A final consideration: this plant and the production of ethanol in general depends greatly on a mixture of federal, state, and even local government incentives. These incentives are applied to production, distribution, and at the pump level. Consequently, traditional market factors have been obscured. Value-added accruing to investors is highly dependent on subsidies, which in and of themselves are dependent on consistency in current public policy supporting ethanol. This analysis does not attempt to off-set the general effects of massive federal and state subsidization of ethanol production in Iowa or the U.S.

Appendix: One Digit Industrial Summary Tables

Industrial Output	Direct	Indirect	Induced	Total
Agriculture	-	2,036,620	23,057	2,059,677
Mining	-	36	2	38
Construction	-	462,268	22,892	485,161
Manufacturing	-	321,050	70,882	391,931
Ethanol	57,050,000	9,496	190	57,059,688
Trans., Comm., and Public Util.	-	1,057,745	51,950	1,109,695
Trade	-	1,952,074	391,747	2,343,821
Finance, Ins., & Real Est.	-	514,085	415,048	929,134
Services	-	578,180	376,336	954,516
Government	-	785,384	47,594	832,978
Other	-	-	1,811	1,811
Instutitions	-	-	-	-
	57,050,000	7,716,938	1,401,509	66,168,449

Value Added	Direct	Indirect	Induced	Total
Agriculture	-	545,788	6,053	551,841
Mining	-	22	1	23
Construction	-	307,173	10,845	318,018
Manufacturing	-	209,272	16,680	225,952
Ethanol	7,279,280	1,278	26	7,280,584
Trans., Comm., and Public Util.	-	355,994	21,996	377,990
Trade	-	1,328,660	274,563	1,603,223
Finance, Ins., & Real Est.	-	339,353	298,169	637,522
Services	-	318,093	209,731	527,824
Government	-	295,470	20,158	315,628
Other	-	-	1,789	1,789
Instutitions	-	-	-	-
	7,279,280	3,701,104	860,010	11,840,394

Labor Income	Direct	Indirect	Induced	Total
Agriculture	-	331,643	3,665	335,308
Mining	-	13	1	14
Construction	-	281,051	8,842	289,893
Manufacturing	-	162,269	10,998	173,267
Ethanol	1,493,750	314	5	1,494,069
Trans., Comm., and Public Util.	-	214,858	10,822	225,680
Trade	-	807,181	155,604	962,785
Finance, Ins., & Real Est.	-	108,185	33,414	141,599
Services	-	235,759	161,436	397,195
Government	-	153,774	12,156	165,930
Other	-	-	1,620	1,620
Instutitions	-	-	-	-
	1,493,750	2,295,047	398,565	4,187,362

Jobs	Direct	Indirect	Induced	Total
Agriculture	-	13.7	0.3	14.0
Mining	-	-	-	-
Construction	-	8.5	0.3	8.8
Manufacturing	-	4.4	0.5	4.8
Ethanol	35.0	-	-	35.0
Trans., Comm., and Public Util.	-	6.2	0.3	6.5
Trade	-	24.9	11.4	36.2
Finance, Ins., & Real Est.	-	3.9	1.4	5.3
Services	-	11.9	8.7	20.6
Government	-	3.6	0.3	3.9
Other	-	-	0.2	0.2
Instutitions	-	-	-	-
	35.0	76.9	23.5	135.4