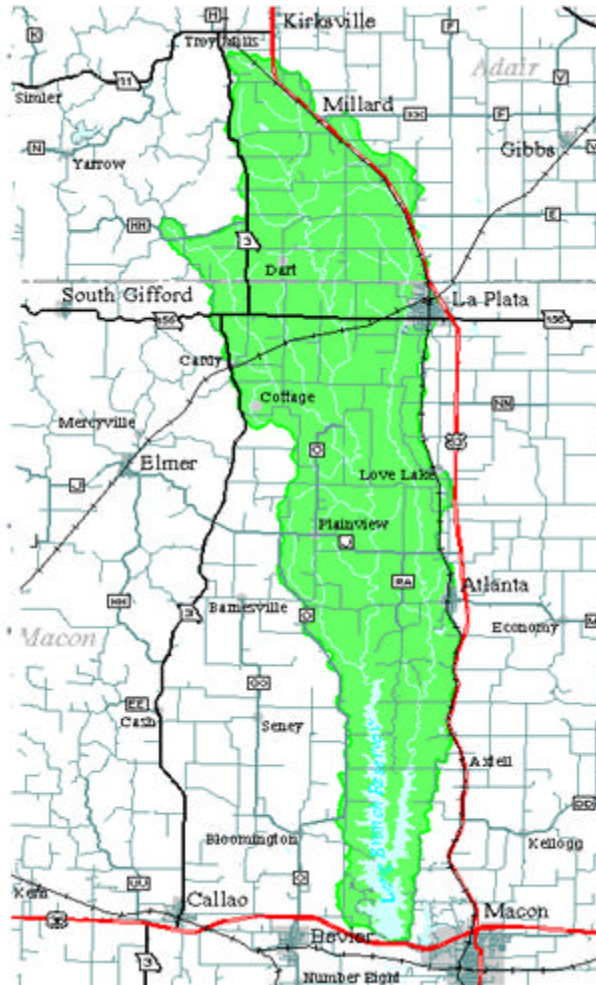


The Economic Impacts of Doubling the Capacity of the Macon County Ethanol Plant



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by

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In Connection with the Long Branch Watershed
Assessment Project

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Community Policy Analysis Center
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Table of Contents

	<u>Page</u>
Acknowledgements	1
Executive Summary	2
Introduction	3
Study Description.....	5
Results	8
Conclusion	14
Appendix	15
References	17

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Executive Summary

This report projects the economic impacts on Macon and Adair Counties from the operation of the Macon ethanol plant with doubled capacity – an increase in capacity of 100%. The IMPLAN input-output model is used to project employment, total output, labor income and value added impacts. The Show Me model is used to project broader changes such as labor force, commuting patterns, total personal income and tax revenues over time. These models show a modest to small impact from the operation of the increased capacity plant with the majority of benefits going to Macon County.

Key Findings

- It is projected that there will be an increase of 102 jobs to Macon County per year.
- It is projected that there will be an increase of 12 jobs to Adair County per year.
- It is projected that there will be an increase of \$34 million in annual total output to Macon County.
- It is projected that there will be an increase of \$900 thousand in annual total output to Adair County.
- The labor force is projected to increase by 1.4% in Macon County and 0.1% in Adair County over the 2003-2010 period from the operation of the increased capacity plant.
- Total personal income is projected to increase by 1.2% in Macon County and 0.2% in Adair County over the 2003-2010 period from the operation of the increased capacity plant.

Introduction

Previous studies have analyzed the economic impacts of ethanol plants in Missouri. Van Dyne (2002) reports the impact of two ethanol plants currently operating in Missouri, the Northeast Missouri Grain, LLC (NEMO Grain) and the Golden Triangle Energy, LLC plants. The Van Dyne (2002) study includes impacts from the construction and operation of the ethanol plants on 8 counties in the region. This study reports the projected impacts from the operation of the Northeast Missouri Grain, LLC plant on Macon and Adair counties and the impact of increasing the capacity of the plant by 100%. It must be noted the results reported here do not include the benefits from the construction of the original or the increased capacity plants only their operation.

The approach followed in this report is similar to Van Dyne (2002) utilizing the input-output model IMPLAN to produce employment, labor income, value added and total output impacts. However, a further step is taken by using data from IMPLAN in the Macon and Adair Show Me models to investigate the impact on broader social variables, such as labor force, total personal income, commuting patterns and tax revenues. A more detailed description of the IMPLAN and Show Me models are provided in the appendix of this report.

The NEMO Grain ethanol plant is located three miles east of the town of Macon, Missouri, in Macon County. Therefore, all impacts start there. The IMPLAN model is first adapted for impacts on Macon County, and then it is extended to a two-county model (Macon and Adair) to project the impacts on Adair County. The capacity of the plant is also an important factor. The IMPLAN model was first adopted to project the impacts of the original size plant. These projections were then used to estimate the impact of the increased capacity plant on Macon and Adair Counties.

The Northeast Missouri Grain, LLC Ethanol Plant

The NEMO Grain ethanol plant currently operates a 22 million gallon per year ethanol facility employing 31 full time employees and using 8,000,000 bushels of corn. As of October 2002, NEMO Grain is in the process of increasing the capacity of the plant to produce approximately 44 million gallons of ethanol per year (Burnett 2002). This study projects important economic impacts from the operation of this new capacity plant.

Along with increasing the capacity of the plant, NEMO Grain has also entered into a contract with a marketing company, Ethanol Products CO₂, to sell the CO₂ generated in the ethanol production process. NEMO Grain has also entered into a joint venture with the City of Macon to recover waste heat from the ethanol production process (Burnett 2002). In addition, NEMO Grain will use the steam from electricity generation in their ethanol production process. These two changes are also taken into consideration in the impacts projected in this study. With these assumptions and the doubling of the capacity of the plant, NEMO Grain's annual revenues could be upwards of \$51 million.

Study Description

Key assumptions for this study include the prices of ethanol and co-products, the total employment and payroll at the new plant, the increase in corn prices and the amount of corn sold and produced by local farmers. Ethanol co-products include dried distillers grains and solubles (DDGS), CO₂ and electricity produced for the city of Macon. Van Dyne (2002) reports that the employment would increase by approximately 3-8 employees. Therefore, the number of employees is assumed to increase from 31 with the original sized plant to 36 with the new plant.

Regarding corn prices, Matt Gerhold (NEMO Grain Crop Production Manager) estimates the impact of the original plant on the price of corn to be approximately 15 cents per bushel. Macon area farmers supply approximately 957,000 bushels or 12% of NEMO Grain's corn inputs; Adair County supplies 268,000 bushels or approximately 3.35% of NEMO Grain's input needs. These estimates are included as benefits of the original sized ethanol plant. However, it is assumed that farmers only benefit from an increase of 15 cents per bushel not from an increase in corn production. It is assumed that farmers do not increase their production of corn because land is fixed. Johnson (1995) made a similar assumption in a study on the impacts of a biodiesel plant. In reality, there may be an increase in corn production from substitution away from other crops, however this increase in production is likely to be small.

To determine the benefits of the increased capacity plant, to be conservative, it was assumed that farmers would not receive another increase of 15 cents per bushel nor would they increase the amount of corn they produced to sell to the ethanol plant. Thus, it is assumed for the increased capacity plant, that all corn that can be provided by local farmers already is provided to the original sized plant. New corn inputs are expected to come from outside the region. Table 1 reports the key assumptions used in IMPLAN to project the impact of the original plant on Macon and Adair Counties. In IMPLAN, two models were used, one with Macon County data and the other including both Macon and Adair Counties.

**Table 1: Key Assumptions for the Original Plant
Entered into the IMPLAN model**

Area	Macon & Macon/Adair Counties
Employment	31
Annual Payroll	\$1,135,000
Annual Sales	22million gallons ethanol @ \$0.85/gallon 60 thousand tons DDGS @ \$80/ton 32 thousand tons CO ₂ @ \$30/ton Steam from electricity generation savings – \$400,000
Total sales	\$25.5million

Current employment at the plant is 31 people with annual payroll of \$1,135,000. Total annual sales include \$22 million gallons of ethanol at \$0.85 gallon. The plant also produces 60 thousand tons of DDGS that is sold at approximately \$80 per ton. The plant produces approximately 32 thousand tons of CO₂ that is not currently sold; however, it could generate income of approximately \$30 per ton (Burnett 2002). These sales combined with the savings generated from the steam imply potential annual sales of approximately \$25.5 million. These are the assumptions that are used in the IMPLAN model.

For the increased capacity plant, it is assumed that employment will increase by 5 persons and the payroll will increase by approximately \$183,000 (five times the average salary at the original plant). The sales of ethanol and the co-products are essentially doubled for the new plant. These assumptions are reported in Table 2.

Table 2: Key Assumptions for the Increased Capacity plant

Area	Macon & Macon/Adair Counties
Employment	36
Annual Payroll	\$1,318,065
Annual Sales	44million gallons ethanol @ \$0.85/gallon 120 thousand tons DDGS @ \$80/ton 64 thousand tons CO ₂ @ \$30/ton Steam from electricity generation savings – \$400,000
Total Annual Sales	Approximately \$51million

The assumptions for the original and increased capacity plants represent conservative, but realistic assumptions. Van Dyne (2002) reports a price of ethanol of \$1.00-\$1.65 per gallon and \$80 per ton of DDGS, but ignores the possibility of using steam in the production process since this did not seem as much of a reality at the time that report was prepared. The price of ethanol of \$0.85 per gallon represents a more realistic assumption given the price of current sales (Gerhold 2002). Van Dyne (2002) also analyzes a scenario where the CO₂ produced is

sold, however he does not report expected prices. Burnett (2002) estimates that the price of CO₂ could range from \$30-75 per ton and the cost savings from using the steam in the range of \$337,000 to \$472,000.

The assumptions reported in Table 1 were used in the IMPLAN model, which generated employment, income, value added and total output impacts for two scenarios Macon and Macon and Adair for the impact of the original plant. This projection was then used to estimate the impacts for an increased capacity plant. Employment and income results from the increased capacity plant were then used as a scenario in the Macon and Adair Show Me models.

Compared to the Show Me Model, IMPLAN is limited in the results it produces. IMPLAN provides static projections of mainly economic variables such as employment, labor income, value added, and total output. The Show Me model provides projections for broader variables such as labor force, commuting tendencies, total personal income and tax revenues over time. Therefore, the Show Me model can be used to show more detail in the distribution of the benefits of the ethanol plant expansion. Further, the Show Me model allows for more of a comparison, between counties and for the same county over time.

Results

This section will report the results from both the IMPLAN and Show Me models. The results reported from the IMPLAN model are for two areas, Macon County and Adair County and two sizes of plants, the original size and the increased capacity plant. The Adair County results were calculated by subtracting the Macon IMPLAN model results from the Macon/Adair IMPLAN model results. The Show Me model results are also reported for the impact of the increased capacity plant on Macon and Adair counties. The gross results from IMPLAN for Macon County and the original sized plant are reported in Table 3 and the results net of crop production increases are reported in Table 6.

Table 3: IMPLAN Gross Results for the Original Plant – Macon County				
Impact	Direct	Indirect	Induced	Total
Employment (persons)	31	297	34.5	362.6
	Millions of Dollars			
Labor Income	1.135	4.664	0.449	6.299
Value Added	1.135	8.929	0.945	11.009
Total Output	25.5	16.877	1.529	43.907

The impact of the plant calculated by IMPLAN reported in Table 3 included the benefits from increased corn production. The IMPLAN model calculates an increase in corn production in response to the ethanol plant with land as a flexible input (Table 4). To find the net impact of the plant the crop increase impact is subtracted from the results in Table 3 while the increase in income from the 15 cents a bushel is added in (Table 5). In reality, there may be a small benefit from increased corn production. Therefore, if anything the net results in Table 6 are understated.

Table 4: IMPLAN Results Increased Crop for the Original Plant – Macon County				
Impact	Direct	Indirect	Induced	Total
Employment (persons)	196	20.8	18.2	235.6
Millions of Dollars				
Labor Income	2.498	0.31	0.263	3.071
Value Added	5.4	0.576	0.498	6.474
Total Output	7.765	0.947	0.804	9.517

Table 5: IMPLAN Results Increased Income for the Original Plan – Macon County				
Impact	Direct	Indirect	Induced	Total
Employment (persons)	1.1	0.1	0.1	1.3
Millions of Dollars				
Labor Income	0.015	0.003	0.002	0.035
Value Added	0.015	0.002	0.001	0.019
Total Output	0.143	0.006	0.004	0.154

In calculating the numbers reported in Table 6, first, the gross effect was calculated from IMPLAN (Table 3). This indicated a total output impact of \$7.765 million on the crop sector. Second, the impact of increased crop production was calculated by IMPLAN (Table 4). Increasing the crop sector by \$7.765 million generated the Table 4 impacts. Table 4 was subtracted from Table 3 since land is assumed fixed. Finally the impact of the 15 cents a bushel times by the number of bushels delivered was estimated by IMPLAN (Table 5). This impact was added back in, to represent the increase in the price of corn. These calculations result in the impact of the operation of the original plant on Macon County reported in Table 6.

Table 6: IMPLAN Net Results for the Original Plant – Macon County				
Impact	Direct	Indirect	Induced	Total
Employment (persons)	31	80.8	16.4	128.3
Millions of Dollars				
Labor Income	1.135	1.888	0.238	3.263
Value Added	1.135	2.97	0.448	4.554
Total Output	25.5	8.314	0.729	34.544

The impacts from the operation of the original sized plant with the sales of ethanol, CO₂, DDGS and the use of steam are an increase of 128.3 jobs per year, \$3.2 million in annual labor income, \$4.5 in annual value added and \$34.5 million in annual total output to Macon county. Van Dyne (2002) reports an annual total output increase of almost \$173 million for the operation of two ethanol plants in Missouri in an eight county model.

The annual impacts on Macon County from the operation of the 44 million gallon per year (an increased capacity plant) plant were a total impact of 230.6 jobs, \$6.2 million in income, \$9 million in value added to the region and an increase of total output of \$68.9 million dollars (Table 7). These results reflect the fact that no increase in income from the price of corn is added to the gross impact under the assumption of fixed land area. These results are the impact of the increased capacity plant on the economy of Macon County, but also reflect impacts from the original sized plant. Data entered into the Show Me model should only represent the impact of doubling the capacity of the plant, thus the impact of the original sized plant was subtracted.

Table 7: IMPLAN Results for the Increased Capacity Plant – Macon County				
Impact	Direct	Indirect	Induced	Total
Employment (persons)	36	161.6	32.8	230.6
Millions of Dollars				
Labor Income	1.318	3.773	0.474	6.491
Value Added	1.318	5.938	0.895	9.089
Total Output	51	16.622	1.454	68.934

Results for Adair County, for the original plant are 12.4 jobs per year, \$0.46 million in annual labor income, \$0.68 million in annual value added and \$0.96 million in annual total output (Table 8). There is 0 direct impact since the plant is located in Macon County. To generate the results for Adair County, similar calculations for crop production and income were calculated and subtracted or added in. Further, to generate the impact on Adair County alone the results from the Macon County model were subtracted from the Macon/Adair County model for the original plant.

Table 8: IMPLAN Results for the Original Plant – Adair County

Impact	Direct	Indirect	Induced	Total
Employment (persons)	0	2.6	10.6	12.4
Millions of Dollars				
Labor Income	0	0.234	0.236	0.469
Value Added	0	0.359	0.323	0.68
Total Output	0	.426	0.54	0.966

Impacts for Adair County from increased capacity plant are 24.8 jobs, \$0.929 million in labor income per year, \$1.308 million in value added per year and \$1.872 million in total annual output (Table 9). These results also reflect the impact of the original plant on Adair County. Thus, the impact of the original plant must be subtracted for the Show Me Model.

Table 9: IMPLAN Results for the Increased Capacity Plant – Adair County

Impact	Direct	Indirect	Induced	Total
Employment (persons)	0	5.2	21.2	24.8
Millions of Dollars				
Labor Income	0	0.466	0.496	0.929
Value Added	0	0.713	0.638	1.308
Total Output	0	0.843	1.069	1.872

The results from the IMPLAN models project the impact of doubling the capacity of the original plant to be an increase in jobs of 102.3 in Macon County per year and 12.4 in Adair County; annual labor income by \$3.22 million in Macon County and \$0.46 million in Adair County; annual value added by \$4.53 million in Macon County and \$0.62 million in Adair County; and annual total output by \$34.39 and \$0.9 million for Macon and Adair counties respectively (Table 10). This shows that the majority of the benefits from doubling the capacity of the plant will accrue to Macon County.

Table 10: IMPLAN Total Net Effect for the Increased Capacity Plant – Macon & Adair Counties		
	Macon	Adair
Employment (persons)	102.3	12.4
	Millions of Dollars	
Labor Income	3.228	0.46
Value Added	4.535	0.628
Total Output	34.39	0.906

The scenario developed for the Macon County Show Me model included the impact from an increase in employment of 102.3 jobs, an increase in the external employment of 12.4 jobs (the increase from Adair County) and an increase in annual total personal income of \$3.228 million. Similarly, the Adair County model scenario included an increase of 12.4 jobs, increase in external employment (the change in Macon) of 102.3 jobs and an increase of \$0.46 million in total annual personal income. These scenarios were entered into the Show Me models in the year 2003 and the reported impacts are those likely to occur by 2010.

The results for the Show Me model indicate small to modest increases for Adair and Macon counties from the operation of an increased capacity ethanol plant in Macon County (Table 11). For Macon County, the impacts are an increase in labor force of 114 people, total annual personal income of \$4.8 million, incommuters of 12 people, outcommuters of 20 people and an increase of \$42 thousand in county sales tax revenues per year. These represent modest increases compared to the baseline since labor force for would increase by 1.4%, total personal income by 1.2%, incommuters by 1.4%, outcommuters by 1.1% and county sales tax revenues by 2.9%. Expectedly, Adair County can expect less significantly less impacts from the operation of the increased capacity plant in Macon County, with only tenths of percentage increases in labor force, total annual personal income, incommuters, outcommuters and yearly county sales tax revenues.

Table 11: The Show Me Model Results – Macon and Adair Counties, 2003-2010

	Macon County		Adair County	
	Change	% Change	Change	% Change
Labor Force (persons)	114	1.4	14	0.1
Total Personal Income (millions of \$)	4.87	1.2	1.1	0.2
Incommuters	13	1.4	3	0.1
Outcommuters	20	1.1	5	0.4
County Sales Tax Revenues (millions of \$)	0.042	2.9	0.479	0.2

Conclusions

Overall, the impacts from doubling the capacity of the ethanol plant in Macon County can be expected to generate small to modest benefits for the region, with the majority of the benefits going to Macon County. Results from the IMPLAN models show that Macon County stands to gain \$34.39 million in total annual output while Adair County only \$900 thousand each year. On the employment side, Macon County can expect to gain 102.3 jobs while Adair County only 12.4. There is a similar distribution of benefits in labor income and value added as well. Macon County can expect an increase in annual labor income of \$3.2 million and annual value added of \$4.5 million; Adair County can only expect yearly increments of \$0.46 and \$0.62 million in labor income and value added, respectively.

Results from the Show Me models indicate that the doubling the capacity of the ethanol plant will also have more of an impact on Macon County over time. For the 2003-2010 period, Macon County can expect an increase in total personal income of 1.2% and Adair County only 0.2%. Labor force impacts reflect a similar result as the Macon County labor force can be expected to increase by 1.4% and Adair County only 0.1%. Commuting patterns reflect that Macon County is likely to experience a 1.4% increase in incommuting while Adair County would see an increase of 0.4% in outcommuting. Macon County outcommuting will increase by 1.1% and Adair County's incommuting will only increase by 0.1%. In terms of annual tax revenues, Macon County can expect to experience a larger impact there as well – Macon County can expect an increase of 2.9% in county sales tax revenue and Adair County only 0.2%.

Input-Output Modeling

Input-output (I/O) modeling was first developed in the late 1930s and has become widely used in regional economics since that time. I/O provides a framework for measuring the linkages among sectors (a term used interchangeable with 'industries') in a region's economy. The model is based on observed economic data for a specific geographical area (e.g. a county or state). Basically, the input-output system keeps track of the flow of goods from each sector to other sectors and the final consumers. The flow of one sector's output to other industries reflects the inter-sectoral linkages in an economy.

With I/O there is a fixed proportion of inputs for each unit of output. Fixed proportions imply there are no substitutions between inputs, regardless of price changes or new technology. In addition, all the firms in a sector are assumed to need the same average mix of inputs. For example, if a sector called "vehicle construction" included firms that produce full-sized trucks and firms that produce golf-carts, I/O assumes the same proportion of inputs, capital, and labor are used in both types of firms. Fixed proportions also signify that small and large producers have the same input mix and efficiency in production. Another assumption is constant returns to scale. That is, in order for output to double, all of the inputs used in production must double. Also, because there are no resource constraints, there is no assumed production capacity.

Impact analysis for PLANning: IMPLAN and the Show Me Model

In the past, to use I/O in a study, significant investments in time and money were needed in order to collect necessary primary and secondary data and to set up the I/O model. Today, there are several pre-packaged I/O models available to researchers that can run on personal computers. One of the more popular models is called Impact analysis for PLANning (IMPLAN). IMPLAN contains comprehensive national data that is used to estimate regional data on a county-by-county basis. This model allows the researcher to specify the geographic region of interest. In addition, the model is relatively easy to modify to include primary or more recent data. It is this flexibility that makes IMPLAN very effective in meeting the needs of various researchers.

IMPLAN is used in the creation of scenarios in conjunction with the Show Me Model. This model is frequently used to generate estimates of total employment and income when a community is interested in knowing the impacts of an economic development event. A change in employment or income has a multiplier effect because of the inter-industry linkages in the

local economy. IMPLAN measures these linkages. The Show Me Model is then used to allocate the estimated changes in employment and income over several years. The fiscal, economic, and demographic projections that are made in a scenario now incorporate the new circumstances. The scenario results, when compared to the baseline, provide valuable information that can be used in local decision-making.

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CPAC scientists work closely with state and local government leaders, local businesses and community groups to provide research and educational programs that will inform key decisions, and assist them in understanding how policy decisions at all levels of government affect their community's quality of life.

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