Southwestern Oklahoma State University
Center for Economic & Business Development
Director: Dr. Marvin Hankins

RESEARCH

# *Economic Impacts of Ag ChemCo*

**Prepared for:**

Ag ChemCo
Oklahoma State Regents for Higher Education

**Prepared by:**

Jon Chiappe
Stephen Nelson

June 2003

SWOSU
Southwestern Oklahoma State University

# CONTENTS

# EXECUTIVE SUMMARY

The Center for Economic & Business Development at Southwestern Oklahoma State University used a REMI model to measure the economic impacts of an Ag ChemCo facility to be located in western Oklahoma. The Ag ChemCo facility would convert native prairie grasses and crop residue, such as wheat straw and sorghum stalks, gathered and transported from within western Oklahoma into commercial grade polymers.

Using data provided from a feasibility study and a representative of Ag ChemCo, the forecasted economic impact results for the proposed biomass facility are shown to not only positively affect western Oklahoma, but also to positively affect the rest of Oklahoma and the state as a whole. Some of the economic impacts shown to positively affect western Oklahoma include employment, population, income, and Gross Regional Product. A bulleted list of some of the economic impacts that the proposed biomass facility to have upon western Oklahoma's economy:

- **Employment** to be 1,335 jobs higher by 2010
- **Population** to be 861 people higher by 2010
- **Disposable Personal Income** to be $26.56 million higher in 2010
- **Gross Regional Product** to be $119.1 million higher in 2010
- **Regional Output** to be $265.7 million higher in 2010

Within the report, each of these variables is also shown to have positive economic impacts, but greater magnitudes, for the state of Oklahoma.

# 1 BACKGROUND

In July of 2002, the Oklahoma State Regents for Higher Education approved a biomass research project to be conducted by the Center for Economic and Business Development (CEBD) at Southwestern Oklahoma State University. The purpose of this project was to determine the feasibility of building a lignocellulosic biomass to commercial grade polymer conversion plant in western Oklahoma. The project was the product of a collaborative effort between the CEBD and Ag ChemCo to analyze what would be necessary to see the 1) cost effective production, collection, and transportation of agricultural feedstock, and 2) agricultural feedstock storage and business systems to deliver it to processors realized. This study is a logical extension the July 2002 project and focuses on what the economic impact such a plant would have on the region if it were built in western Oklahoma.

The Center serves western Oklahoma by conducting economic research, building strategic alliances, promoting small business growth, and pursuing projects to help strengthen and diversify the economy of the region and Oklahoma. Western Oklahoma's economy is highly dependent upon the energy and agriculture sectors. The energy sector has always been highly volatile and tied to world affairs. US Agriculture has seen historic gains in productivity. According to the United States Department of Agriculture, farm productivity more than doubled from 1948 to 1996.[1] As prices for traditional crops in traditional markets have dropped this increased productivity has kept many farmers in business that would have otherwise gone bankrupt. In order to stay solvent, the region's farmers need more opportunities to develop new markets internal to the region to their crops.

Building a biomass to commercial grade polymer conversion plant in western Oklahoma would provide just such an opportunity to the region's farmers. Given the state of world affairs, the United States is more aggressively funding research aimed at reducing our dependence on foreign oil. This is evidenced by the January 30th, 2003 announcement by President Bush of a $1.2 billion hydrogen fuel initiative aimed at reversing the United States increasing dependency on foreign oil.[2] In addition, there is a public trend to strive for better environmental awareness and stewardship. Because of these two factors there are opportunities for companies actively researching and developing viable alternatives to petroleum based products. Ag ChemCo is an example of a company capitalizing on this opportunity.

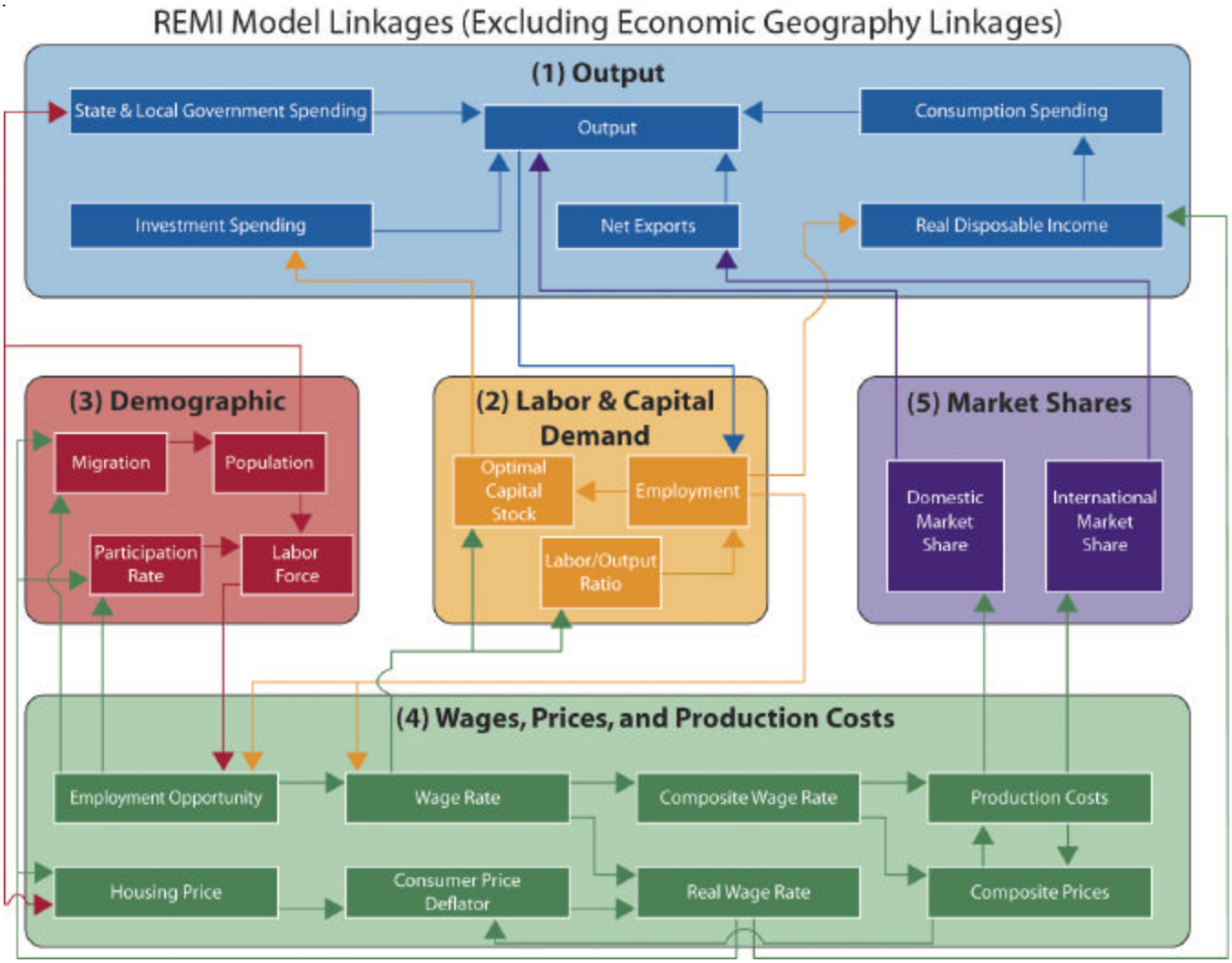
Ag ChemCo competes in the agricultural chemical industry, and uses annually renewable resources, or biomass, to create a proprietary commercial grade polymer. In 2002, Ag ChemCo finished construction of a biomass to commercial grade polymer conversion plant in the Midwest. The plant is capable of producing more than 300 million pounds (140,000 metric tons) of commercial grade polymer per year and uses up to 40,000 bushels of locally grown corn per day as the raw materials for the manufacturing process. The plant that is the focus of this study would use native prairie grasses as well as crop residues, including wheat straw and sorghum stalks, for raw materials.

# 2 Economic Impact Analysis Method

The Center for Economic & Business Development uses a six region, 53 sector REMI model to forecast how a given economic activity occurring in one region would affect that region, a group of regions, and/or the state. The REMI model measures this economic impact by first forecasting the region's/state's performance as if there were no changes (the control forecast), and then forecasting the region's/state's performance if the economic activity occurred (the alternative forecast). The difference between the two forecasts represents the economic impact of the economic activity upon the region, group of regions, and/or the state. It is these economic impacts that will be reported in the Economic Impact Analysis section of this report.

## 2.1 REMI - About the Model

Regional Economic Models, Inc. (REMI), based in Amherst, MA, produces economic modeling software that enables users to "answer what if questions" about their economies. Each REMI model is tailored for specific geographic regions using employment, demographic, and industry inputs unique to the modeled region. The REMI simulation model uses hundreds of equations and thousands of variables to forecast the impact that a policy change has upon an economy. A basic graphic representation of some of the linkages in the economic modeling software is presented below.




Used with permission from Regional Economic Modeling, Inc.

As can be seen, the REMI model contains five "blocks". Each block has its own variables and interactions so that changing any one variable in the model not only affects other variables in its own block, but also variables in other blocks. For example, if XYZ Corporation expanded its operations in Oklahoma City by hiring an additional 100 new employees, then that initial employment increase would ultimately affect output, population, migration, wage rates, etc. It is through the model's linkages and interactions that employment's (in Block 2) direct effects upon optimal capital stock (Block 2), employment opportunity (Block 4), and real disposable income (Block 1), that the employment gain works its way through the model to affect each of the other variables.

Commenting first on employment's positive effect upon optimal capital stock, this variable will increase from an employment gain because (1) some new employees will demand newly constructed houses, and (2) physical capital will be required to assist the labor to produce output. Optimal capital stock interacts with actual capital stock (not shown) to affect the level of investment (Block 1) in the model which ultimately increases Oklahoma City's output (Block 1). Higher optimal capital stock when compared to actual capital stock spurs investment in the region since the difference represents unfulfilled demand for physical capital. And output (Y) increases since it is equal to the sum of personal consumption (C), state & local government spending (G), investment (I), net exports from the region (X-M) as well as demand for intermediate inputs.

Commenting next upon employment's effect upon employment opportunity, this variable increases because 100 new jobs have been created in the economy. An increased employment opportunity will positively affect wage rates (Block 4) if the region's employment is growing faster than the region's labor force (Block 3). Wage rates interact with the consumer price deflator, which is an adjustment factor accounting for differing inflation rates in various regions, to affect real wage rates (Block 4). Higher real wage rates in one region compared to another region serve as an incentive for people to move between geographic regions; thus real wage rates affect migration (Block 3).

Commenting last upon employment's effect upon real disposable income (Block 1), as jobs are created, income paid to the new employees also increases. The newly employed will save a portion of their income and spend a portion of their income upon consumer goods, the latter of which increases consumption (Block 1). As a component of output, increased personal consumption produces a subsequent rise in output.

Obviously, the previous example is only a simple illustration of a more complex model. For more information about the REMI model and its equations, please read Regional Economic Modeling by George Treyz (Kluwer Academic Publishers, 1993.) [3]

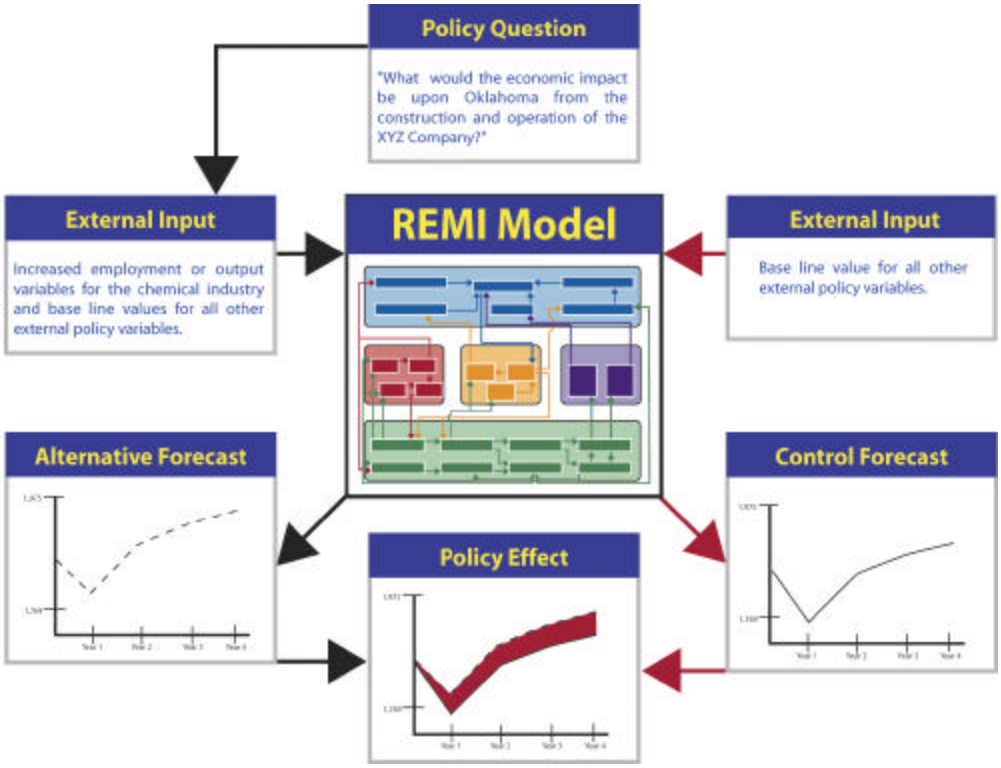
## 2.2 Forecasting with the REMI Model

Given the previous basic illustration of the REMI model, the process that the REMI model uses to forecast the economic impact of a policy change can be illustrated. The process begins with a policy question and concludes with a comparison between a control forecast and an alternative forecast. The accompanying diagram assists with the illustration.

A control forecast, which uses current data regarding the economy, is generated by the REMI model. The control forecast represents the economic situation *ceteris paribus,* and the economy will follow similar trends in the future as had been experienced in the past.

The alternative forecast allows the user to input variable changes to occur in future time periods. Only those variables that would be affected by the policy change being measured would be changed in the alternative forecast. The REMI model then forecasts economic performance based upon the policy variable changes.

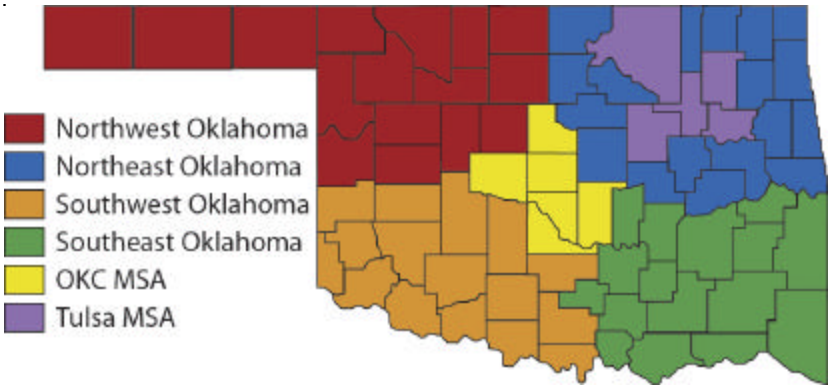
The difference between the alternative and the control forecasts, measured by the distance between the two forecast lines, represents the ***economic impact*** of the policy change upon the economy. If the alternative forecast is greater than the control forecast, then a positive economic impact results for the economy. A negative economic impact results should the alternative forecast be less than the control forecast.




Used with permission from Regional Economic Modeling, Inc.

## 2.3 Geographic Regions

As is observable from the accompanying map, the state of Oklahoma is divided into six regions in the REMI model used by the CEBD. They are: Northwest Oklahoma, Northeast Oklahoma, Southwest Oklahoma, Southeast Oklahoma, the Oklahoma City metro area, and the Tulsa metro area. The Oklahoma metro area and the Tulsa metro area correspond to the Metropolitan Statistical Areas (MSAs) defined by the Office of Management & Budget.




The Office of Management & Budget (OMB) defines metropolitan areas in the United States based upon the size of the economies and commuting patterns. The two largest MSAs by population in Oklahoma are Oklahoma City MSA and Tulsa MSA. As defined by the OMB, the Oklahoma City MSA is comprised of six counties (Canadian, Cleveland, Logan, McClain, Oklahoma, and Pottawatomie counties), and the Tulsa MSA is comprised of five counties (Creek, Osage, Rogers, Tulsa, and Wagoner counties).[4]

Additionally, any of the regions may be combined with any combination of the other regions to produce a user-defined region for the purposes of measuring economic impacts. For example, if an economic impact were to be quantified for Eastern Oklahoma, then the three regions of Northeast Oklahoma, Southeast Oklahoma and the Tulsa metro area would be combined to be reported as Eastern Oklahoma.

## 2.4 Limitations of Economic Impact Analysis

It is important to note that while economic impact analysis is a valuable tool for economic development, economic impact analysis does have limitations. Resource Systems Group, Inc. identified some of the limitations of their economic impact analysis tool. Those limiting factors that pertain to REMI-modeled economic impact analysis are:

- Economic impact analysis cannot determine whether a new economic activity/project is economically feasible or profitable. It is possible that projects with very large favorable economic impacts may be unprofitable.[5]

- Economic impact analysis cannot identify the specific individuals or the location of individuals or businesses impacted. For example, the analysis may show that a specific number of jobs will be generated in the trucking industry, but it cannot determine if those jobs will be filled from a specific town.[5]

- Economic impact analysis cannot determine whether the outcomes of an economic activity are socially or environmentally beneficial.

Regarding the first point, the purpose of economic impact analysis is not to determine whether a new economic impact activity is profitable. Rather, the purpose of economic impact analysis is to quantify the impact of the new economic activity upon an economy. Other assessment tools, like market feasibility studies or cost/benefit analyses, can help decision-makers determine whether an economic activity/project is profitable.

Regarding the second point, although the economic impact cannot identify a specific company or city, the REMI model can forecast the region in which the economic impact will occur. With the state divided into six regions, the level of detail is greater in the REMI model than with other economic impact analysis models.

Regarding the final point, Resource Systems Group, Inc. reported that economic impact analysis "can only deal with impacts that are easily quantifiable in dollars or employment. Environmental, health, or social impacts are not normally assessed, even though they may have economic implications."[5] While this may be a limitation of IMPLAN-modeled economic impact analysis, this is not a limitation with REMI-modeled economic impact analysis. Admittedly these externalities are not easily quantifiable, but they may still be quantified through the use of well-formed surveys. With a quantifiable amount associated with the externality, its impact may then be modeled through an additional simulation.

There is at least one other limitation when measuring the economic impacts upon a region not mentioned in the Resource Systems Group, Inc. report. That limitation relates to using aggregated industry data to measure economic impacts. Most economic impact tools use historical data to model future events. Some of the historical data is aggregated in order to make the modeling tool more affordable and user-friendly. Using aggregate industry data to model the economic impact of a specific company requires the assumption that the specific company is a good sample of the aggregate of the whole industry.

Lastly, it should be noted that economic impact analysis is not the same tool as a cost-benefit analysis. A cost-benefit analysis quantifies all of the costs, including social and environmental costs, and all of the benefits associated with a project, and if the ratio of benefits to costs is greater than 1.0, then this becomes the basis for approving a project. Economic impact analysis does not have any threshold associated with the tool. Rather, the REMI-modeled economic impact analysis will forecast quantifiable amounts of employment, population, income, etc. over a range of years for any region. These quantifiable forecasts can then be used with other tools, including cost-benefit analysis and feasibility reports to assist in the decision-making process.

## 2.5 Limitations of the REMI model

Separate from the limitations of economic impact analysis, there are unique limitations to the REMI model. Every economic impact model attempts to simulate real world conditions, and every economic impact model has its own unique weaknesses. The primary weakness of our REMI model is that the geographic regions in the model cannot be disaggregated further. This means that our version of the REMI model cannot forecast the economic impacts upon smaller regions. Specifically, the six regions cannot be broken into the counties comprising their respective region. The reader should bear in mind that every model has its weaknesses, and while it is not the purpose of this report to list the relative strengths and weaknesses of each of the economic impact models, we want to be as transparent as possible regarding the REMI modeling software used by the CEBD.

## 2.6 Strengths of the REMI model

One of the key features differentiating the REMI simulation model from other economic impact measurement tools is the fact that REMI uses several economic impact methodologies to predict impacts upon an economy. Whereas other tools rely upon one methodology to predict economic impacts, REMI combines several economic impact methodologies, which has the effect of minimizing the weaknesses of any one methodology. Methodologies included in the REMI model are input-output, econometric equations, economic-base, and it also includes aspects of computable general equilibrium.

An additional strength of the REMI model involves its dynamic nature. Whereas economic impact models relying solely on input-output are only able to make static one year forecasts, the REMI model is able to forecast the economic impacts over a number of years.

Also differentiating the REMI model from other economic impact models is its ability to report the economic impacts with a myriad of economic and/or demographic variables. This means that not only will traditional economic impact variables (for example, employment, income, gross regional product, etc.) be reported by the REMI model, but the model is also able to report other economic and socioeconomic variables (for example, capital stock, economic migrants, population by age/gender, etc.) as well. By forecasting nontraditional economic and socioeconomic variables, the REMI model provides a more complete picture of the impacts a given scenario would have upon an economy.

# 3 Project Information

Before results of the economic impact study are presented, it is necessary to present information unique to this project as this information serves as inputs into the REMI model. The primary variables used as inputs into the REMI model include construction amounts for the proposed plant, projected output of the biomass facility when it becomes operational, and increased sales in the Farm sector, Railroad industry, Trucking industry and Agricultural Services industry. All of the variables used as inputs in our study were obtained either through interviews with an Ag ChemCo representative, or from a feasibility study conducted to study the production and availability of wheat straw in western Oklahoma.

## 3.1 Project Assumptions

In order to conduct an economic impact analysis of the proposed biomass facility with the REMI model, certain assumptions must be made. These assumptions include the time frame, construction disbursements, and geographic locations of the increased economic activity attributable to the proposed biomass facility.

The construction phase of the project would last two years. Our study assumes that the construction phase begins in 2005 and ends in 2006. The total amount spent during the construction phase of the project is expected to be $278 million. Of this amount, $78 million would be spent on producer's durable equipment and the remainder on the plant's construction. In 2005, our study assumes that $67 million would be spent on construction of the facility and $26 million would be spent on producer's durable equipment. The remaining disbursements, $133 million for construction and $52 million for producer's durable equipment, would be spent in 2006.

Operations of the proposed biomass facility would begin in 2006 at one-third of its operational capacity and gradually increase to its operational capacity by 2008. Operational capacity at the proposed biomass facility would produce $250 million worth of output per year. Therefore, the dollar value of output in the model is $83.3 million in 2006 and $166.7 million in 2007. The Ag ChemCo facility located in the Midwest is classified as an Agricultural Chemical manufacturing facility (SIC 287). The proposed facility would also be classified as such a facility, so all of the model's inputs for operations are directed to occur in the Agricultural Chemical manufacturing industry in western Oklahoma.

The previous information would be sufficient to run an economic impact simulation; however, the CEBD was given more specific information regarding dollar amounts that the facility would spend on other economic sectors. With this information, we are able to further customize the REMI model to include these specifics. (Please see Appendix A for a more detailed discussion regarding how we made these adjustments within the REMI model.)

The detailed information includes expected expenditures upon: the biomass, the baling of the biomass, and the transportation of the biomass from the field to the facility. The source from which we obtained the more detailed information was a feasibility report detailing the production and availability of wheat straw in western Oklahoma for Ag ChemCo and Southwestern Oklahoma State University in 2002.

Regarding the biomass, the proposed facility would require 700,000 dry tons (dt) of biomass annually. Additionally, Ag ChemCo would like to spend no more than $36/dt of biomass delivered to its facility. Therefore, the annual expenditure for the delivered biomass feedstock is $25.2 million, and this total expenditure would have to be divided among the farmers, balers and transporters of the biomass.

From the aforementioned feasibility study, the baling cost is expected to be $15/ dry ton. Therefore, the remaining $21/dt of biomass would be divided between the farmers and the transporters. The feasibility study states that the transportation cost depends upon the distance from the facility. In order to conservatively forecast the impact upon the farming sector, this study assumes the most expensive transportation cost ($11.5/dt or $8.05 million annually). The remaining $9.5/dt (or $6.65 million) would therefore be

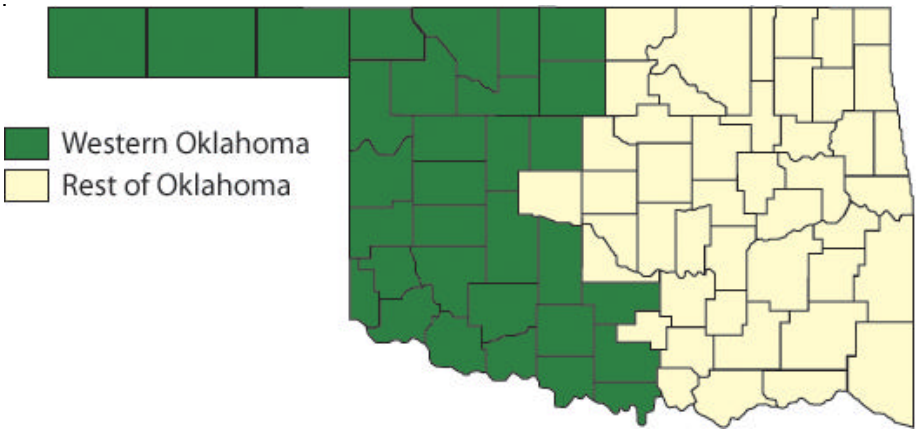
income for the farmers. The transportation cost is further divided into railroad transportation, of which is assumed to receive approximately 75% of the transportation income, and the trucking industry, receiving the remaining 25% of the transportation income. As with operations, these expenditures would increase from one-third of the normal operating level in 2006 to the full operating expenditures in 2008.

In short, the four industries for which we were given more specific information were the Farm Feed Grains industry (the biomass), the Agricultural Services industry (biomass baling services and biomass storage services), the Railroad industry (biomass transportation), and the Trucking industry (biomass transportation). The more detailed information provided allowed the CEBD to further customize the economic impact simulation for Ag ChemCo.

## 3.2 Project Area

As previously explained, there are six sub-state regions in our version of the REMI model. For the purposes of this study, we will combine southwest Oklahoma and northwest Oklahoma to report the economic impacts of the proposed biomass facility upon western Oklahoma. The rationale for combining southwest and northwest Oklahoma into western Oklahoma is not only derived from the presence of the Farmrail system in western Oklahoma, but also from the fact that most of the biomass will be supplied from the farmers of western Oklahoma. The annual transportation of 700,000 dt of biomass is a significant logistical and cost issue for the proposed biomass facility. The presence of the Farmrail system in western Oklahoma would be a substantial asset for the region in addressing the issue.

In addition to reporting the economic impacts upon western Oklahoma, we will report the economic impacts upon the state of Oklahoma by combining western Oklahoma with the Rest of Oklahoma.



# 4 Conventions of Reporting Impacts

We will adhere to the following five guidelines when reporting the economic impacts of the Ag ChemCo facility.

## 4.1 Convention 1 - Economic Impacts

In discussing the economic impacts, it is important for the reader to keep in mind that most of the graphs present the economic impact of the proposed biomass facility as measured by the difference between REMI's alternative forecast and control forecast. The control forecast predicts economic and demographic variables into the future if nothing changes (*ceteris paribus*). The alternative forecast predicts the same variables for the economy given the economic stimulus, which in this case represents the construction & operation of the biomass facility as well as the more detailed information regarding expenditures of the proposed biomass facility on the four industries. The difference between the two forecasts represents the economic impact that the stimulus has upon the state and regional economies.

Because the scales are extremely large for many of the economic and socioeconomic variables, only the economic impacts will be graphed. Presenting the information in this format not only allows comparison across geographic regions, but it also focuses on the most relevant information - the economic impacts. However, we will also present, in tabular format, the forecasted 2010 levels of some of the alternative and control forecasts. Doing this will assist in order not only to better inform the reader, but also and to better communicate the economic impacts that the proposed biomass facility will have upon western Oklahoma and the state as a whole.

As an example, REMI forecasts western Oklahoma's population to grow to 636,199 people by 2010 if nothing changes in the economy between now and 2010 (For comparison, western Oklahoma's 2000 population equaled 617,420 people.). If the only change in the economy is the construction and operation of the Ag ChemCo facility, then REMI forecasts western Oklahoma's population will grow to 637,060 people by 2010. Therefore, the economic impact, or the response to economic stimulus of the new facility, would be 861 more people (637,060 people - 636,199 people) in western Oklahoma by 2010. While it will be the economic impact (861 people) that will be graphed, both the control forecast level and the alternative forecast level will be tabularly presented with the economic impact for the 2010 year to communicate the relative scale.

## 4.2 Convention 2 - Variable Groupings

We intend to present the economic impacts that the proposed biomass facility would have in western Oklahoma and the state in similar variable groupings, or "blocks", as REMI uses to communicate economic linkages. Therefore, there will be five primary sections corresponding to the five "blocks" identified by REMI (see page 3 for an illustration of the five blocks).

## 4.3 Convention 3 - Variable Definition

Many of the economic and socioeconomic variable definitions will be presented in boxes. Accompanying these definitions will be both (1) a list of variables that affect the variable being discussed, and (2) a list of variables that will be affected by the variable being discussed. This is intended to help the reader understand some of the linkages in the REMI model.

## 4.4 Convention 4 - Constant Dollars

Also of note, except for the wage, income and income adjusment variables contained in Block 4 (section 5.4), monetary figures will be reported in constant 1996 dollars.

## 4.5 Convention 5 - Net Present Value

All reported net present value figures use the entire 2005-2025 time frame and a 5% discount rate.

# 5 Economic Impact Analysis Results

## 5.1 Block 1 - Output Variables

The first block of variables, the Output block, will relate the impacts that the proposed biomass facility would have upon the region's GRP, output and real disposable income. As was explained in the Project Assumptions section, much of the initial stimulus is entered into the model in Block 1. And as will be seen in the upcoming blocks, the initial stimulus will work its way through the rest of the blocks and their associated economic and socioeconomic variables.

### 5.1.1 Gross Regional Product

Gross Regional Product (GRP), which is analogous to the nation's Gross Domestic Product (GDP), measures the value of all final goods and services produced in a region during the year. Intermediate goods are not included in GRP since their value will ultimately be included in the value of the final goods produced in the region in a given year. However, while not included in GRP, intermediate goods are included in regional output.

**Gross Regional Product**

Gross Regional Product (GRP) as a value added concept is analogous to the national concept of Gross Domestic Product. It is equal to output excluding the intermediate inputs. It represents compensation and profits.

**Affected By**

Consumption, International Exports, Investment, State & Local Government Spending

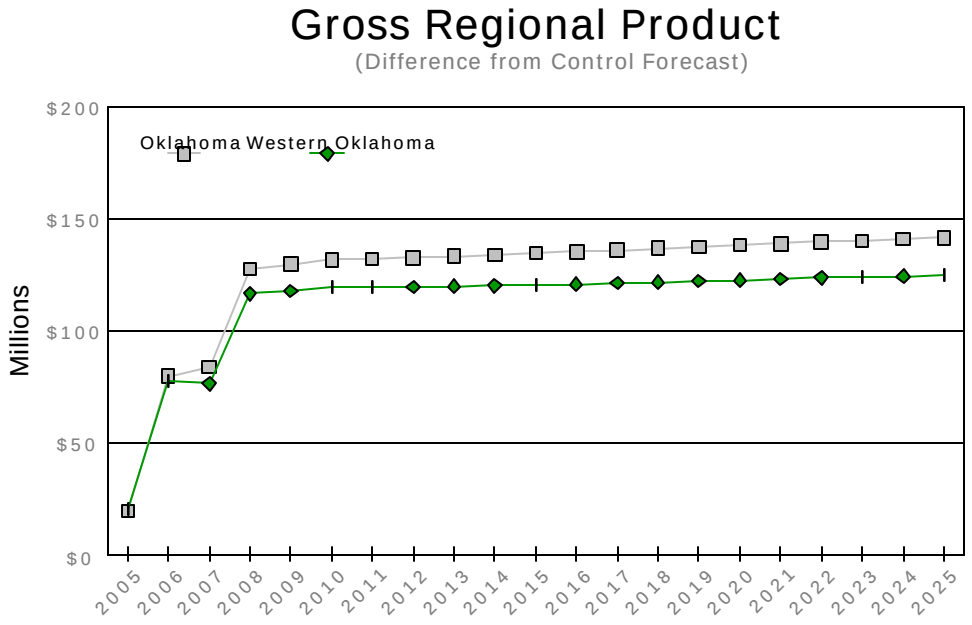
**Affecting**

Commodity Access Index, Change in Local Supply, Employment, Output

As economists will know, there are two methods of measuring GRP - the expenditure approach and the income approach. Both measurement methods will produce equal GRP values since an expenditure for one business/entity would be classified as income for a different business/entity. (Alternative names for the two approaches are final-demand GRP for the expenditure approach and value-added GRP for the income approach.)

The four components of spending (consumption spending, investment spending, government spending, and net exports) are added together to calculate GRP when using the expenditure method. When using the income method, the many types of income (for example, employee's income, proprietor's income, rental income, indirect taxes, corporate profit, etc.) are summed to calculate a region's GRP. Most of the GRP impacts will be reported using the expenditure (final-demand) approach; however, the income impact upon the Farm sector will be reported using the income approach since its impacts are not included in the expenditure approach.

The accompanying graph highlights the impacts that the Ag ChemCo facility would have upon GRP in western Oklahoma and the state of Oklahoma. As a sub-state region, western Oklahoma's impacts are included in the state's impacts. So, whenever the economic impacts in the state are greater than those experienced in western Oklahoma, then there are positive economic impacts occurring in




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $26.360 billion | $26.479 billion | $119.1 million |
| State of Oklahoma | $161.526 billion | $161.657 billion | $131.5 million |

the rest of Oklahoma, which is all the counties in Oklahoma except those western Oklahoma. Conversely, should the economic impacts occurring in western Oklahoma be greater than the impacts in the state, then negative economic impacts are occurring in the rest of Oklahoma. In fact, just such an instance occurs in 2005 when western Oklahoma's GRP is projected to be $20.4 million higher, while the state's GRP is projected to be $19.6 million higher. The difference, ($0.8 million), indicates that economic activity slows down slightly in the rest of Oklahoma during the first year of the plant's construction. The rationale for this is that some of the construction workers from the rest of Oklahoma are being drawn to western Oklahoma to assist in the construction of the facility. It should be noted, before too much concern is raised, that the only negative GRP impact upon the rest of Oklahoma occurs in 2005. When operations begin in 2006 at the biomass facility, positive economic impacts begin affecting the rest of Oklahoma's GRP. Additionally, the magnitude of the negative impact, $0.8 million, is minuscule (0.0007%) when compared to the GRP for the rest of the state - $110.75 billion.

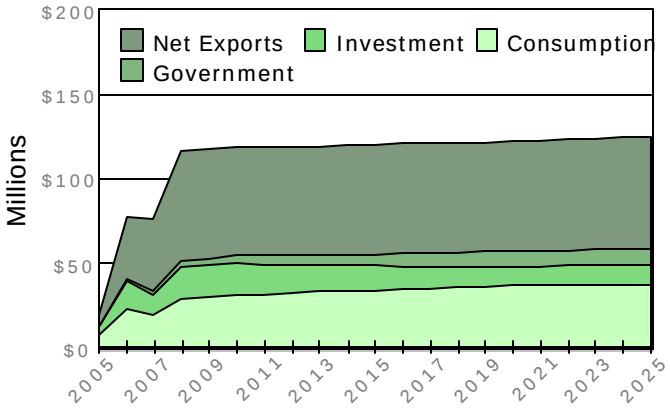
Referring to the table on the previous page, the REMI model projects Oklahoma's GRP would be $161.526 billion in 2010 if nothing changes in the state's economy. However, if the Ag ChemCo plant is constructed and operated in western Oklahoma, then REMI projects Oklahoma's GRP would be $161.657 billion in 2010. Therefore, the economic impact, which is the difference between the two projections, would be $131.5 million upon the state's GRP.

The economic impacts upon GRP can be delineated by expenditure source that the Ag ChemCo facility has upon the different regions. The following area graphs illustrate the relative proportions of GRP held by each of the four expenditure sources over the modeled time frame. On average over the time frame, consumption spending accounts for 28.7% of the increased GRP in western Oklahoma and 29.4% of the increased GRP in the state. Similarly, investment spending accounts for 12.6% of the increased GRP in western

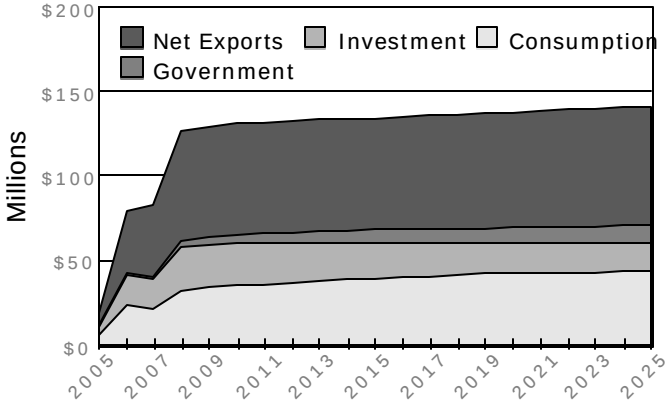
## Expenditure Source of GRP

(Difference from Control Forecast)

Western Oklahoma




Oklahoma




| Spending Component | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Consumption (region) | $14.806 billion | $14.837 billion | $31.35 million |
| Investment (region) | $5.239 billion | $5.257 billion | $18.67 million |
| Government (region) | $8.200 billion | $8.205 billion | $4.5 million |
| Net Exports (region) | ($1.884 billion) | ($1.820 billion) | $64.7 million |
| Consumption (state) | $94.228 billion | $94.264 billion | $35.45 million |
| Investment (state) | $31.074 billion | $31.096 billion | $25.29 million |
| Government (state) | $29.173 billion | $29.177 billion | $4.8 million |
| Net Exports (state) | $5.975 billion | $6.041 billion | $65.9 million |

Oklahoma and 15.7% in the state. Government spending, accounting for 5.5% of the regional GRP increase and 5.4% of state GRP increase, is positively correlated to population. The rationale for this is that as population increases, then more demands would be placed upon government services (for example: police protection, public school education etc.). It should be noted that in the REMI model, government spending includes state and local government spending, but not federal government spending since federal government spending is treated as an exogenous variable entering the model as imports. Last of the four expenditure components, net exports account for the largest share of the increased GRP for western Oklahoma (53.2%) and the state (49.6%), which is reasonable since much of the output from the Ag ChemCo facility is expected to be exported.

Commenting briefly about the table accompanying the two area graphs on the previous page, consumption spending in western Oklahoma accounts for about 15.7% of total consumption spending in Oklahoma in both the control forecast and the alternative forecast. Nevertheless, most (88.4%) of the economic impact that the Ag ChemCo facility has upon consumption spending occurs in western Oklahoma.

Net exports in western Oklahoma are negative in both of REMI's 2010 alternative and control projections, which means that the region is importing more than it is exporting. As previously stated, a portion of the explanation is attributable to the fact the REMI treats federal government spending as an exogenous variable entering the model as imports. Farm subsidies and defense spending would therefore be included as federal government spending, so it is not unreasonable that western Oklahoma is projected to have negative values for net exports. Even so, the economic impact that the biomass facility would have ($64.7 million) makes net exports less negative in the alternative forecast.

Since the economic impacts upon GRP build up over time, viewing the impacts as net present values may help the reader understand the cumulative impacts that the Ag ChemCo facility would have over the modeled time frame. The accompanying table relates the net present values of GRP and its four expenditure components between 2005 and 2025.

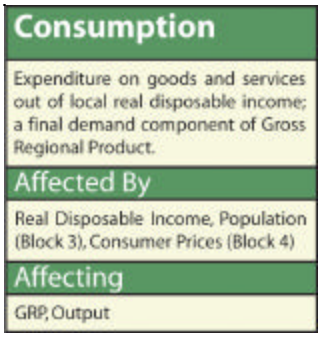
## Net Present Value of GRP

| GRP Component | Western Oklahoma | Rest of Oklahoma | *State of Oklahoma* |
|---|---|---|---|
| Consumption | $388,958,992 | $50,879,567 | *$439,838,560* |
| Investment | $184,214,263 | $67,369,632 | *$251,583,895* |
| Government | $69,486,650 | $5,573,849 | *$75,060,499* |
| Net Exports | $728,961,528 | $24,633,129 | *$753,594,657* |
| Total GRP | $1,371,621,433 | $148,456,177 | *$1,520,077,611* |

5% Discount Rate & 21 Years (2005-2025)

As can be seen, if the Ag ChemCo facility were built, GRP in western Oklahoma would have a cumulative net present value of almost $1.372 billion in the region. Because $148.5 million of the GRP impacts occur outside of western Oklahoma, the state of Oklahoma would benefit from a cumulative (summing two sub-state regions) GRP impact of over $1.520 billion. While 90.2% of the GRP impact is projected to occur in western Oklahoma, the region's share of the expenditure components range from 65.4% of investment spending to 96.7% of net exports. For the sake of reference only, the unadjusted sum of the impacts between 2005 and 2025 total almost $2.352 billion for western Oklahoma's total GRP and over $2.619 billion for the state's total GRP. Since the time value of money is not taken into account when the impacts are summed, these values were presented for reference.

### 5.1.1A Consumption (an Expenditure component of GRP)




For the purposes of this report, two of the four expenditure components of the state's GRP will be analyzed in greater detail - consumption spending and investment spending.

In the REMI model, three variables affect the level of consumption spending in the economy - population (block 3), real disposable income (block 1), and consumer prices (block 4). Briefly, a region's consumption will increase as its population increases, its real disposable income increases, and/or its relative level of consumer prices decreases. Additionally, the consumption categories reported here are similar to the national income product accounts (NIPA) used to measure GDP.

Of the major consumption categories, "Other Services" accounts for the largest share (21.5%) of the increased consumption spending. The "Other Services" category of consumption spending is a broad category that includes expenditures for dry cleaning, health insurance, bank fees, legal services, theater and recreational admissions, higher education, investment brokerage charges, and nineteen other services. With such a broad range of services, the REMI model projects increased spending in the "Other Services" category to have a net present value (NPV) over the 2005-2025 time frame of $94.4 million. Not taking into consideration the time value of money, which is an unadjusted sum of the annual impacts, the category's total equals $161.4 million over the whole time period, which translates into an average of $7.7 million per year.

The "Computers & Furniture" category accounts for the second largest proportion (15.8%) of consumption spending. Expenditures in this category include household furniture, household appliances, computer hardware, computer software, audio & video products, china, glassware, utensils and other durable household products. As can be seen from the accompanying table, the NPV (2005-2025) for Computers & Furniture equals $69.5 million. The unadjusted sum of the impacts equals $123.9 million, which translates into an annual average increase of $5.9 million if the Ag ChemCo facility were built in the state of Oklahoma.

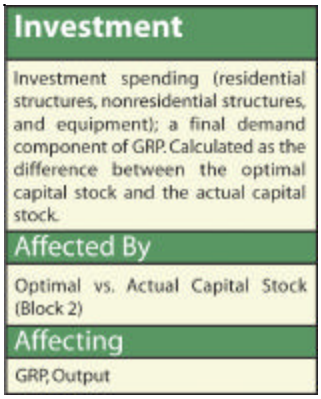
With an NPV=$ 52.0 million, the "Food & Beverages" category accounts for the third largest proportion (11.8%) of the increased consumption spending in the state of Oklahoma. In 2005, the REMI model projects "Food & Beverage" spending to be $1.1 million higher in Oklahoma if the Ag ChemCo facility is built and rise to be $4.7 million higher by the time the facility becomes fully operational. The unadjusted sum of the impacts equals $88.2 million, which translates into an annual average increase of $4.2 million if the biomass facility were built in the state of Oklahoma.

Of the major consumption spending categories whose subcategories may not be intuitive from their headings, "Other Durables" includes expenditures on jewelry & watches, ophthalmic & orthopedic products, books, photo equipment, boats, and pleasure aircraft. The "Other Non-Durables" category includes consumer expenditures on tobacco, toiletries, cleaning & household products, magazines, newspapers, drug preparations & sundries, and six other nondurable subcategories. The "Housing" category does not refer to mortgage payments made by home owners; rather, this category primarily includes consumer expenditures for rental housing and rental space. The "Household Operations" category includes consumer expenditures for electricity, natural gas, telephone, water & sewage, domestic services and other household operations.

## Net Present Value of Consumption

| | Net Present Value |
|---|---|
| Vehicles & Parts | $23,707,053 |
| Computers & Furniture | $69,482,171 |
| Other Durables | $14,225,996 |
| Food & Beverage | $52,044,263 |
| Clothing & Shoes | $32,371,881 |
| Gasoline & Oil | $7,246,861 |
| Fuel Oil & Coal | $676,107 |
| Other Non-Durables | $32,322,408 |
| Housing | $46,877,389 |
| Household Operations | $31,861,660 |
| Transportation | $19,573,001 |
| Medical Care | $15,106,747 |
| Other Services | $94,354,497 |
| Total NPV | $439,850,034 |

5% Discount Rate & 21 Years (2005-2025)




### 5.1.1B Investment (an Expenditure component of GRP)

In economics, investment refers to spending on fixed assets; for example, housing, commercial buildings, and durable equipment. While the investment spending category is not as detailed as the consumption spending category, it still differentiates where the investment spending activity is taking place.

The variables affecting investment spending, actual capital stock (block 2) and optimal capital stock (block 2) , do not affect investment directly, rather there is an interaction between the variables before the level of investment spending changes. Investment spending will increase if optimal capital stock is greater than actual capital stock. When this is the case, the difference between the two variables represents the future level of investment spending required to satisfy current demand for capital stock. As will be seen in the capital stock section of this report, markets do not immediately satisfy demand for capital stock.

As can be seen from the accompanying table, the NPV (2005-2025) of investment spending equals nearly $218.6 million. Over the entire time period, the unadjusted sum of the increased investment spending equals $354.7 million for an annual average increase of $16.9 million in the state of Oklahoma.

As a proportion of the total, investment spending on producer's durable equipment accounts for the greatest share (65.3%). Investment spending in this category includes spending on equipment used to add value or manufacture goods as well as equipment used to process information. The unadjusted sum of the total increase equals $235.4 million, which translates into an annual average increase of $11.2 million. Regarding the pattern of the economic impacts, investment spending in this category starts $2.5 million higher in 2005, peaks at $14.2 million higher in 2009, and steadily declines to $10.2 million higher in 2025.

## Net Present Value of Investment

| | Net Present Value |
|---|---|
| Residential | $58,636,912 |
| Non-Residential | $17,113,750 |
| Producer's Durable Equip. | $142,800,651 |
| Total NPV | $218,551,313 |

5% Discount Rate & 21 Years (2005-2025)

New residential investment spending, which includes investment spending on single family and multifamily housing structures, also comprises a significant proportion (26.8%) of the increased investment spending. The NPV of the increased residential investment spending equals $58.6 million, the unadjusted sum for this category totals $92.7 million, and the annual average equals $4.4 million. Similar to the producer's durable equipment category, residential investment starts at its lowest ($1.7 million) in 2005, peaks in 2009 ($6.6 million), and steadily declines through 2025 ($3.1 million).

As the final component of investment spending, nonresidential investment spending accounts for the remaining proportion (7.9%) of the total investment spending increases. It should be noted that investment spending is a result of, but does not include, the construction of the Ag ChemCo facility. The unadjusted sum of the total nonresidential investment spending in Oklahoma equals $26.6 million for an annual average of $1.3 million. As with the previous components of investment spending, the nonresidential investment spending increases begin slow ($0.4 million), peak in 2009 ($2.1 million), and steadily decline until 2025 ($0.8 million).

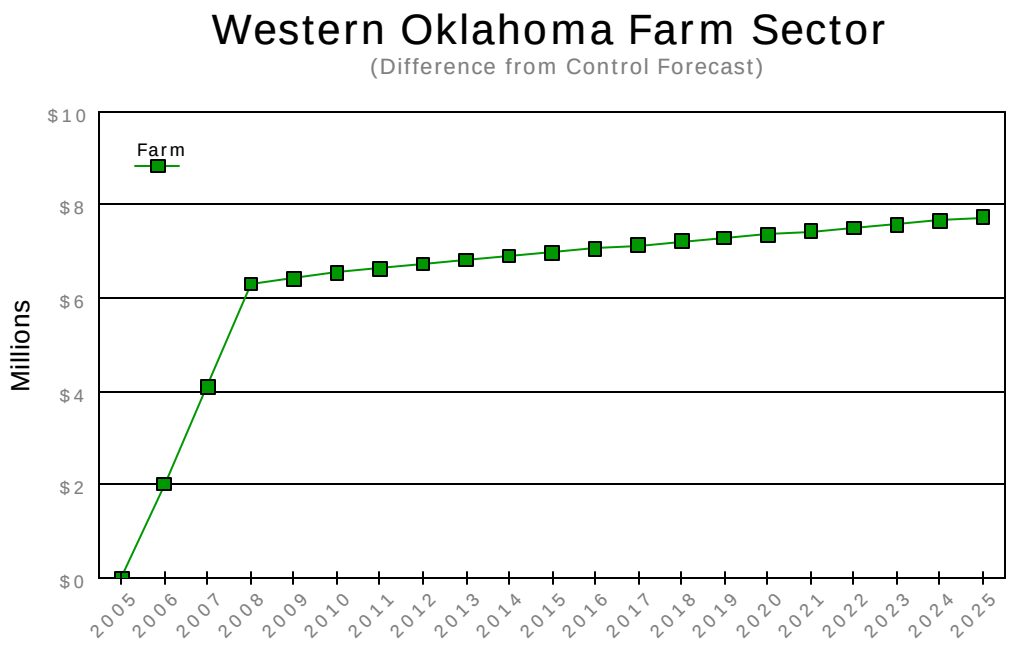
While both the optimal capital stock variable and the actual capital stock variable will be discussed in greater detail with the second block of variables (section 5.2.4), for the purposes of this section, actual capital stock is defined as the amount of capital stock presently existing in the economy. Optimal Capital Stock is defined as the amount of capital stock that would have to exist in the economy in order to satisfy current demand for capital stock.

### 5.1.1c Farm Income (an Income component of GRP)

As mentioned in the beginning of the GRP section, there are two methods of measuring GRP - the expenditure method and the income method. Since both methods produce the same GRP result, the sum of the expenditure components is equal to the sum of the income components. The only income component that will be discussed in this project will be farm income.

In 2005, the first year of the project, Ag ChemCo operations have not yet begun, so there is no impact upon farm income. In 2006, when Ag ChemCo is assumed to operate at one-third of capacity, the economic impact upon farm income is over $2.0 million. By 2008, when operations at Ag ChemCo is expected to reach full capacity, the economic impact upon farm income is projected to be $6.3 million. As can be seen from the accompanying graph, farm income grows through the rest of the time period and by 2025 the projected economic impact is $7.7 million. The unadjusted sum of the impacts in the 2005-2025 time frame equals $133.6 million, and the net present value of the increased economic impacts equals $75.8 million over the 2005-2025 time frame.

As is observable from the table accompanying the graph, all of the economic impacts upon farm income occur in western Oklahoma since the state's economic impact in 2010 ($6.6 million) is equal to western Oklahoma's economic impact ($6.6 million) in the same year. (This is also the reason that there is only one line displayed on the graph.)




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $1.091 billion | $1.097 billion | $6.6 million |
| State of Oklahoma | $2.876 billion | $2.882 billion | $6.6 million |

Also of note, farm income in western Oklahoma is projected to account for approximately 37.9% of Oklahoma's farm income in 2010 in both the control forecast and the alternative forecast. Since western Oklahoma's GRP accounts for 16.3% of the state's GRP in 2010, it can be seen that western Oklahoma is more reliant upon the farm sector than the state as a whole, Another way to relate the importance of farm income in western Oklahoma relative to the state is that farm income accounts for approximately 4.1% of western Oklahoma's GRP, whereas for the state of Oklahoma, farm income accounts for less than 1.8% of the state's GRP.

### 5.1.2 Regional Output

**Output**

The amount of production in dollars, including all intermediate goods purchased as well as value-added (compensation and profit). Can also be thought of as sales. Output = Self-Supply + Exports + Intraregional Trade + Exogenous Production.

**Affected By**

Consumption, International Exports, Investment, State & Local Government Spending, Intermediate Inputs, Share of Domestic Markets

**Affecting**

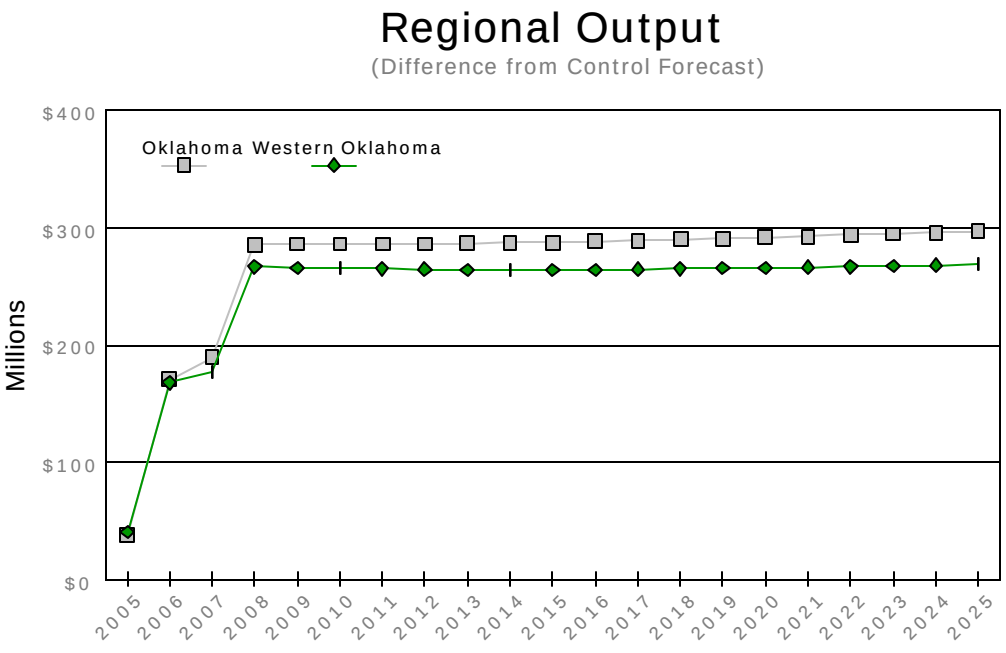
Commodity Access Index, Change in Local Supply, Employment, Intermediate Inputs

As will be recalled, Gross Regional Product is equal to the value of all final goods and services produced in a region during the year. Not included in the calculation of GRP is the value of intermediate goods, which is a significant source of economic activity in any regional economy. The reason that intermediate goods are not included in GRP is that the value of the intermediate goods would be counted twice in the GRP calculation. For example, automobile tires destined for use in the auto assembly industry are classified as intermediate goods since the value of the final product, a finished automobile, already includes the value of the tires in its price. Slightly complicating the picture is that not all tires are classified as intermediate goods. Tires destined for retail service stations are classified as final goods, and thus included in GRP, since the tires will be used as replacements on existing vehicles.

Returning to the topic, the calculation of regional output includes the economic activity associated with intermediate goods and services, and an alternative method to view the calculation of regional output is as the sum of GRP and intermediate inputs. Looked at in this light, many of the variables affecting and affected by regional output are the same variables affecting and affected by GRP. The primary difference between GRP an regional output is intermediate demand.

Beginning the regional output analysis, in 2005, when construction activity accounts for all of the increased economic activity, REMI forecasts the economic impact that the project has upon the state of Oklahoma would be $41.0 million. Most of the impact, $39.0 million, is projected to occur in western Oklahoma. As can be seen from the graph, the economic impacts of the biomass project experience a large growth rate in 2006 when construction activity finishes and operations begin at one-third of the facility's capacity. The growth rate slows, but the economic impacts still increase in 2007 when operations increase to two-thirds of capacity. In 2008, when the biomass facility reaches its operational capacity, the economic impacts experience another large growth rate and remain stable after that year.

In 2010, the REMI model forecasts Oklahoma's total regional output would be $253.361 billion if the Ag ChemCo facility were constructed and operated. With a 2010 control forecast of $253.074 billion, the economic impact that the biomass facility would have upon Oklahoma's regional output is projected to be $286.6 million. As can be seen from the table, most of the economic impact upon regional output would occur in western Oklahoma ($265.7 million).




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $38.640 billion | $38.905 billion | $265.7 million |
| State of Oklahoma | $253.074 billion | $253.361 billion | $286.6 million |

Intermediate demand for goods and services is projected to account for approximately 31.8%, or 12.28 billion, of western Oklahoma's regional output in 2010. As a proportion of regional output, the state of Oklahoma has more economic activity from intermediate demand since intermediate demand is projected to account for 36.2% or 91.548 billion, of the state's regional output. This means that the rest of Oklahoma is more dependent upon intermediate demand than western Oklahoma.

As with GRP, regional output can be broken into further detail. The accompanying table relates the economic impacts that the Ag ChemCo facility would have upon private nonfarm output over the whole time period. The table relates the same information for three geographic regions with the impacts in western Oklahoma and the rest of Oklahoma summing to equal the impacts in the state of Oklahoma.

The economic impact that the Ag ChemCo facility would have upon Oklahoma's regional output has a net present value of over $3.276 billion. Since the facility would be located in western Oklahoma and would use farm, rail, and ag services inputs from the region, the majority (92.4%) of the economic impacts are projected to occur in western Oklahoma.

As would be expected, the greatest economic impact upon the private nonfarm sectors occurs in the Non-Durable Manufacturing sector since the Ag ChemCo facility is classified in the Agricultural Chemicals industry - a nondurable manufacturing industry. The NPV of the economic impacts upon western Oklahoma's Non-Durable Manufacturing sector is projected to be over $2.376 billion. An additional $47.8 million NPV economic impact is projected to occur in the rest of Oklahoma's nondurable manufacturing sector bringing the total NPV for the state to over $2.424 billion.

Other nonfarm sectors of interest in this study are the TCPU (Transportation, Communication and Public Utilities) sector and the AFFS (Agricultural, Forestry & Fisheries Services) sector. The TCPU sector is of interest because both the Railroad industry and the Trucking industry are subsets of the TCPU sector, and the AFFS sector is of interest because baling services and ag storage services are subsets of the AFFS sector. Regarding the level of detail for the AFFS sector in the REMI model, the model contains only two industries. They are the Ag Services industry and Forestry/Fisheries/Hunting industry, and over 99.0% of the NPV economic impacts occur in the Ag Services industry in this study.

As can be seen from the table, the NPV of the economic impacts upon the TCPU sector's output in western Oklahoma total $115.4 million. Of the whole sector, the Railroad industry makes up 22.5% of the increased TCPU demand in a typical operation year and the Trucking industry accounts for 29.3% of the increased demand. The Trucking industry accounts for a greater share largely due to the indirect and induced economic activity occurring because of population increases and other industries expanding. Public utilities (electricity & water) also account for a sizeable share of the increased demand during a typical operation year at 29.7%.

## Net Present Value of Regional Output

| Output Industry | Western Oklahoma | Rest of Oklahoma | *State of Oklahoma* |
|---|---|---|---|
| Durable Manufacturing | $14,698,567 | $35,482,241 | *$50,180,808* |
| Non-Dur Manufacturing | $2,376,747,667 | $47,820,699 | *$2,424,568,366* |
| Mining | $5,708,360 | $17,788,073 | *$23,496,433* |
| Construction | $162,985,245 | $6,438,266 | *$169,423,511* |
| Trans, Comm & Public Util | $115,365,307 | $37,720,744 | *$153,086,051* |
| Finance, Ins & Real Estate | $47,265,158 | $25,455,597 | *$72,720,754* |
| Retail Trade | $79,196,695 | $14,333,791 | *$93,530,485* |
| Wholesale Trade | $65,260,895 | $16,405,829 | *$81,666,723* |
| Services | $88,879,866 | $44,829,847 | *$133,709,713* |
| Ag, For & Fish Services | $71,083,680 | $3,010,713 | *$74,094,394* |
| Total Regional Output | $3,027,191,440 | $249,285,799 | *$3,276,477,240* |

5% Discount Rate & 21 Years (2005-2025)

### 5.1.3 Real Disposable Income

**Real Disposable Income**

Personal income minus taxes & social contributions plus dividends, rents and transfer payments.

**Affected By**

Employment (Block 2), Commuter Income or Outflow, Property Income Transfers, Taxes, Social Security Payments, Wage Rate (Block 4), Consumer Prices (Block 4)

**Affecting**

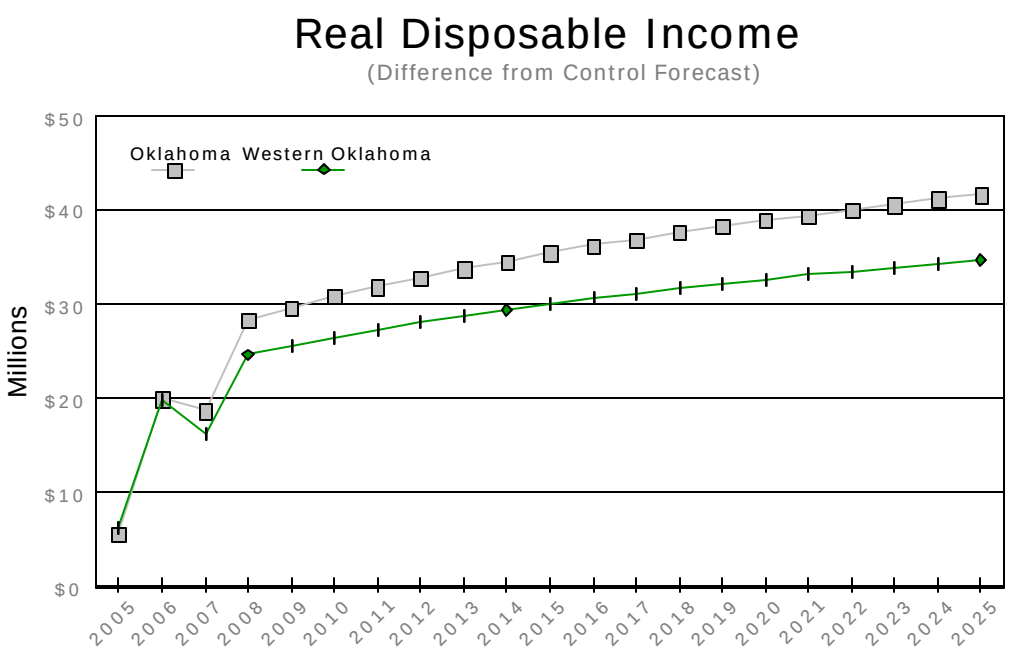
Consumption, Optimal Residential Capital Stock (Block 2)

Real disposable income is the amount of income that is available to be spent (or saved) by the population. It is not the total personal income, rather it is the total personal income adjusted for taxes and other income adjustments, which will be discussed with the Block 4 variables (beginning with section 5.4.4).

The real disposable income variable is affected by a number of variables outside of the Block 1 variables and may be thought of as a bridge to the Block 4 variables that provide wage, price and cost information in the REMI model. The primary variable affected by real disposable income is Consumption, discussed in section 5.1.1a, but it also affects the optimal level of capital stock (Block 2). The optimal level of capital stock represents the demand for capital stock, primarily housing in this case, and when a region's disposable income increases, the population spends a portion of the new income upon housing .

The economic impacts that would occur because of the construction and operation of the Ag ChemCo facility begin in 2005 with a $6.2 million impact upon western Oklahoma's real disposable income and a $6.6 million impact upon Oklahoma's real disposable income. After a large growth rate in 2006 in which the state's and the region's real disposable income is projected to be $20 million higher, the economic impact upon real disposable income decreases in 2007. It is important to keep in mind that the decrease does not mean lower income levels in the state and region, rather a decrease in the economic impact of the project upon real disposable income. The reason for this movement is that construction activity ends in 2006, and although operations increase from one-third of capacity in 2006 to two-thirds of capacity in 2007, the operational increase is not enough to make up for the end of the construction phase. By 2008 however, the economic impact that the Ag ChemCo facility is projected to have upon real disposable income experiences another large growth rate as operations increase to the facility's capacity.

Observable from the table accompanying the graph, the REMI model projects real disposable income would total $93.771 billion in 2010 for the state of Oklahoma if there were no changes. If the only change in the economy between now and then were the construction and operation of the Ag ChemCo facility, then the REMI model projects real disposable income to total $93.802 billion in the state. This means that the Ag ChemCo facility would have almost a $31 million impact upon the state's real disposable income in 2010. Of the total impact upon real disposable income, $26.56 million, or 85.8%, is projected to occur in western Oklahoma.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $12.167 billion | $12.194 billion | $26.56 million |
| State of Oklahoma | $93.771 billion | $93.802 billion | $30.94 million |

By 2025, the economic impact upon real disposable income is projected to be $41.7 million for Oklahoma and $34.7 million for western Oklahoma. The unadjusted sum of the economic impacts upon real disposable income over the whole time frame total $590.5 million in western Oklahoma and $693.4 million for the state of Oklahoma. The NPVs of the real disposable income impacts equal $337.8 million in western Oklahoma and $393.7 million for the state of Oklahoma.

### 5.1.4 Summary of Block 1 Impacts

Over the 2005-2025 time frame, some of the economic impacts that the Ag ChemCo facility were shown to have in western Oklahoma were:

- An NPV economic impact of $1.372 billion upon western Oklahoma's GRP
- An NPV economic impact of $389.0 million upon western Oklahoma's Consumption spending
- An NPV economic impact of $184.2 million upon western Oklahoma's Investment spending
- An NPV economic impact of $69.5 million upon western Oklahoma's Government spending
- An NPV economic impact of $729.0 million upon western Oklahoma's Net Exports
- An NPV economic impact of $75.8 million upon western Oklahoma's Farm Income
- An NPV economic impact of $3.027 billion upon western Oklahoma's Regional Output
- An NPV economic impact of $337.8 million upon western Oklahoma's Real Disposable Income

The impacts listed above are not the only economic impacts that the Ag ChemCo facility would have upon the regional economy - and ultimately the state economy. Given the integrated nature of the REMI model, the above impacts work their way through the rest of REMI's blocks of variables to impact other economic and socioeconomic variables. Relating the many variables is a comparative advantage offered by the REMI model and it allows the users to communicate the impacts of the Ag ChemCo facility in more detail than would be available if other economic impact software were used. The Block 1 variables will be shown to impact:

- Employment in Block 2
- Optimal Capital Stock in Bock 2
- Economic Migration in Block 3
- Cost & Price variables in Block 4
- Market shares (to be reported as imports and exports) in Block 5

Additionally, the economic impacts should not be viewed in isolation. Meaning, the regional output increases are not separate from the real disposable income increases - or for that matter separate from the population increases. Illustrating this point, the primary "shock" introduced to the economy was an increase in output from the Agricultural Chemical industry in western Oklahoma (the Ag ChemCo facility). Capital and labor are needed to produce this output increase, so the initial shock causes demand for employment and employment to increase (in Block 2). The increase in employment creates an increase in employment opportunity (a block 4 variable but not discussed in this study). And, initially, with a set labor force, demand for employment is increasing faster than the supply of labor. So, this imbalance causes wage rates to rise in order to attract labor to the jobs. An increase in the wage rates relative to the wage rates in other regions is the stimulus that attracts economic migrants, and with more migrants, the region's population increases. Because government spending is directly related to population in the REMI model, the increase in population will result in increased government spending (see page 13 for an explanation) which is one of the variables that affect regional output. So although the initial shock was entered into the model as an increase in regional output, not all of the reported regional output is Ag ChemCo output - some of it is output attributable to government spending increases because population increased.

## 5.2 Block 2 - Labor & Capital Demand Variables

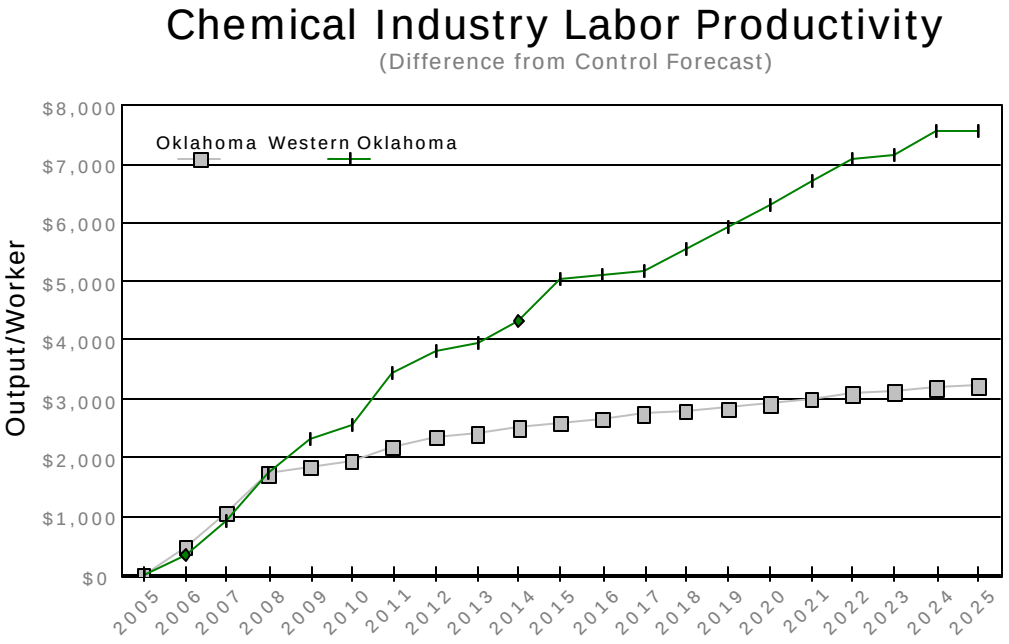
The second block of variables relates the economic impact that the Ag ChemCo facility would have upon the region's, as well as the state's, employment, labor productivity, and capital stock. This second block of variables serves to relate demand for factors of production (labor and capital - land is a third factor of production, but not covered here) necessary to increase the level of output in the economy. As will be seen later, this block of variables will interact with the third block of variables, Population & Labor Supply variables, to produce market clearing wage, price and cost adjustments in the fourth block of variables.

### 5.2.1 Labor Productivity


Labor productivity, which is defined as the total dollar value of output divided by its number of workers, relates the dollar value of output produced per employee. When labor productivity increases it usually means that output's rate of growth is increasing faster than employment's rate of growth.

Labor productivity can be measured for economies, sectors, industries, and even individual companies. For the purposes of this report, we will only report the changes in labor productivity for the Chemical industry in the regional and state economies. Since the Ag ChemCo facility would be classified in the Chemical industry, it might be expected that the greatest changes occur within that industry. And while there is an economic impact upon the labor productivity within other industries, the magnitude of those changes does not compare with the scale of those changes observed in the Chemical industry.

As a reminder, most of the graphs display the economic impact of the Ag ChemCo facility upon the regional and state economies, and there would not be any impact upon the Chemical industry labor productivity in 2005 since the Ag ChemCo plant would not begin its operations until 2006 in our model. Most of the growth between 2006 and 2008 occurs because operations at the facility are increasing to its capacity. After 2008, the relative increases in labor productivity occur for other reasons, which may include a labor force learning from mistakes, new machinery, new technology, or the productivity gains associated with clustering of industries.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $495,898/worker | $498,471/worker | $2,574/worker |
| State of Oklahoma | $480,384/worker | $482,350/worker | $1,965/worker |

In the 2010 control forecast, REMI forecasts labor productivity to be $495,898/worker in western Oklahoma and $480,384/worker in the state. This means that the average Chemical industry worker in western Oklahoma is more

productive ($15,514/worker) than the average Chemical industry worker in the state as a whole. In the 2010 alternative forecast, REMI projects labor productivity to be $498,471/worker in western Oklahoma and $482,350/worker in the state of Oklahoma. Therefore, the economic impact that the Ag ChemCo facility would have upon western Oklahoma would be $2,574/worker in 2010. Likewise, the economic impact that the Ag ChemCo facility would have upon the state would be to increase labor productivity in the Chemical industry by $1,965/worker. These economic impacts would not occur unless the Ag ChemCo facility locates in western Oklahoma.

The impact upon western Oklahoma is greater than the impact in the state because the facility would be located in western Oklahoma and the labor productivity impacts are more concentrated in the region than in the state. The labor productivity variable is unlike other variables in that the magnitude of the impact is greater in the region than in the state as a whole. This does not mean that the rest of Oklahoma is experiencing negative economic impacts in labor productivity. Rather, the output gains in western Oklahoma's Chemical industry have to be spread among more Chemical industry employees in the state.

### 5.2.2 Oklahoma Employment

**Employment**

Bureau of Economic Analysis (BEA) concept based on place of work; includes full-time and part-time employees.

**Affected By**

Labor/Output Ratio, Output (Block1), Labor Productivity

**Affecting**

Capital Stock, Real Disposable Income (Block 1), Employment Opportunity (Block 4), Wage Rate (Block 4)

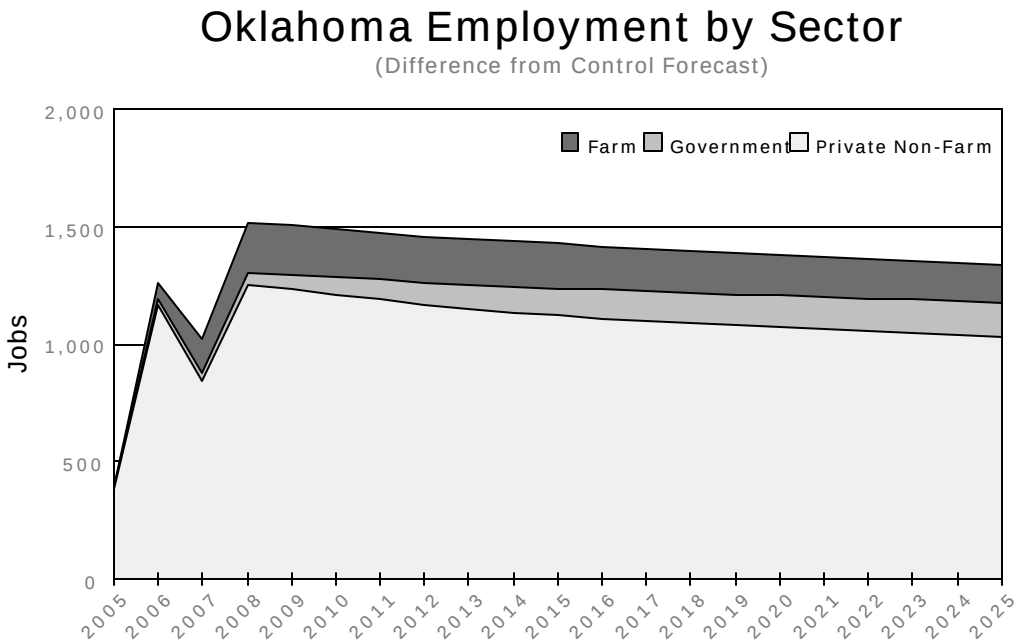
In order to give more detail for the employment data, the employment statistics will be separated by geographic region. Economic impacts that the Ag ChemCo facility is projected to have upon the state of Oklahoma will be presented in this section, and the economic impacts that the Ag ChemCo facility is projected to have upon western Oklahoma will be presented in the next section (5.2.3).

The accompanying area graph relates the economic impact that the Ag ChemCo facility would have Oklahoma's total employment (the topmost line) and the relative proportions held by the three major employment divisions (private nonfarm employment, government employment, and farm employment). As will be seen later in this section, private nonfarm employment will be further dissected to communicate employment impacts upon ten sectors in the economy. Most of these major sectors can be further disaggregated; however, we will only disaggregate the impacts upon nondurable manufacturing employment to relate the relative impacts upon the industries contained within the nondurable manufacturing sector. Lastly, further detail will be presented detailing occupational employment impacts projected to occur in the state.

One of the variables affecting employment is output, and as will be recalled, the operational capacity at the proposed biomass facility would produce $250 million worth of output per year. Since the output variable is used as one of the model's inputs., employment will need to increase to achieve the desired level of output.

In 2005, the economic impact that the facility's first year of construction has upon Oklahoma is to increase total employment by 392 jobs. Of that total, 387 jobs occur in the private nonfarm division and the remaining 5 jobs occur in the government division. Since the Ag ChemCo facility would not begin operating until 2006, there is no impact upon the farm employment in 2005. Regarding the private nonfarm employment in 2005, about 62.4% (241 jobs) of it occurs in the Construction sector, about 17.1% (or 66 jobs) occurs in the services sector, and another 12.1% (or 47 jobs) occurs in the Retail Trade sector.

Total employment increases in 2006 to 1,264 jobs as construction is completed and operations begin at one-third of capacity in the Ag ChemCo facility. About 5.8% (or 74 jobs) of the total employment in 2006 is Farm employment, and 1.7% (or 21 jobs) is government




| Sector Employment | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Private Non-Farm | 1,879,037 Jobs | 1,880,250 Jobs | 1,214 Jobs |
| Government | 351,061 Jobs | 351,135 Jobs | 73 Jobs |
| Farm | 90,577 Jobs | 90,784 Jobs | 206 Jobs |
| Total State | 2,320,675 Jobs | 2,322,168 Jobs | 1,493 Jobs |

employment. In 2007, the economic impact that the project has upon employment decreases since jobs associated with the facility's construction (a labor intensive industry) are no longer present and the increase in operations to two-thirds of capacity is not enough to offset the decrease in construction employment. It is important for the reader to keep in mind that the graphed decrease is a decrease in the economic impact of the facility and not a decrease in the total level of employment.

In 2008, the economic impact that the Ag ChemCo facility has upon the state rises to its highest point (1,515 jobs) as the facility reaches its operational capacity. After 2008, the employment impacts that the facility has upon the state economy decreases. Labor productivity is the cause of the decreased impacts. As will be recalled from section 5.2.1, not only is labor productivity projected to increase in the Chemical industry over time in the control forecast, it is projected to grow at an even higher rate in the alternative forecast. Given a constant level of output ($250 million) to be produced at the Ag ChemCo facility and increasing productivity (section 5.2.1), the amount of employment necessary to produce the constant output decreases.

Consistent with the formats presented earlier, the table below the Oklahoma employment graph (page 23) relates the control forecast, alternative forecast, and economic impact that the Ag ChemCo facility would have in 2010. As can be seen, if nothing changes economically, total employment is projected to reach 2.321 million jobs in Oklahoma by 2010. Comparatively, 2001 total employment equaled 2.059 million jobs, therefore this represents an increase of approximately 262,000 jobs from 2001. However, should the only economic change be the construction and operation of the Ag ChemCo facility, total employment is projected to be 2.322 million jobs. The economic impact upon Oklahoma's total employment of the biomass facility would be 1,493 jobs in 2010.

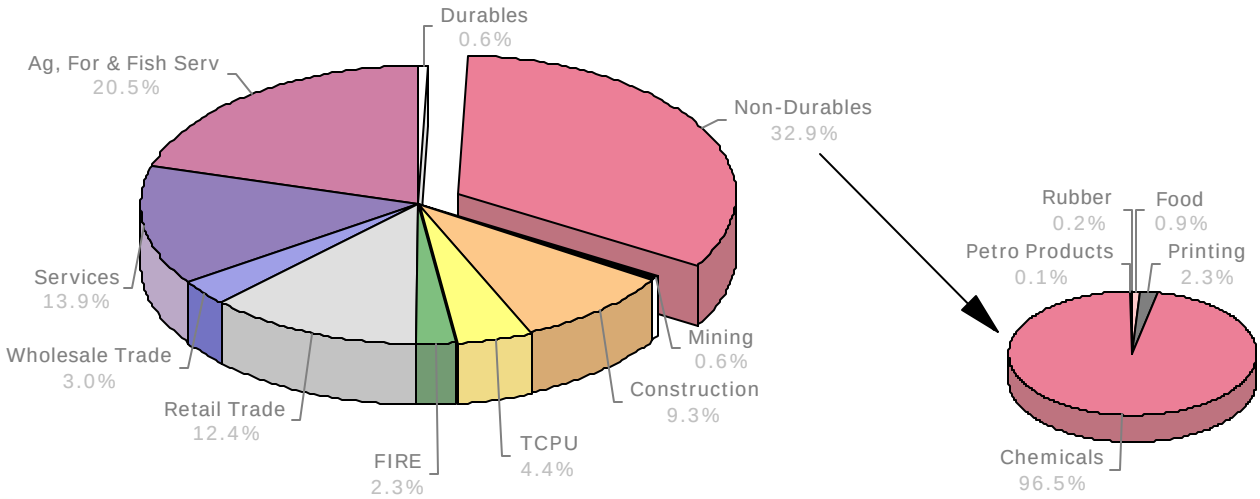
The following pie charts relate the average composition of private nonfarm employment in Oklahoma over the modeled time frame. The average composition was calculated by dividing the average sector employment by the average private nonfarm employment. The smaller pie chart provides greater industry detail directly relating to the nondurable manufacturing industry in Oklahoma. For comparative purposes, the average private nonfarm employment impact equals 1,074.7 jobs over the whole time period.

| Industry Employment |
| --- |
| Employment reported by industry. |
| Affected By |
| Labor Productivity, Output (Block 1) |
| Affecting |
| Occupation Employment, Optimal Non-Residential Capital Stock, Residentially-Adjusted Employment, Real Disposable Income (Block 1) |

As would be expected, the nondurable manufacturing sector accounts for the greatest share (32.9%) of employment gains primarily because the Ag ChemCo facility is classified as a Chemical industry. The average employment associated with the nondurable manufacturing sector equals 353.5 jobs. Furthermore, most of the employment gains in the nondurable manufacturing sector are projected to

Average Composition of Private Non-Farm Employment in Oklahoma

(Employment Proportions resulting from Biomass Facility)



occur in the Chemical industry. The chemical industry is further comprised of eight chemical industries including the Agricultural Chemical industry, industrial organic chemical industry, etc.

Other major sectors accounting for large proportions of the employment gains are the Agriculture, Forestry & Fisheries sector (20.5% or 220.3 jobs), the Services sector (13.9% or 149.3 jobs), Retail Trade sector (12.4% or 133.3 jobs), and the Construction sector (9.3% or 99.9 jobs). Almost all of the employment gains in the Agriculture, Forestry & Fisheries sector are attributable to agricultural services provided to farmers in the region - harvesting services, baling services, etc.


The greatest level of employment detail offered by the REMI model is occupational detail, which is calculated using national industry averages. For example, not all of the employment gains in the agricultural chemical industry will be production workers. There will be management occupations, clerical occupations, etc. The relative proportion held by the various occupations is determined by the national average in the agricultural chemical industry. Therefore, if production occupations account for fifty percent of the occupations in the national agriculture industry, then the model will use that proportion to calculate the number of production workers associated with Ag ChemCo. Associated with this information, the assumption is made that the Ag ChemCo facility is representative of the national agricultural chemical industry.

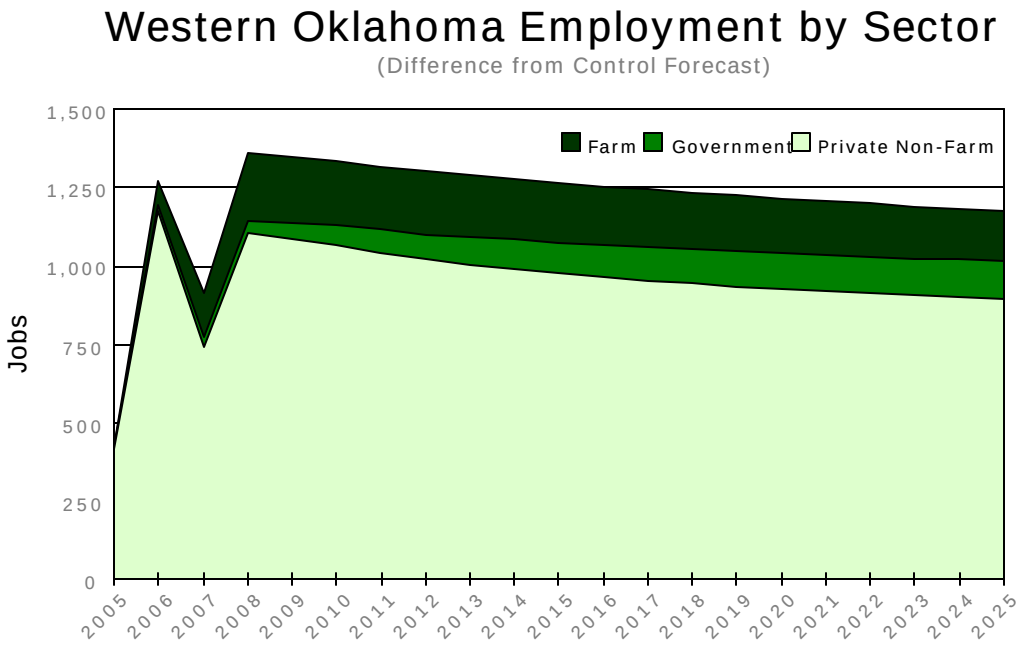
While the model provides information for ninety-four occupational categories, they remain broad categories and only the top fifty occupations impacted by the Ag ChemCo facility are presented in Appendix B. As an example of the broad nature of some of the occupational categories, management occupations (#2 on the list of occupational employment) includes twenty-seven more specific management occupations - including chief executives, operations managers, sales managers, construction managers, and purchasing managers.

### 5.2.3 Western Oklahoma Employment

Since the Ag ChemCo facility will be located in western Oklahoma, most of the economic impacts are projected to occur in the region. It is for this reason that much of the impact information for western Oklahoma will appear similar to the impact information presented for the state in the previous section. As will be noticed, the primary difference between the state's economic impact and the region's economic impact will be the magnitude of the impact.

During the two-year construction phase (2005-2006) of the project, western Oklahoma's employment gains are greater than the state's employment gains. This indicates that the economic impact of the facility's construction attracts workers from the rest of Oklahoma to build the Ag ChemCo facility in western Oklahoma. To expound upon these impacts, total employment grows from 423 additional jobs in 2005 to 1,271 additional jobs in 2006 in western Oklahoma. Over the same period in the state of Oklahoma, total employment grows from an additional 392 jobs to an additional 1,264 jobs. Given this information, the impact in the rest of Oklahoma equals 31 fewer jobs in 2005 and 7 fewer jobs in 2006. All of these employment differences can be traced to the construction industry in which construction workers are being attracted to western Oklahoma to build the Ag ChemCo facility.

By 2007, after the construction phase has ended and the Ag ChemCo facility is operating at two-thirds of capacity, the employment impacts are greater in the state (1,019 jobs) than the region (917 jobs). This means that there are positive employment impacts (102 jobs) occurring in rest of Oklahoma when the facility's operations constitute the only source of additional economic activity. As will be discussed in the economic migration section (section 5.3.1), the relative employment opportunities also show up in the economic migration statistics in which western Oklahoma has more economic migrants than the state in 2005 when the construction phase is starting. This means that some of western Oklahoma's economic migrants are coming from the rest of Oklahoma. By 2007, the state has more economic migrants than the region.




| Sector Employment | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Private Non-Farm | 278,506 Jobs | 279,571 Jobs | 1,065 Jobs |
| Government | 80,592 Jobs | 80,656 Jobs | 64 Jobs |
| Farm | 34,353 Jobs | 34,559 Jobs | 206 Jobs |
| Region | 393,450 Jobs | 394,786 Jobs | 1,335 Jobs |

In the 2010 control forecast, the REMI model projects western Oklahoma's private nonfarm employment to total 278,506 jobs, and the 2010 alternative forecast projects private nonfarm employment to total 279,571 jobs. As can be seen from the table, the economic impact of the Ag ChemCo facility in 2010 equals 1,065 jobs. Since the economic impact upon the state's private nonfarm employment totals 1,214 jobs in the same year, the rest of Oklahoma benefits from an employment impact of 149 private nonfarm jobs. A comparison of the relative size of the region's and the state's private nonfarm sector reveals that the region accounts for approximately 14.8% of private nonfarm sector employment in Oklahoma.

Regarding western Oklahoma's farm sector employment, the economic impact of the Ag ChemCo facility is projected to be 206 jobs in 2010. As will be recalled from the state's farm sector employment, the economic impact will also be 206 jobs in 2010. This indicates that all of the impacts that the Ag ChemCo facility will have on the farm sector will occur in western Oklahoma.

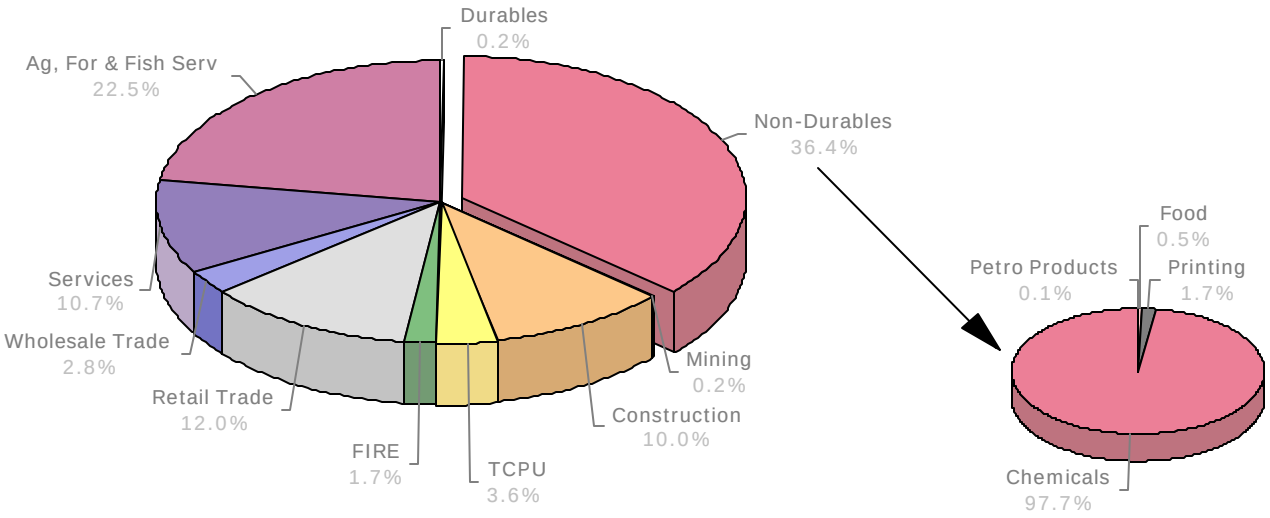
As with the state of Oklahoma, the economic impacts upon private nonfarm employment can be identified based on the same average composition within the ten major sectors. Given the location of the Ag ChemCo facility, the proportion of nondurable manufacturing employment is greater in western Oklahoma (36.4%) than the state of Oklahoma (32.9%). Further detail reveals that employment in the chemical industry comprises nearly all (97.7%) of the nondurable manufacturing employment in western Oklahoma.

As with the state of Oklahoma, Agricultural, Forestry & Fisheries sector employment accounts for the second-largest share of private nonfarm employment at 22.5%.. Whereas the service sector accounted for the third-largest proportion of private nonfarm employment in Oklahoma, the retail trade sector accounts for the third-largest in western Oklahoma. This means that a greater share of the service sector jobs occur in the rest of Oklahoma (which is composed of northeast Oklahoma, southeast Oklahoma, the Tulsa MSA and the Oklahoma City MSA) than in western Oklahoma.

Regarding the service sector, the 2010 economic impact results in an additional 111 jobs in western Oklahoma and an additional 165 jobs in Oklahoma. Analysis of the data reveals that most of the service sector jobs are projected to occur in the business service industry which includes advertising, services to buildings, equipment rental, personnel supply and computer data processing services.

Average Composition of Private Non-Farm Employment in Western Oklahoma

(Employment Proportions resulting from Biomass Facility)



### 5.2.4 Capital Stock

Capital stock is divided into three components in the REMI model, residential capital stock, nonresidential capital stock and utility capital stock. Residential capital stock includes residential housing in the regional economy, nonresidential capital stock includes commercial & industrial buildings and machinery, and utility capital stock includes fixed assets used by electric and gas utilities like pipelines and power substations.

**Actual Capital Stock**

The amount of capital stock exsisting in the economy.

**Affected By**

Cumulative effects of Investment

**Affecting**

Gap Between Actual & Optimal Capital Stock, Investment Spending (Block 1)

**Optimal Capital Stock**

The amount of capital stock that would need to exsist in the economy in order to satisfy current demand for capital stock.

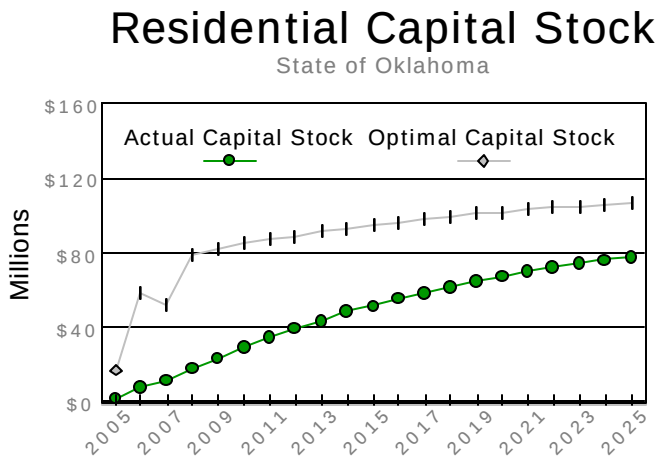
**Affected By**

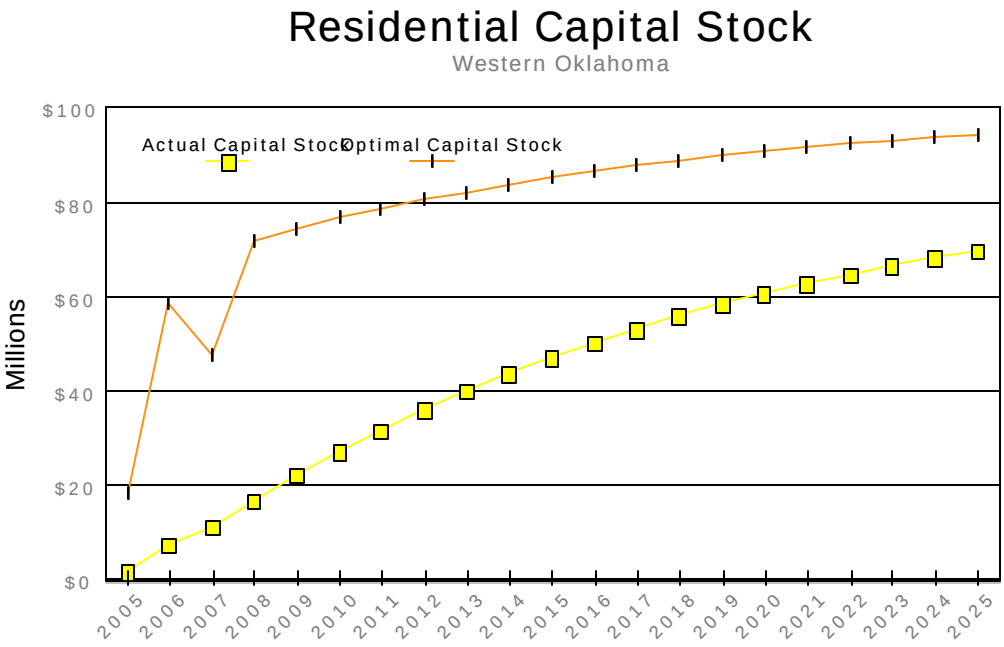
Real Disposable Income (Block 1)

**Affecting**

Gap Between Actual & Optimal Capital Stock, Investment Spending (Block 1)

While actual capital stock refers to the amount of capital stock presently existing in the economy, optimal capital stock refers to the amount of capital stock that would presently need to exist in the economy in order to satisfy current demand for capital stock. The difference between the two variables represents the future level of investment spending required in order to satisfy current demand for capital stock in the economy. And it is this gap between the two variables that provides the stimulus for investment spending (section 5.1.1b) changes.



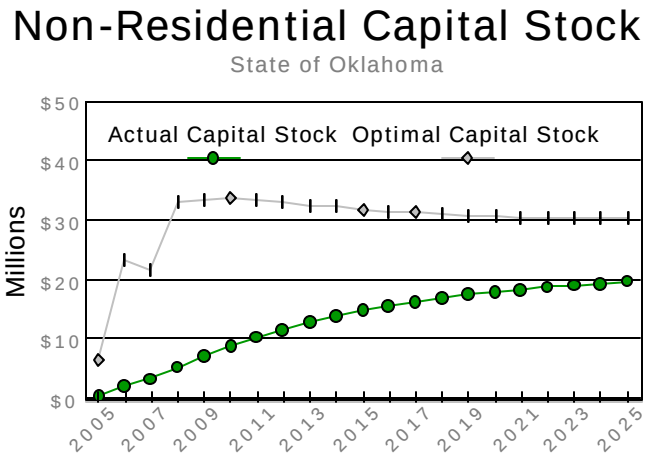

| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $25.310 Billion | $25.338 Billion | $29.42 Million |
| State of Oklahoma | $134.583 Billion | $134.613 Billion | $27.22 Million |

An important note, the actual capital stock variable is a cumulative impact variable in the model, which means that the reported impact in any given year is equal to the sum of the impacts that occurred in previous years. For example, the 2010 economic impact of the Ag ChemCo facility upon residential capital stock is projected to be $27.2 million in western Oklahoma. The $27.2 million figure does not mean that there will be $27.2 million worth of residential capital stock being added to western Oklahoma's residential capital stock in 2010. Rather, the $27.2 million figure is the additional residential capital stock that is projected to be added over the 2005-2010 time

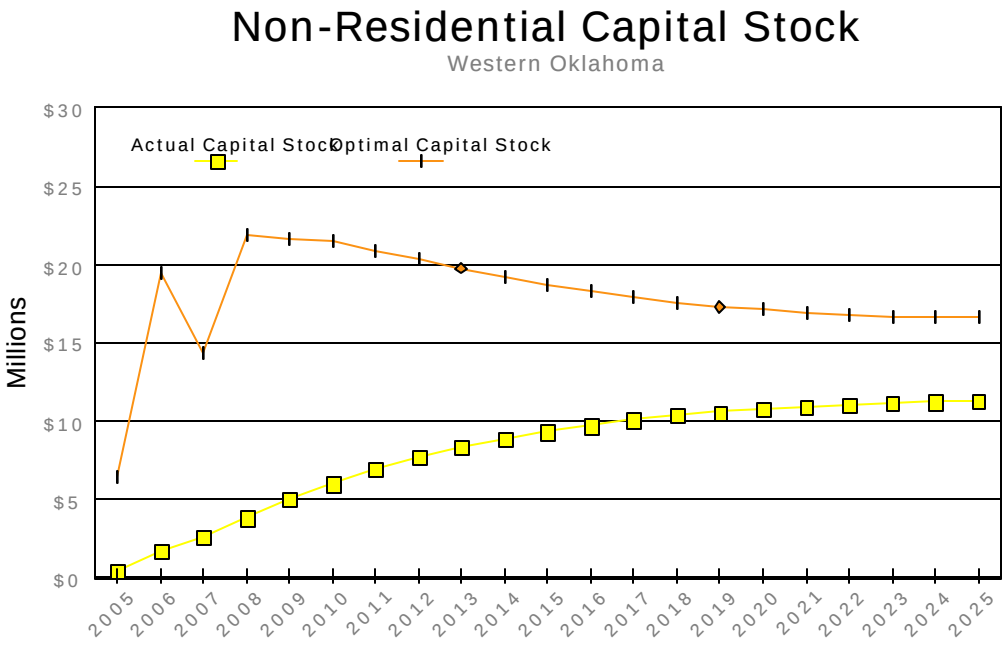
frame. To calculate the capital stock added to the economy in any given year, take the difference between the current year's figure and the previous year's figure.

Observable from the residential and nonresidential line graphs, the optimal capital stock variable fluctuates more than the actual capital stock variable. The reason for this is that optimal capital stock is directly influenced by changes in real disposable income. As real disposable income fluctuates, the demand for capital stock also fluctuates in the economy. However, actual capital stock changes gradually over time since it takes time for the markets to react and add additional capital stock to the economy.

Specifically addressing nonresidential capital stock, the 2010 control forecast projects nonresidential capital stock to be $11.386 billion in western Oklahoma and $70.416 billion in the state. With the 2010 alternative forecasts equal to $11.393 billion in western Oklahoma and $70.425 billion in the state, the 2010 economic impacts that the Ag ChemCo facility would have upon nonresidential capital stock would equal $6.07 million in western Oklahoma and $8.90 million in the state.




By 2025, the economic impact that the Ag ChemCo facility would have upon Oklahoma's economy would be to produce an additional $78.3 million worth of residential capital stock and an additional $19.8 million worth of nonresidential capital stock. Most of the capital stock impacts would occur in western Oklahoma as the economic impact upon the region's residential capital stock is projected to be $69.9 million by 2025 and the impact upon the region's nonresidential capital stock is projected to be $11.4 million by 2025. New residential capital stock in western Oklahoma accounts for 88.7% of the state's new residential capital stock, while new nonresidential capital stock in western Oklahoma accounts for 57.6% of the state's new nonresidential capital stock by 2025.

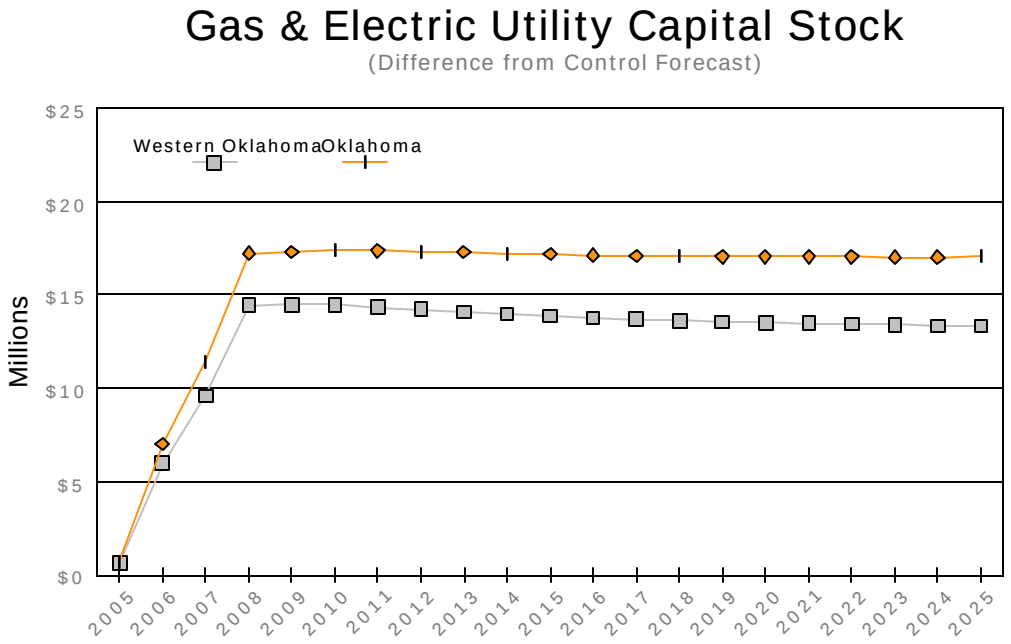



| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $11.386 Billion | $11.393 Billion | $6.07 Million |
| State of Oklahoma | $70.416 Billion | $70.425 Billion | $8.90 Million |

Unlike residential and nonresidential capital stock variables, the REMI model projects only the actual level of utility capital stock (please see the next page for the utility capital stock graph). The optimal level of

utility capital stock is not reported since utility capital stock responds to changes in the levels of residential and nonresidential capital stock. The rationale for this is that utility companies will not build capital stock unless there is a reason to build capital stock. The expansion in nonresidential capital stock provides the stimulus for the expansion in utility capital stock.

As can be seen from the accompanying graph, the economic impact the Ag ChemCo facility has upon utility capital stock quickly increases between 2005 and 2008 in both the state and the region. The impacts stabilize after 2008, and the peak economic impact upon utility capital stock occurs in 2010 for both the region and state - $14.48 million in western Oklahoma and $17.43 million in the state.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $3.951 Billion | $3.965 Billion | $14.48 Million |
| State of Oklahoma | $19.403 Billion | $19.420 Billion | $17.43 Million |

The relative proportions of each of the capital stock categories provides additional information regarding the composition of capital stock in both the region and the state. In western Oklahoma, residential capital stock accounts for approximately 62.3% of the total capital stock, nonresidential capital stock accounts for approximately 28.0% of the total, and utility capital stock comprises the remaining 9.7% of total capital stock. Alternatively for the state of Oklahoma, residential capital stock accounts for 60.0% of total capital stock, nonresidential capital stock accounts for 31.4% of the total, and utility capital stock accounts for the remaining 8.6% of total capital stock.

### 5.2.5 Summary of Block 2 Impacts

Over the 2005-2025 time frame, some of the economic impacts that the Ag ChemCo facility were shown to have in western Oklahoma were:

- Additional labor productivity in the chemical industry of $2,574/worker in 2010 increasing to $7,568/worker in 2025
- Additional private nonfarm employment totaling 1,065 jobs in 2010
- Additional government employment totaling 64 jobs in 2010
- Additional farm sector jobs totaling 206 jobs in 2010
- Additional total employment gains totaling 1,335 jobs in 2010
- Additional residential capital stock totaling $69.9 million by 2025
- Additional nonresidential stock totaling $11.4 million by 2025
- Additional utility capital stock totaling $13.4 million by 2025

The impacts listed above were affected by variables already discussed with the block 1 variables (including output and real disposable income) and will be shown to have been impacted by some of the wage rate variables in block 4. Alternatively, some of the variables impacted by the Block 2 variables are:

- Investment spending in Block 1
- Real disposable income in Block 1
- Participation rate in Block 3
- Cost & Price variables in Block 4

## 5.3 Block 3 - Population & Labor Supply Variables

Block three's variables detail the impacts that the proposed biomass facility would have on population and labor supply. The third block of variables serve to relate the population and labor supply adjustments projected to occur in order for the market to satisfy demand for new employment created in the second block of variables. These adjustments in population and labor supply are largely influenced by employment (block 2) and wage rates (block 4). Additionally, the changes in population and labor supply interact with the labor and capital demand variables (block 2) to produce wage, price and cost adjustments in block four variables.

### 5.3.1 Economic Migration

Understanding what economic migration is, what it impacts, and what impacts it, will give the reader a better understanding of the information presented in this section. Economic migration is the variable within block three that drives economic population growth within a region. A detailed definition of economic migration and the variables that it interacts with can be found to the right.

**Economic Migration**

Migrants under age 65 (who were part of the civilian population in the US the preceding year) who respond to economic and amenity factors; if value is negative, then more people are moving out of a region than moving in and vice versa; the rate of migration is determined by REO, RWR, and the amenity term.

**Affected By**

Commodity Access Index (Block 1), Employment Opportunity (Block4), Relative Wage Rate (Block 4)

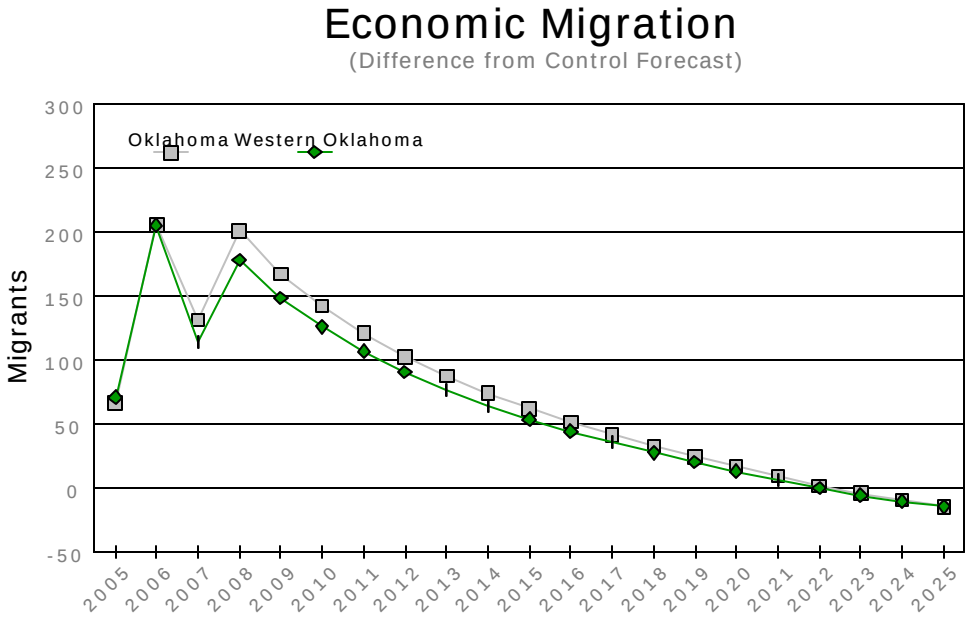
**Affecting**

Population

The three variables that effect economic migration are Relative Employment Opportunity (REO), Relative Real Wage Rate (RWR), and the amenity term (Commodity Access Index). REO is the employment opportunity within a region relative to the rest of the United States. The RWR is a variable that takes into consideration both the average wage by industry and the cost of living within a region compared to the same two variables in the rest of the United States. The amenity term is a quality of life measurement variable. Increases in REO, RWR, and the amenity term equates to higher economic migration impacts. It should be noted that economic migration does not include international migrants, retired migrants, or military dependents.

An important aspect to remember about economic migration is that it is "additive". That is, each year's migration figure is separate from the previous year's figure and these figures are added to the population. Positive economic migration is indicative of a growing population. In the next section (5.3.2) the impacts on population will be shown and the reader will be able to see the correlation between economic migration and population. Before moving on to population it should be noted that most of the economic migration impact takes place in western Oklahoma versus the rest of Oklahoma. This is to be expected given that the facility will be constructed in western Oklahoma.

The accompanying graph shows the impact on economic migration caused by the construction and operation of the proposed biomass conversion facility from 2005 to 2025. As stated in the project assumptions (section 3.1),




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | 502 migrants | 628 migrants | 126 migrants |
| State of Oklahoma | 5,327 migrants | 5,470 migrants | 143 migrants |

construction will start in 2005 and finish in 2006. Operations ramp up to capacity by 2008. All of these actions have impacts on economic migration into western Oklahoma that show up in the graph.

In 2005 and 2006, there were 71 and 205 economic migrants respectively in western Oklahoma as a result of construction. This tapers off in 2007 to 114 economic migrants as construction ends in 2006 and operations start at less than 100% capacity. There are not enough new jobs associated with the plant operating at partial capacity to attract more workers than those who are leaving because of construction ending. When the plant finally reaches full capacity in 2008 economic migration in western Oklahoma once again rises above 170 to reach 179 migrants on the year. After 2008, the economic migration impacts slowly decrease until 2023 when they become a negative impact at -14 migrants.

A negative impact means that economic migration in the alternate forecast has dropped below the level in the control forecast. This does not mean that economic migration levels are forecasted to reach negative levels, rather it means that the number of economic migrants are slightly lower than would have otherwise been expected. This negative impact can be explained in part by increased worker productivity as reported in section 5.2.1 as well as by the fact that the REO and RWR variables decrease as the supply of labor increases (see the labor force analysis in section 5.3.4).

The negative impact levels in the final years of the project are not overly significant due to the fact that the net difference between the control forecast and the alternate forecast is 1,524 migrants for the state and 1,360 migrants for western Oklahoma over the entire period. It simply means that the region's early migration gains were greater than could be sustained and they are returning to equilibrium.

Moving on, the table below the graph shows the actual levels of the two regions economic migration for the year 2010 in the control and alternate forecasts. Looking at western Oklahoma one sees that the control forecast predicts 502 migrants, while the alternate forecast predicts 628 migrants. The impact, which is the difference between the alternate and control, is 126 migrants in 2010. The reader can see that this figure corresponds to what is graphed.

### 5.3.2 Population

**Population**

Mid-year estimates of population, including survivors from the previous year, births, special populations, and three types of migrants (economic, international, and retired).

**Affected By**

Economic Migration

**Affecting**

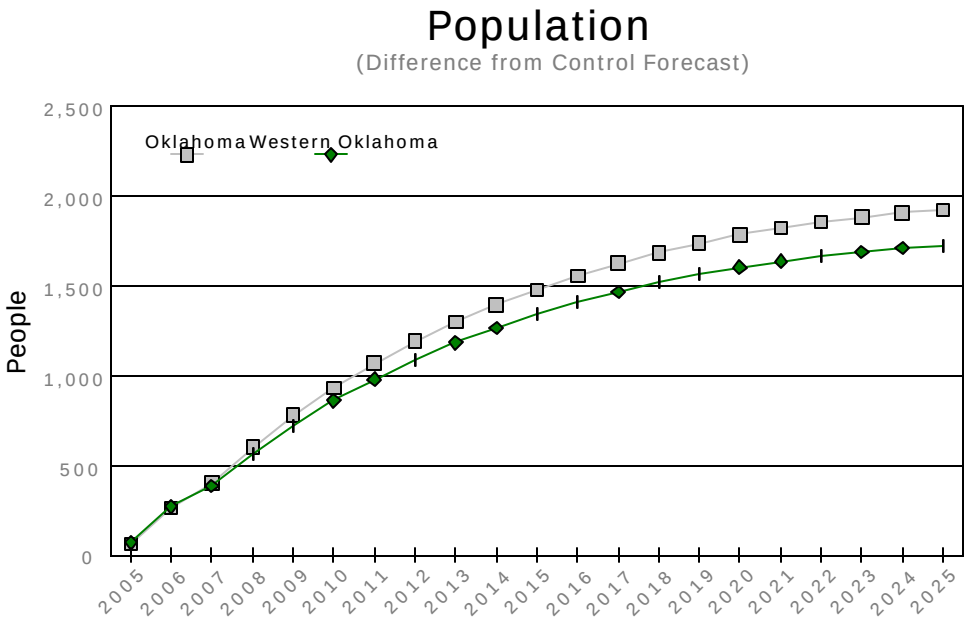
Potential Labor Force, Labor Force, Local/State Government Spending (Block 1), Consumption Spending (Block 1), Housing Price (Block 4)

Population is the next economic variable in block three and is directly affected by economic migration. It is also important in the REMI model because it impacts several other variables including labor force, government spending, and housing prices. Perhaps the most important aspect of population is the impact that it has on consumption spending, which is one of the driving forces of the economy.

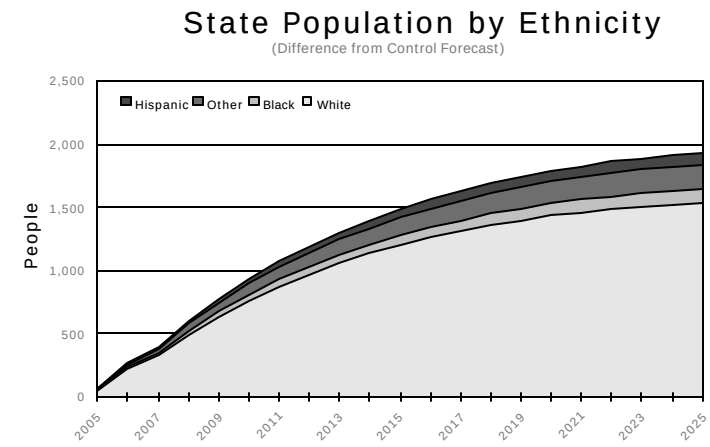
Below is a graph of the population impacts on western Oklahoma and the state as a whole. As the reader can see, both regions are very similar and follow the trends set by their respective economic migration graphed in section 5.3.1. This occurs because each year the total number of economic migrants is added to previous years population to come up with the current years population. Birth and death rates also factor into this calculation, but play a minor role in the economic impacts upon population. The graph shows that both regions experience an increasing population impact. Both western Oklahoma and Oklahoma see a slightly slower growth rate in 2007, with the state gaining 400 people and western Oklahoma gaining 387 people. This is the first year after construction finishes and plant operations have yet to reach capacity. Referring to the economic migration graph in section 5.3.1, one can see that economic migration impacts dropped considerably in this year. This is another illustration of how impacts work through the economy.

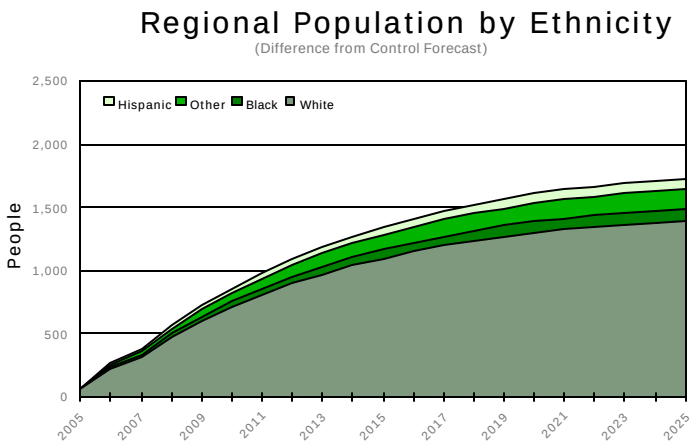
Western Oklahoma and the state's population impacts continue to climb until 2025. The state's population impact end at 1,928 more people, while the population impact for western Oklahoma ends with 1,726 more people in 2025. As will be recalled, there were 1,524 economic migrants in Oklahoma of which 1,360 economic migrants came to western Oklahoma. Therefore, 79.0% of the state's population growth and 78.8% of the region's population growth are attributable to economic migration. The remaining population growth is mostly attributable to an increase in the number births minus the number of deaths. Retired migrants and international migrants play a smaller role in the population growth.

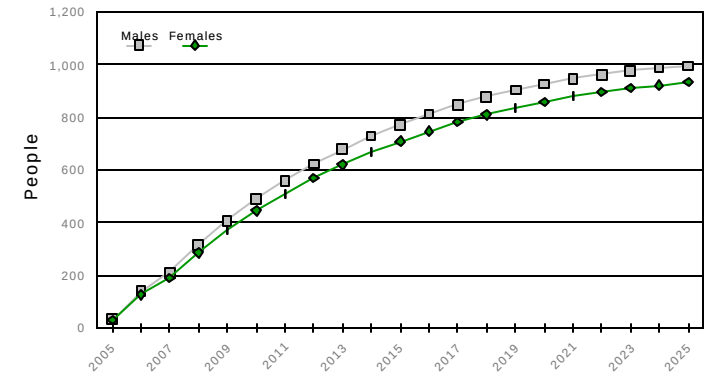
The table below the graph shows how the data for the graph was derived. For instance, to derive the population impact that the proposed biomass facility would have on western Oklahoma in 2010 one would take the difference between the alternate forecast level and the control forecast level. In this case, 637,060 people minus 636,199 results in an economic impact of 861 people. The same is done for the state subtracting the 3,655,250 people from the control forecast from the 3,656,185 people of the alternate forecast to get the economic impact of 935 people. In 2010, a majority of the economic impact on population occurred within the western Oklahoma region as 92.1% (861 people out of 935 people) of the population growth impacted western Oklahoma. This remains true for the whole time period graphed; although, the rest of Oklahoma's share of the impact grows the closer one gets to 2025.

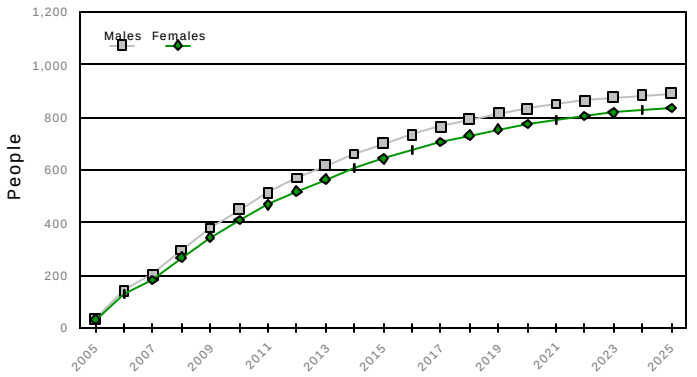



| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | 636,199 people | 637,060 people | 861 people |
| State of Oklahoma | 3,655,250 people | 3,656,185 people | 935 people |




To give the reader some perspective on these forecasts and impacts, Oklahoma's estimated population in 2001 according to the United States Census Bureau was 3,460,097 people. Also according to the US Census Bureau western Oklahoma's estimated 2001 population was 611,608 people.[6] Western Oklahoma is the thirty-two county region defined in section 3.2.

The next two graphs show the impact on the state's and western Oklahoma's population broken out by ethnic group. These graphs reflect the current ethnic diversity levels and growth rates occuring in the region, which plays a large role in how REMI determines what the ethnic breakout of the population differences will be.

The impact on western Oklahoma's population broken down by gender is initially very even between males and females. In 2010 western Oklahoma's population impact is composed of 451 males and 410 females. As the forecasts extend further into the future the impact becomes slightly skewed toward males. Western Oklahoma's population impact in 2025 is made of 892 males and 834 females. This also occurs for the state's population impacts with the impact broken out by gender resulting in 490 males and 445 females in 2010 and 996 males and 932 females in 2025.

As the graphs in this section show the building of a biomass conversion plant would have a definite economic impact upon the state. The impacts on population in turn affect the regions participation rates, which will be discussed in the next section.

### 5.3.3 Participation Rates

**Participation Rate**

The actual labor force divided by the size of the population in a particular age-gender-racial cohort.

**Affected By**

Employment to Potential Labor Force Ratio, Relative Wage Rate (Block 4)

**Affecting**

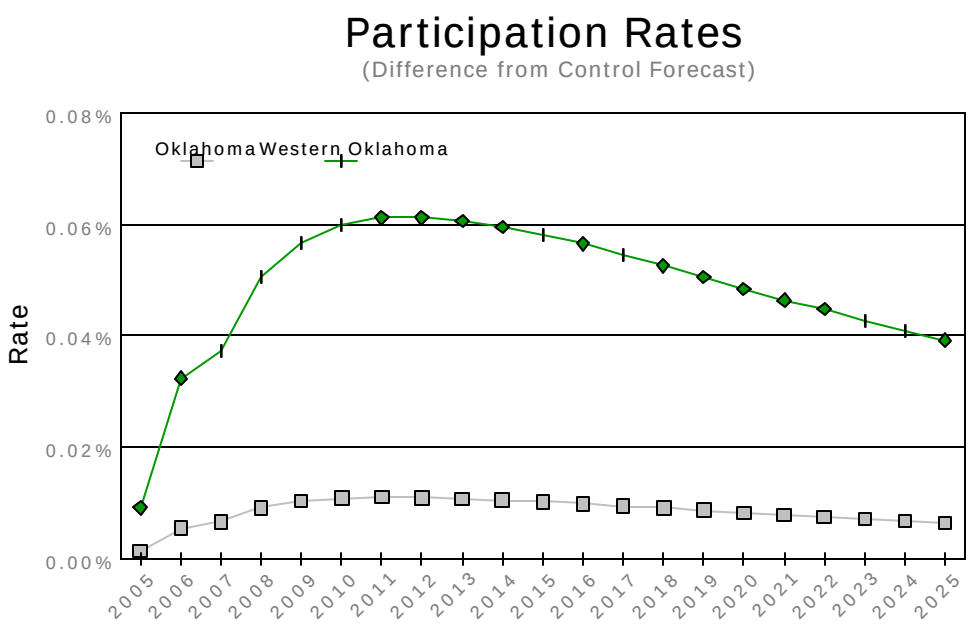
Labor Force

Participation rates are important because they reveal what percentage of the working age population is part of the labor force. This rate can be indicative of how the economy is doing and of how large a supply of labor there is to produce the goods and services demanded by the population.

Taken with the other variables, the impact on western Oklahoma's participation rate shows that the biomass conversion plant would have a sizable impact on western Oklahoma. As with the other graphs in this report the graph below reports impacts that this project would have or the difference between REMI's control forecast and on an alternate forecast. The table below the graph gives an example of how the impact is calculated for the year 2010.

The graph also indicates that, as a whole, the state's participation rate would change very little, only slightly more than a peak of 0.01% over the lifetime of the period graphed. Western Oklahoma on the other hand sees a more pronounced impact on its participation rate. Construction of the facility has an immediate impact with western Oklahoma's participation rate jumping to just below .01% in 2005 before climbing to .03% in 2006. Western Oklahoma's participation rate impact continues to climb until 2011 when it reaches .06%. It then starts to slowly erode in 2013 until it falls to .04% in 2025. These impacts are important because a regions participation rate along with its population determines how large its labor force is.

Below the graph is a table showing an example of what data was used to calculate the impacts in the graph. As mentioned previously a control REMI forecast is run with all things being equal, then an alternate REMI forecast is run with the economic changes that will take place inputted into the model. Then to compute the impact one simply subtracts the control forecast figure from the alternate forecast figure. In this case the participation rate for western Oklahoma in 2010 is 59.84% in the control forecast, while the participation rate is 59.90% for the alternate forecast. The difference of the two is 0.06%, which is indeed the impact reported in 2010 for western Oklahoma's participation rate.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | 59.84% | 59.90% | 0.06% |
| State of Oklahoma | 63.88% | 63.89% | 0.01% |

While a 0.06% impact upon the perticipation rate appears negligible, it truly has a measurable impact upon the labor force. For example, assuming a regional labor force of 100,000 people, a 0.06% impact would translate into an additional 60 people entering the labor force who otherwise would not have entered the labor force.

### 5.3.4 Labor Force

**Labor Force**

The number of people in the labor force, i.e., employed or seeking work; calculated with participation rates by age-gender-racial cohort.

**Affected By**

Population, Participation Rate

**Affecting**

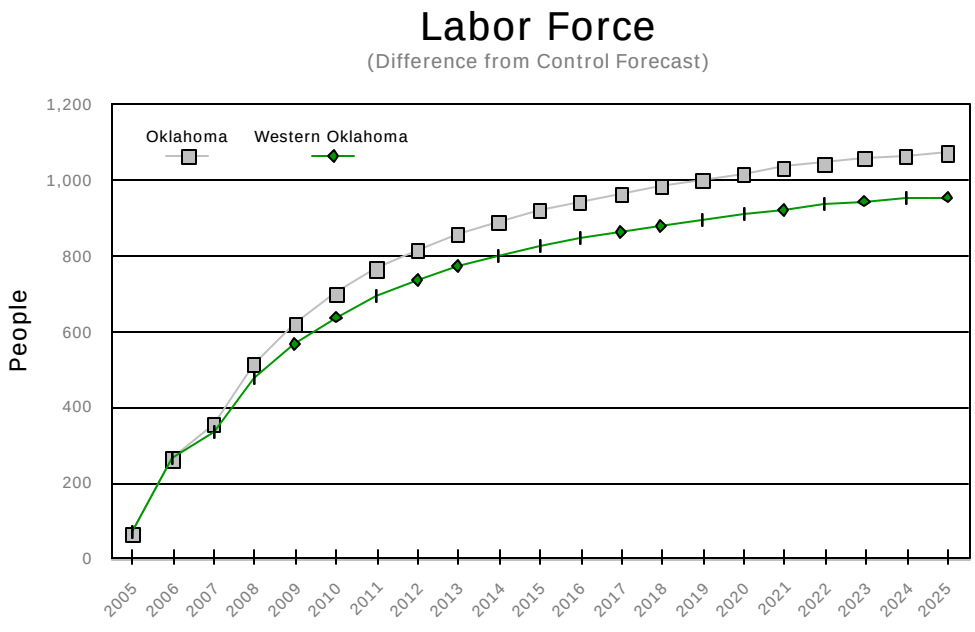
Employment Opportunity (Block 4), Wage Rate (Block 4)

Labor force, the last variable in the Population and Labor Supply block that will be discussed, impacts a region's employment opportunity and wage rate. It is important to note that these two variables come back into block three by impacting economic migration, which illustrates the circular nature of the economy and the complex interrelationships of the variables within the REMI model. The wage rate variable is a block four variable and will be discussed in more detail in section 5.4.1.

The graph below shows what impacts that the proposed biomass facility would have on the state's and western Oklahoma's labor force. The impacts are very similar during the construction phase, that lasts from 2005 to 2006. In 2005 construction has an immediate impact on western Oklahoma with 72 more people in the labor force. This figure jumps to 265 people as construction on the plant peaks and finishes in 2006. After construction finishes there is a lull in activity as production is ramped up until it reaches capacity in 2008. This is exhibited in the graph by the smaller growth that occurs in 2007 followed by a sharper increase in 2008 when the labor force impact reaches 474 people.

When production reaches full capacity in 2008 one can see the facility starts to impact the rest of Oklahoma, which is represented by the gap between the state's labor force impacts and the region's labor force impacts. In 2008, the total impact on Oklahoma's labor force is 511 people and the impact upon western Oklahoma's labor force is 474 people. Therefore, the Ag ChemCo facility is projected to grow the rest of Oklahoma's labor force by an additional 37 people in 2008.

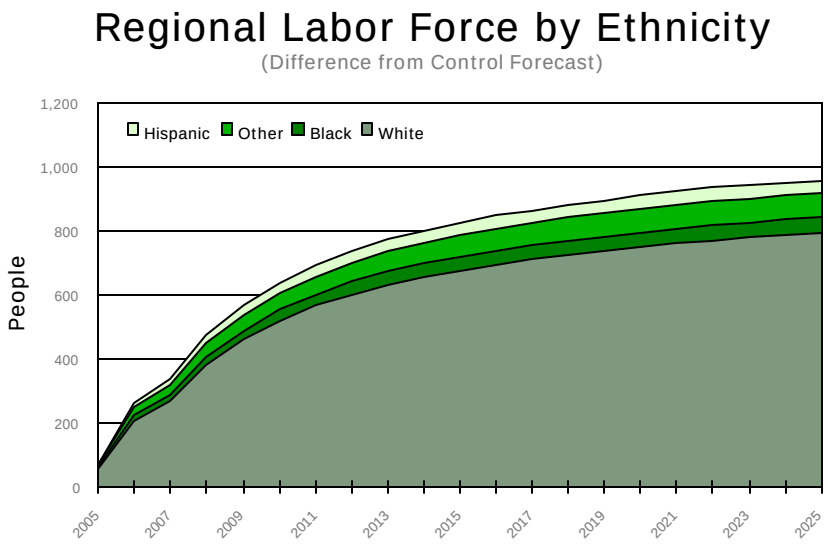
The labor force impact continues to grow until the end of the period graphed. The western Oklahoma region sees its labor force impact grow to 956 people by 2025. The state's labor force receives a slightly higher impact by 2025 with 1,074 people added to the labor force. This means that 118 people will have been added to the rest of Oklahoma's labor force by the end of the modeled time frame.

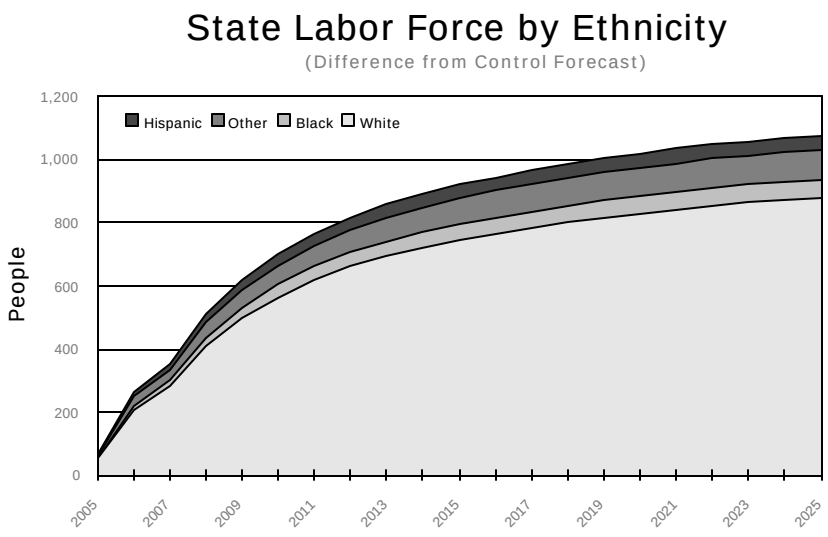



As with the previous sections, the reported numbers are impact figures. These impact figures are calculated by subtracting the REMI control forecast level from an alternate forecast level that is obtained by making changes to the relevant REMI variables and running the model again to see what effect the changes have. The control and alternate forecast labor force levels for both western Oklahoma and the state are reported for 2010 in the table below the graph.

| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | 304,239 people | 304,878 people | 639 people |
| State of Oklahoma | 1,844,754 people | 1,845,455 people | 701 people |

Western Oklahoma is forecasted to have 304,239 people in the labor force in 2010 ceterus paribus. The




alternate forecast predicts a labor force of 304,878 people. Oklahoma as a whole is forecasted to have 1,844,754 people in the labor force in 2010 ceterus paribus. The alternate forecast shows the labor force to have 1,845,455 people.

The final column shows the difference, or the impact, between the two forecasts. For western Oklahoma the impact is 639 and for Oklahoma the impact is 701. These numbers will correspond with what is reported in the graph above the table.

The remaining labor force graphs break down the labor force impacts by ethnicity for both Oklahoma and western Oklahoma. This information is presented for information purposes only, and these breakouts should equal the same total impact graphed on the previous page. The ethnic breakout of western Oklahoma's labor force impact mirrors the ratios one sees presently in western Oklahoma. The same is true of the ethnic breakout for the state and consequently as one would expect the two breakouts are very similar in their ethnic makeup.

### 5.3.5 Summary of Block 3 Impacts

Over the course of time that this study covers, the following impacts are expected to occur if the Ag ChemCo biomass facility is built in western Oklahoma:

- A positive net impact on western Oklahoma's economic migration of 1,360 migrants between 2005 and 2025
- A positive impact on western Oklahoma's population with the addition of 1,726 people by 2025
- A positive impact on western Oklahoma's participation rate of .06% in 2010
- A positive impact on western Oklahoma's labor force with the addition of 956 people by 2025

Some of the variables that these impacts will affect are:

- Employment opportunity in block 4
- Wage rate in block 4
- Housing prices in block 4
- Local/state government spending in Block 1

## 5.4 Block 4 - Wages, Prices & Cost Variables

As has been alluded to in other sections, the fourth block of variables provides a means for the model to make wage, price and cost adjustments in response to the relative movements in the supply and/or demand of factors of production as well as the consumption variables previously covered in this report. Additionally, variables detailing income and adjustments to income (section 5.4.4 to section 5.4.7) will also be covered with this fourth block of variables. While these variables are not actually contained in the fourth block of variables, they serve as a bridge between the wage and price variables covered in block 4 and the real disposable income variable in block 1 (section 5.1.3).

### 5.4.1 Wage Rates

The four graphs accompanying this section relate the economic impact (in percentage terms) that the Ag ChemCo facility would have upon western Oklahoma's average annual wage rate in the ten private nonfarm sectors. Only the wage rate impacts for western Oklahoma's private nonfarm sectors will be reported since the Ag ChemCo facility would be concentrated in the region.

**Wage Rate**

Average annual wage rate, calculated by dividing wage and salary disbursements by employment.

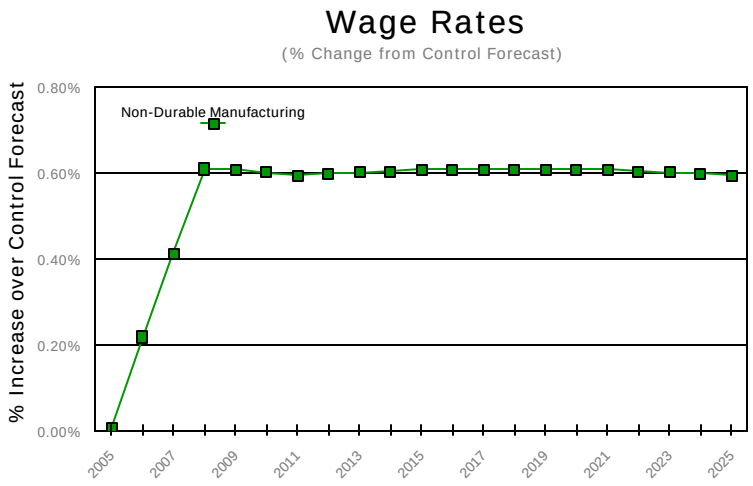
**Affected By**

Employment (Block 2), Employment Opportunity

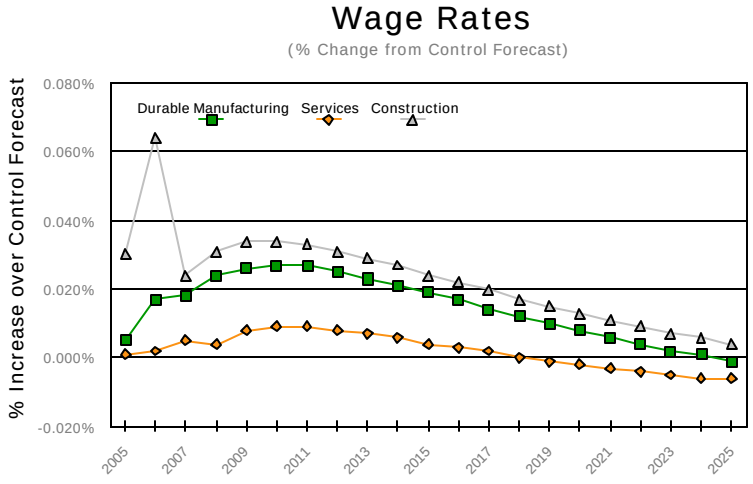
**Affecting**

Real Wage Rate, Composite Wage Rate

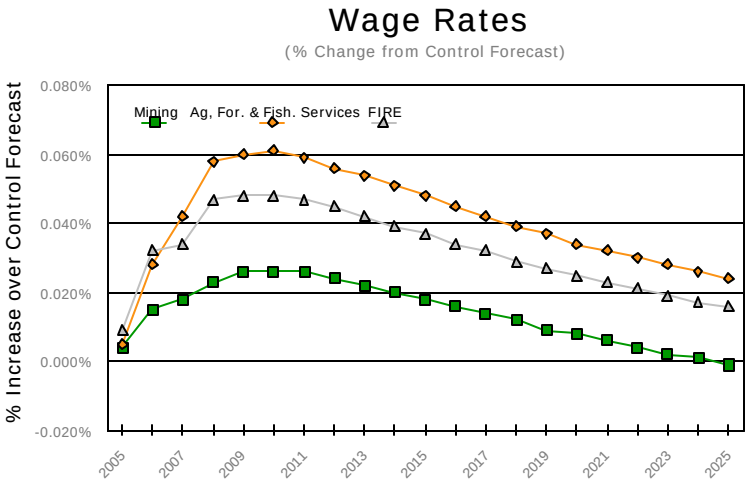
In the first few years of the Ag ChemCo project, the demand for labor increases at a faster rate than the supply of labor. Demand for labor is measured by the employment (block 2) necessary to increase regional output (block 1) in the agricultural chemical industry, while the supply of labor is measured by labor force (block 3). As will be recalled, western Oklahoma's total employment is projected to increase 1,335 jobs by 2010, while the region's labor force is projected to increase 639 workers by 2010. This imbalance places upward pressure on the region's wage rate, which is evidenced in the graphs accompanying this section.

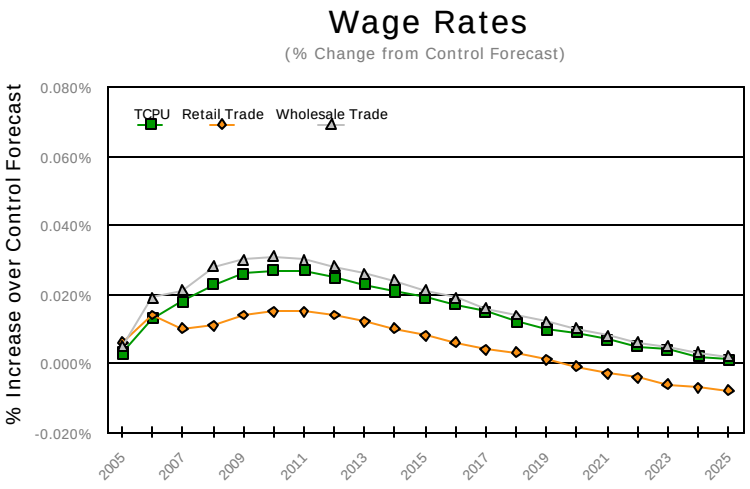



As can be seen from the first graph, there is very little impact upon nondurable manufacturing wages in 2005 since operations at the facility have yet to begin. The wage rate impacts increase between 2006 and 2008 as operations at the facility begin at one-third of capacity in 2006 and reach capacity by 2008. After 2008, the economic impacts remain stable.




Assuming a $30,000 average annual wage in the nondurable manufacturing sector, a 0.6% increase in the sector's wage rates means that annual wages would be $180/year higher, on average, in western Oklahoma's nondurable manufacturing sector. The yearly wage rate increase may not appear too impressive, but it should be remembered that the impact is being distributed over the entire regional nondurable manufacturing sector. Analysis of both the wage & salary data and the employment data in the nondurable manufacturing sector reveals that the new jobs created would pay over $50,000/year on average in 2010. *This does not mean that the actual salaries will be over $50,000 at the Ag ChemCo facility in 2010, rather this is the value predicted by the REMI model in order to increase the labor force in western Oklahoma's nondurable manufacturing sector.*




Due to the construction of the biomass facility, average wage rates in western Oklahoma's construction sector increase from approximately 0.03% higher in 2005 to about 0.06% higher in 2006. As with the nondurable manufacturing sector, it should be kept in mind that these impacts are spread over the entire regional construction sector. A 0.03% impact upon a $30,000 annual wage rate would increase the average annual wage rate by approximately $9/year. After the facility's construction ends in 2006, the impacts upon western Oklahoma's average construction sector wage rate decreases. However, average annual wage rates do remain higher than the control forecast as a result of the impacts of residential and nonresidential capital stock construction.

Similar to the regional construction sector, the remaining eight private nonfarm sectors experience wage rate impacts on a similar smaller scale than experienced in the nondurable manufacturing sector. Before 2010, more upward pressure is placed on wage rates until the region's labor force adjusts. However, towards the latter portion of the time period, the wage rates in the retail trade and service sectors fall below 0%. While this does not mean wage rates are decreasing, it does indicate that wage rates fall below the control forecast. This indicates that there may be an oversupply of labor in the retail trade and service sectors, and with the relative wages falling, provides incentive for lower economic migration.

When a region's wage rate increases relative to the nation's wage rate, economic migrants are attracted to the area to take advantage of the higher relative wages. These economic migrants add to the region's labor force, thereby alleviating some of the upward pressure initially placed on wage rates. In western Oklahoma's case, the Ag ChemCo facility provides incentive for an additional 126 economic migrants (section 5.3.1) to relocate to western Oklahoma in 2010. These are migrants who would otherwise not have relocated to the region.

Higher relative wage rates not only positively impact economic migration, but they also positively impact the region's participation rate (section 5.3.3). The higher relative wage rates induce a greater proportion of the working aged population to enter the labor force. In western Oklahoma's example, the higher wage rates increased the region's participation rate 0.06% in 2010. While apparently small, this increased participation rate translates into more than 180 additional people entering the labor force who otherwise would not have entered the labor force.

The wage rate increases evidenced in this section provide the market adjustments necessary to increase the size of the labor force through additional economic migration (section 5.3.1) and a higher participation rate (section 5.3.3).

### 5.4.2 Personal Consumption Expenditure - Price Index

**PCE - Price Index**

A personal consumption expenditure price index equal to 100 for US in 1992. A region's PCE may or may not be equal to 100 in 1992 - if lower than 100, then the region's prices are lower than the US, and if higher than 100 in 1992, then the region's prices are greater than the US. The variable is used to deflate nominal disposable income and also feeds back into nominal wage changes.

**Affected By**

Housing Prices, Consumer Prices

**Affecting**

Real Wage Rate

The Personal Consumption Expenditure (PCE) variable is an implicit price deflator in the REMI model that measures inflation, which makes the variable similar to the consumer price index (CPI). However, while both prices indices measure inflation and have been used as measures for cost of living, there are differences in the methodology used in their measurement. The CPI measures the prices, and their changes, paid by urban consumers upon a fixed market basket of goods & services . The implicit price deflator measures average prices for all domestic personal consumption. One of the benefits of the PCE implicit price deflator is that it measures the whole market of final goods & services, whereas the CPI measures only a subset of the market (fixed market basket).

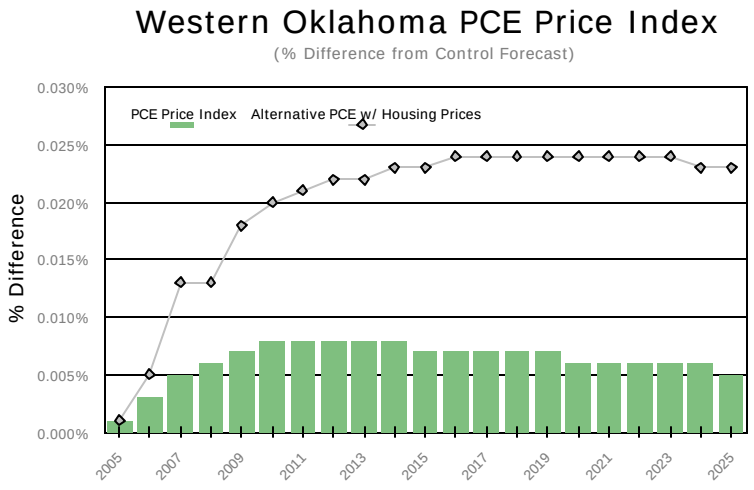
As a note, the PCE price index uses the NIPA consumption categories reported in section 5.1.1a to measure cost of living. The accompanying graphs relate two PCE price indices - the bar chart reports cost of living increases (over control forecast) based on the consumption categories, while the line graph reports cost of living based on both housing prices and the consumption categories.

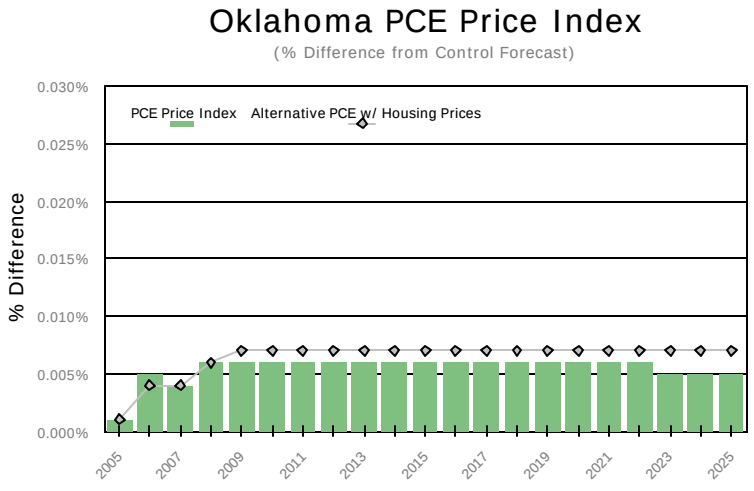
Given the increased consumption reported in section 5.1.1a in western Oklahoma and the state as a whole, prices adjust upwards. While it means that the cost of living increases slightly over any increase that would have otherwise occurred, it does not necessarily mean that the cost of living in western Oklahoma or the state would become more expensive than the cost of living in the U.S.

Illustrating these impacts in monetary terms upon western Oklahoma, groceries that cost $100 in 2003 are projected to cost $115.94 in the control forecast in 2010. In the alternative forecast, those same groceries that cost $100 in 2003 are projected to cost $115.95 in the alternative forecast. Therefore, the economic impact is an increased price of $0.01 upon $100 worth of groceries after seven years in western Oklahoma. A similar one penny impact would occur for the state of Oklahoma with $100 worth of groceries in 2003 costing $116.50 in the 2010 alternative forecast and $116.49 in the 2010 control forecast.

Regarding housing prices, the economic impact of Ag ChemCo increases demand for residential capital stock as illustrated in section 5.2.4. This increased demand for capital stock would increase the price of a $100,000 (2003 price) house by almost $120 over its normal projected capital appreciation by 2010 in western Oklahoma.

The consumer price increases relative to the nation evidenced in this section relate the market adjustments that occur because of the increased consumption and investment occurring in western Oklahoma and the state as a whole.



### 5.4.3 Production Costs

**Production Costs**

The costs of producing goods and services for a regional industry relative to the US; depends on relative factor productivity, relative factor costs, and material input costs.

**Affected By**

Composite Wage Rate, Composite Input Costs

**Affecting**

Composite Input Costs, Consumer Prices, Share of International Exports (Block 5), Share of Domestic Markets (Block 5)

The increased output that occurs as a result of the construction and operation of the Ag ChemCo facility in western Oklahoma causes demand for factors of production to increase. This in turn places upward pressure on the costs of production, which are represented in the accompanying graphs by the bar chart. The remaining line graphs illustrate the relative cost movements for specific factors of production (excluding land). These components of production costs include capital costs, labor costs, fuel costs, and composite input costs (not a factor of production). Definitions of the subcomponents may prove helpful:

Relative Capital Costs - Industry capital costs in the region relative to the US. It includes the effects of corporate & property taxes, investment tax credits, allowable tax depreciation, and the cost of investment inputs.

Relative Labor Costs - Industry labor costs in the region relative to the US. It is one of the components of an industry's factor costs of production and reflects the nominal wage rate faced by the industry.

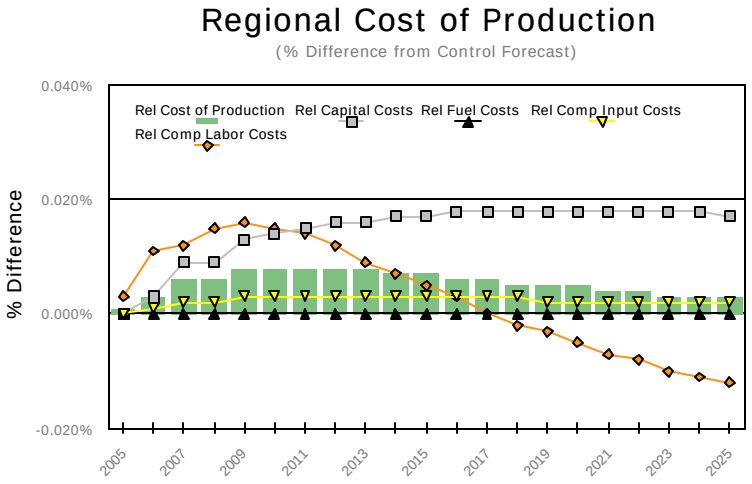
Relative Fuel Costs - Industry fuel costs (all types) in the region relative to the US.

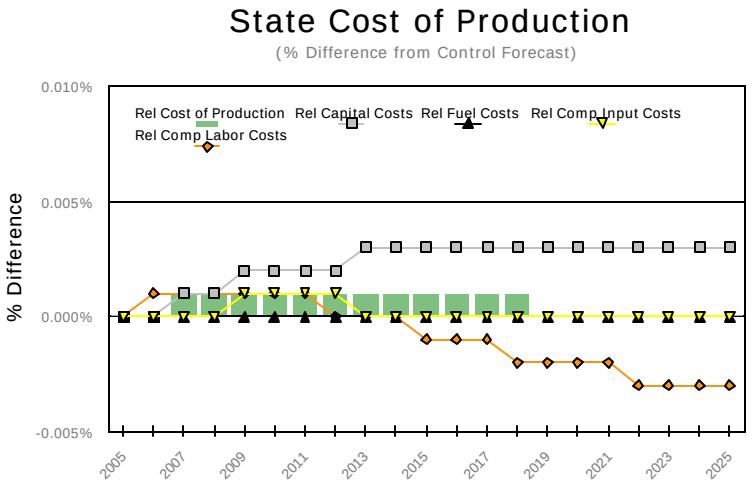
Relative Composite Input Costs - Industry intermediate costs relative to the nation and reflects the relative cost of goods used in production.

Of the four cost components, there is no impact projected to occur in the relative fuel costs in either western Oklahoma or the state, and the projected impact upon the relative costs of intermediate inputs is minimal.

Evident from the graphs, the greatest impacts occur with the relative costs of capital and labor. Initially, the cost of labor increases higher than the control forecast because of the higher nominal wages necessary to attract economic migrants and to increase the participation rate in western Oklahoma. In 2009, which is the peak year, these higher labor costs translate into approximately $5/year per worker earning $30,000/year. After 2017, the labor force has increased sufficiently in western Oklahoma to permit the relative labor costs to decrease below the control forecast.

The production cost increases evidenced in this section relate the market adjustments occurring in the region and state from the increased demand placed on the factors of production necessary to increase output.



### 5.4.4 Proprietor & Labor Income (Bridge variables to Real Disposable Income)

The following income and income adjustment variables serve as a bridge from the wage rate (section 5.4.1) variable previously discussed in this block to the real disposable income variable (section 5.1.3) that plays such an important role in determining consumption spending. Getting across this bridge starts by multiplying the wage rate by employment to produce wage & salary disbursements, which is one of the two components comprising proprietor & labor income. The second component is proprietor & other labor income, and summing the two components equals proprietor & labor income. As a formula:

Proprietor & Labor Income = Wage & Salary Disbursements + Proprietor & Other Labor Income

The area graphs accompanying this section relate proprietor & labor income totals as well as the relative proportions held by its two components. Before progressing too far, it should be noted that proprietor's & other labor income does not include income earned by corporations since it is not a component of personal income.

In western Oklahoma, the economic impact of the construction of the Ag ChemCo facility produces increased wage & salary disbursements totaling $7.7 million and increased proprietor's & other labor income totaling $4.2 million in 2005. The summation of these two components equals $11.9 million for the economic impact upon western Oklahoma. In 2010, when the Ag ChemCo facility is operating at capacity, the combined proprietor's & labor income equal $50.3 million with proprietor's & other labor income comprising 32.2% and wage & salary disbursements comprising 67.8% of the total. By 2025, the impacts upon wage & salary disbursements increase to $49.8 million and the impacts upon proprietor's & other labor income increase to $23.7 million - the total impact is therefore $73.5 million.

**Wage & Salary**

This is a BEA concept; the monetary remuneration of employees, including the compensation of corporate officers, commissions, tips & bonuses, and receipts-in-kind that represent income to the recipient.

**Affected By**

Wage Rate, Employment (Block 2)

**Affecting**

Personal Income

**Proprietor's Income**

This is a BEA concept; the income, including income in-kind, of sole proprietorships, partnerships and tax exempt cooperatives. It also includes employer contributions to private pension and private welfare funds, including privately administered worker's comp funds.

**Affected By**

Wage Rate, Prices, Costs

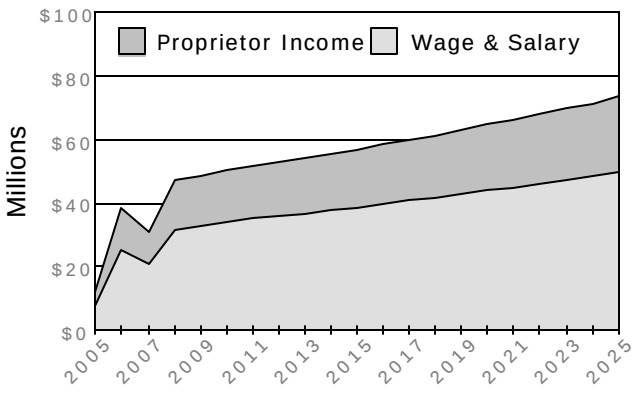
**Affecting**

Personal Income

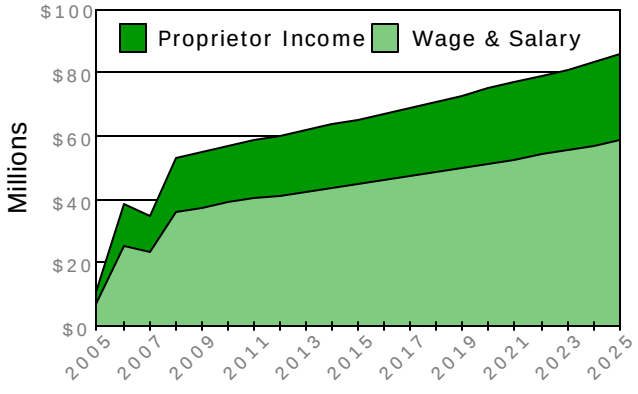
## Proprietor & Labor Income Components

(Nominal Dollars)

Western Oklahoma




Oklahoma




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Reg Prop Income | $4.492 billion | $4.508 billion | $16.2 million |
| Reg Wage & Salary | $9.589 billion | $9.624 billion | $34.1 million |
| State Prop Income | $25.229 billion | $25.247 billion | $18.0 million |
| State Wage & Sal. | $71.515 billion | $71.554 billion | $39.1 million |

Still in western Oklahoma, the unadjusted sum of the yearly economic impacts upon wage & salary disbursements over the 2005-2025 time frame equals $782.7 million, and the NPV of those yearly impacts equals $443.6 million. Similarly, the unadjusted sum of the yearly economic impacts upon proprietor's & labor income equals $371.9 million with a NPV of $211.7 million. From this information, it can be calculated that the sum of the two components produces a total proprietor and labor income equal to $1.154 billion, which has a net present value of $655.3 million associated with it.

Reporting this same series of information for the state of Oklahoma, the economic impact of the construction of the Ag ChemCo facility produces increased wage & salary disbursements totaling $7.2 million and increased proprietor's & other labor income totaling $3.7 million in 2005. The summation of these two components equals $10.9 million for the economic impact upon the state of Oklahoma, which starts out slightly less than the impacts upon western Oklahoma. The reason for this is that some growth is sacrificed in the rest of Oklahoma, but it does not last long. In 2010, when the Ag ChemCo facility is operating at capacity, the combined proprietor's & labor income equal $57.1 million with proprietor's & other labor income comprising 31.5% and wage & salary disbursements comprising 68.5% of the total. By 2025, the impacts upon wage & salary disbursements increase to $58.6 million and the impacts upon proprietor's & other labor income increase to $27.0 million - the total impact upon the state is therefore $85.6 million.

For the state of Oklahoma, the unadjusted sum of the yearly economic impacts upon wage & salary disbursements over the 2005-2025 time frame equals $903.7 million, and the NPV of those yearly impacts equals $508.9 million. This means that $121.0 million (NPV = $65.3 million) of the total wage & salary impacts would occur outside of western Oklahoma - approximately 13.4% of the impacts. Similarly, the sum of the yearly economic impacts upon proprietor's & labor income equals $416.3 million with a NPV of $235.3 million. From this information, it can be calculated that the unadjusted sum of the two components produces a total proprietor and labor income equal to $1.320 billion, which has a net present value of $744.2 million associated with it.

Moving from proprietor & labor income reported in this section to personal income (section 5.4.6) requires adjustments be made to income to account for the different sources and drains upon income. The formula for these income adjustments:

| | |
|---|---|
| | Proprietor's & Labor Income (section 5.4.4) |
| + | Dividend, Rental & Interest Income (not reported) |
| + | Transfer Payments (section 5.4.5) |
| + | Net Residence Adjustment (not reported) |
| - | Social Insurance Contributions (section 5.4.5) |
| | Personal Income (section 5.4.6) |

As a point of information, net residence adjustment is a variable that converts place-of-work income to place-of-residence income. As an example of an adjustment that would be necessary, wage earners who work in the Oklahoma City MSA but reside in northwest Oklahoma would have their income subtracted from the OKC MSA and added to northwest Oklahoma. This would occur since a large proportion of the income would be spent in the place of residence.

### 5.4.5 Income Adjustments (Bridge variables to Real Disposable Income)

Of the four income adjustment variables, only transfer payments and social insurance contributions will be discussed in this report. The construction & operation of the Ag ChemCo facility produces a negative economic impact upon both the region's and the state's transfer payments until about 2013. The negative impact means that the government's payments for social security, welfare, and/or unemployment insurance are lower than would otherwise occur if the Ag ChemCo facility did not locate in western Oklahoma.

**Transfer Payments**

Income payments to persons for which they do not render current services. These include social security, welfare, and unemployment insurance payments.

**Affected By**

Wage Rate, Employment, Population Demographics (age)

**Affecting**

Personal Income

**Social Ins. Cont.**

Personal contributions for social insurance are contributions made by individuals under the various social insurance programs and are excluded from personal income by treating them as explicit deductions.

**Affected By**

Wage Rate, Employment

**Affecting**

Personal Income

Evident from the table, the REMI model projects state transfer payments to total $21.439 billion in the 2010 control forecast and $21.436 billion in the 2010 alternative forecast. While both amounts are substantial, the economic impact of the Ag ChemCo facility is projected to be $2.3 million lower than would otherwise occur. One possible explanation for this is that because the participation rate increases, people who would have received unemployment compensation have found employment from the increased economic activity.

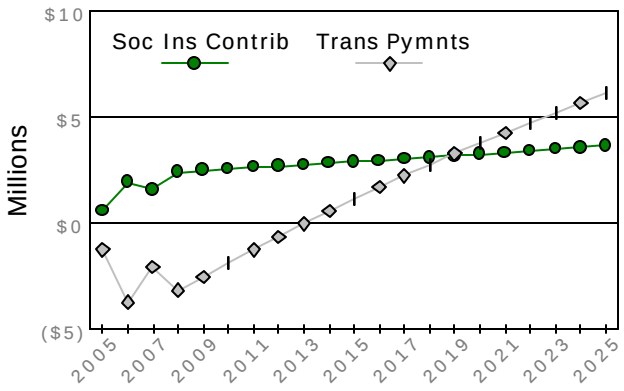
After 2013, the REMI model projects the economic impacts upon transfer payments to become positive. Analysis of the data reveals that the economic impacts also attract people near retirement, and as time progresses more people over 65 years of age begin to retire. These people receive transfer payments in the form of social security. The unadjusted sum of the transfer payments total $25.3 million (NPV = $4.6 million) in the region and $26.0 million (NPV = $4.1 million) in the state.

On the other side of the social insurance equation are people contributing to the programs. The REMI model projects the economic impacts upon social insurance contributions to sum (unadjusted) to $58.7 million (NPV = $33.4 million) in western Oklahoma and $68.1 million (NPV = $38.5 million) in the state over the whole time period. As is apparent, the dollar amount contributed to the social insurance programs would be much greater than the dollar amount paid through the various programs.

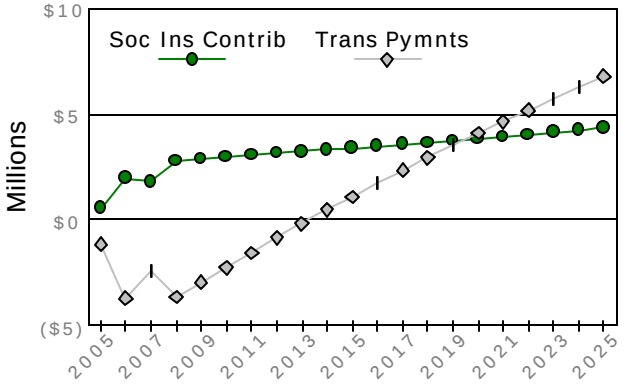
## Transfer Payments & Social Insurance

(Difference from Control Forecast)

Western Oklahoma




Oklahoma




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Reg Soc Ins Cont | $722 million | $725 million | $2.6 million |
| Reg Trans Pymnts | $3.643 billion | $3.642 billion | ($1.9 million) |
| State Soc Ins Cont | $5.583 billion | $5.586 billion | $3.0 million |
| State Trans Pymnts | $21.439 billion | $21.436 billion | ($2.3 million) |

### 5.4.6 Personal Income (Bridge variables to Real Disposable Income)

**Personal Income**

This is a BEA concept based on place of residence; the sum of wage and salary disbursements, other labor income, proprietors' income, rental income, personal dividend income, personal interest income, and transfer payments, less personal contributions for social insurance.

**Affected By**

Wage Rate, Proprietor's & Other Labor Income, Wage & Salary Disburesements, Transfer Payments, Dividends, Rental Income, Social Insurance Contributions

**Affecting**

Real Disposable Income (Block 1)

The personal income variable results from making the income adjustments in the previous section to proprietor's & labor income (section 5.4.4). This is the amount of income that will be taxed for income taxes in section 5.4.7.

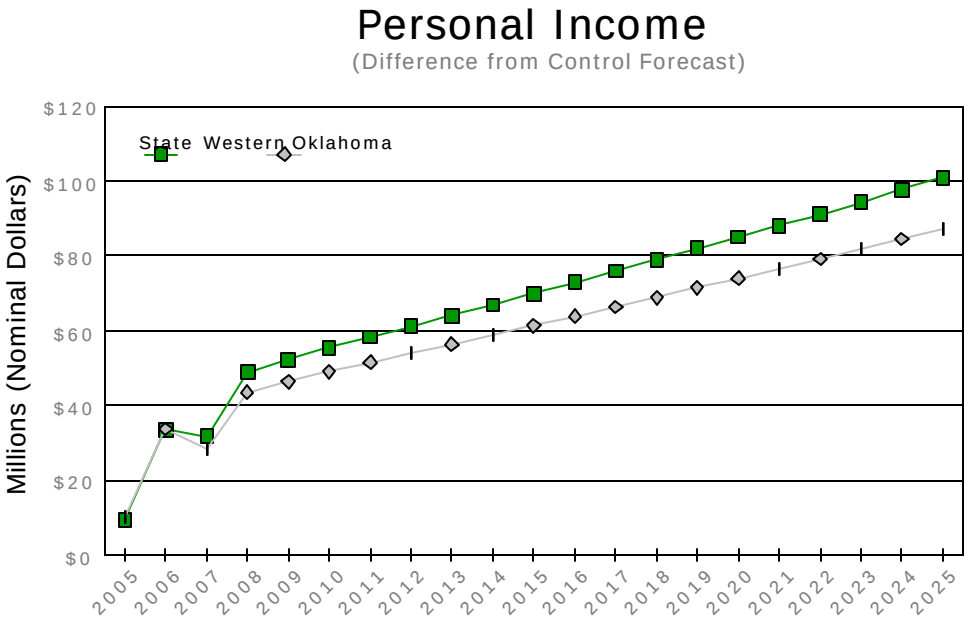
In the first few years of the project, personal income is less than proprietor's & labor income since transfer payments are negative. In the latter years of the study, personal income is slightly larger than proprietor's & labor income largely due to an average annual impact of $3.2 million in dividend, rental & interest income in western Oklahoma.

The personal income variable follows the same pattern as the proprietor's & labor income variable by sharply increasing during the construction phase as well as during the period of time when the facility's operations increase from two-thirds of capacity to full capacity. The now familiar dip in year 3 occurs after construction has finished and operations have yet to reach capacity.

In 2010, the economic impact that the Ag ChemCo facility has on personal income is projected to be $49.0 million in western Oklahoma and $55.4 million in the state of Oklahoma. The unadjusted sum of the yearly impacts total $1.246 billion in western Oklahoma and $1.419 billion in the state of Oklahoma. Associated with these values are net present values of $690.2 million in the region and $781.3 million in the state.

By 2025, the economic impact upon the region's personal income reaches $87.3 million and reaches $100.9 million for the state's personal income.

As a proportion of the state's total personal income, western Oklahoma accounts for approximately 15.4% of the total. However, as a proportion of the total economic impact upon personal income, western Oklahoma accounts for 88.4% of the total.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $20.956 billion | $21.005 billion | $49.0 million |
| State of Oklahoma | $136.505 billion | $136.560 billion | $55.4 million |

### 5.4.7 Income Taxes (Bridge variables to Real Disposable Income)

**Taxes**

BEA concept of personal income taxes, which when subtracted from personal income, results in disposable income. Includes federal, state and local income taxes.

**Affected By**

Personal Income

**Affecting**

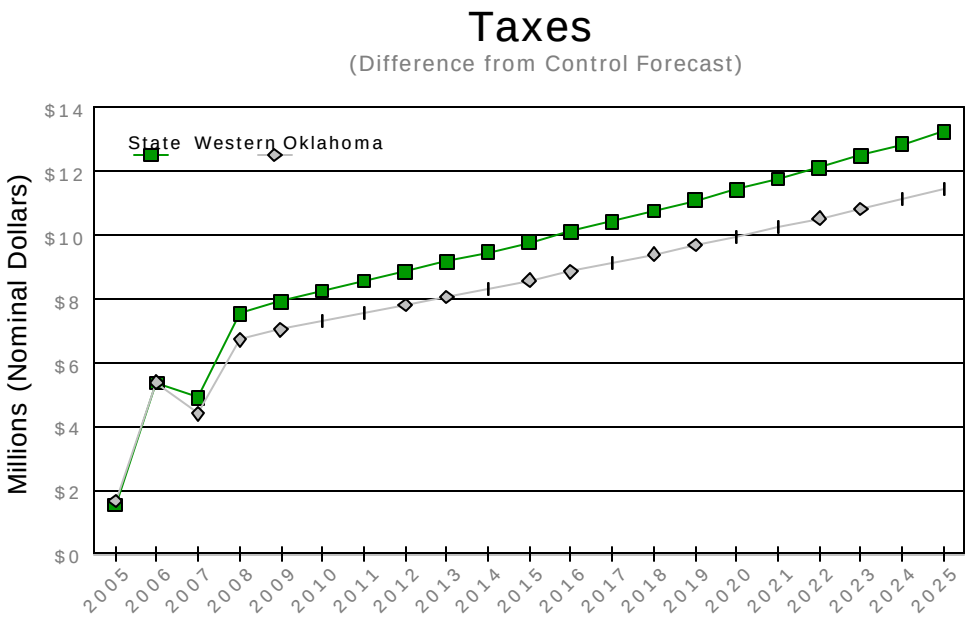
Real Disposable Income (Block 1)

Before the disposable personal income variable is reached, income taxes must be subtracted from personal income (section 5.4.6). The income tax variable in our version of the REMI model includes federal and state income taxes. The equation:

Disposable Personal Income = Personal Income - Income Taxes

The economic impact that the Ag ChemCo facility would have upon income taxes would be to increase income tax collections by a total of $197.5 million in the state of Oklahoma over the 2005-2025 time frame. Of these increased collections, $174.0 million would be collected in western Oklahoma. The net present values of these increased income tax collections equal $110.4 million in the state and $97.9 million in western Oklahoma.

In the 2010 control forecast, the REMI model projects income tax collections to total $2.496 billion in western Oklahoma which accounts for approximately 15.6% of the $15.981 billion in collections occurring in the state. In the 2010 alternative forecast, the REMI model projects income tax collections to total $2.504 billion in western Oklahoma and $15.989 billion in the state. Therefore, the economic impact in 2010 equals $7.3 million in increased income tax collections in western Oklahoma. An additional $0.9 million in increased income tax collections is collected in the rest of the state to bring the state's total increased collections $8.2 million higher in 2010.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $2.496 billion | $2.504 billion | $7.3 million |
| State of Oklahoma | $15.981 billion | $15.989 billion | $8.2 million |

Plugging the 2010 economic impacts that the Ag ChemCo facility has upon taxes and personal income into the above equation reveals that disposable personal income is projected to be $41.7 million in western Oklahoma and $47.2 million in the state of Oklahoma. These are nominal amounts that have not been adjusted for the expected effects of inflation. The final step before reaching real disposable income in section 5.1.3 would be to divide disposable personal income by the PCE price index (section 5.4.2).

### 5.4.8 Summary of Block 4 Impacts

Over the 2005-2025 time frame, some of the economic impacts that the Ag ChemCo facility were shown to have upon wage, price and cost variables in western Oklahoma were:

- Higher average wage rates in the region's nondurable manufacturing sector
- (Slightly) higher prices paid by consumers in western Oklahoma
- (Slightly) higher production costs faced by regional businesses

The impacts listed above were affected by interactions between supply and demand variables contained in blocks 1-3. Alternatively, some of the variables impacted by the Block 4 variables are:

- Real Disposable Income in Block 1
- Consumption in Block 1
- Economic Migration in Block 3
- Imports in Block 5
- Exports in Block 5

In addition to Ag ChemCo's economic impacts upon wage, price and cost variables, the project also impacts the bridge variables between wage rate and real disposable income. Some of those impacts:

- An NPV economic impact of $443.6 million upon western Oklahoma's Wage & Salary Disbursements
- An NPV economic impact of $211.7 million upon western Oklahoma's Proprietor's & Other Labor Income
- An NPV economic impact of $33.4 million upon western Oklahoma's Social Insurance Contributions
- An NPV economic impact of $4.6 million upon western Oklahoma's Transfer Payments
- An NPV economic impact of $690.2 million upon western Oklahoma's Personal Income
- An NPV economic impact of $97.9 million upon Income Tax Collections in western Oklahoma

## 5.5 Block 5 - Market Share Variables (Imports & Exports)

Block 5 in the REMI model is a very small block with only two place-holder variables. These two variables, "share of domestic market" and "share of international market" are market share ratios that affect the study region's "output for domestic market" and "international exports". The market share variables are both affected by the "changes in quantity of supply" variable in block one and "the changes in delivered costs relative to competitor's and other regions delivered prices" variable from block 4. What will be reported in this section are the imports and exports rather than the ratios themselves. Exports is reported because the share of international market variable has a direct relationship with exports. Imports is reported because it is logical to report imports with exports and "share of domestic market" has an indirect relationship with imports.

### 5.5.1 Imports

Imports play a vital role in a healthy economy. Graphed below are the impacts on imports that are predicted to occur should Ag ChemCo build a biomass conversion facility in western Oklahoma. As can be seen, there is very little difference between import impacts occurring in the state and western Oklahoma. This is expected since most of the increased economic activity, including consumption spending (section 5.1.1b) is occurring in western Oklahoma.

**Imports**

The amount of goods and services produced outside the area and consumed locally; a component of demand. A proxy variable for the share of the domestic market captured by a geographic region.

**Affected By**

Production Costs (Block 4), Change in Quantity Supplied (Block 1)

**Affecting**

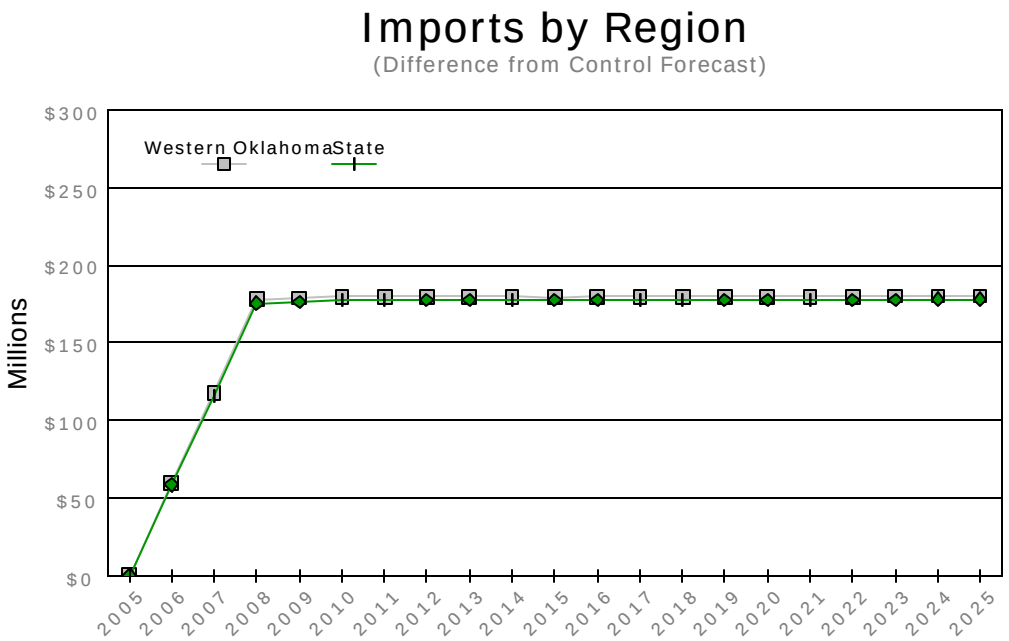
Net Exports (with imports)

The graph supports this showing consistent growth in imports during the construction years of 2005 and 2006 with $604,140 and $60,088,690 in imports respectively. Imports continue to grow after construction finishes and operations start in 2007. In 2008, when the plant is fully operational, the impact on imports into western Oklahoma reaches $178,164,000. This changes very little over the course of time, and in 2025 the impact on imports is $180,460,000.

The impact that the plant would have on Oklahoma's imports is significant because it is for the most part less than the impact on western Oklahoma's imports. What this means is that western Oklahoma would import some of the goods and services it needs, because of the plant, from the rest of Oklahoma.

In order to gauge the impact of imports they must be compared to exports. Instead of simply comparing the two in the last forecasted year or comparing them on a year by year basis we will use Net Present Value or NPV.

NPV is a useful tool for analyzing and comparing groups of similar financial figures. The NPV of western Oklahoma's imports from 2005 to 2025 is $1.970 billion using an idiscount rate of 5.0%. The NPV of Oklahoma's imports for the same

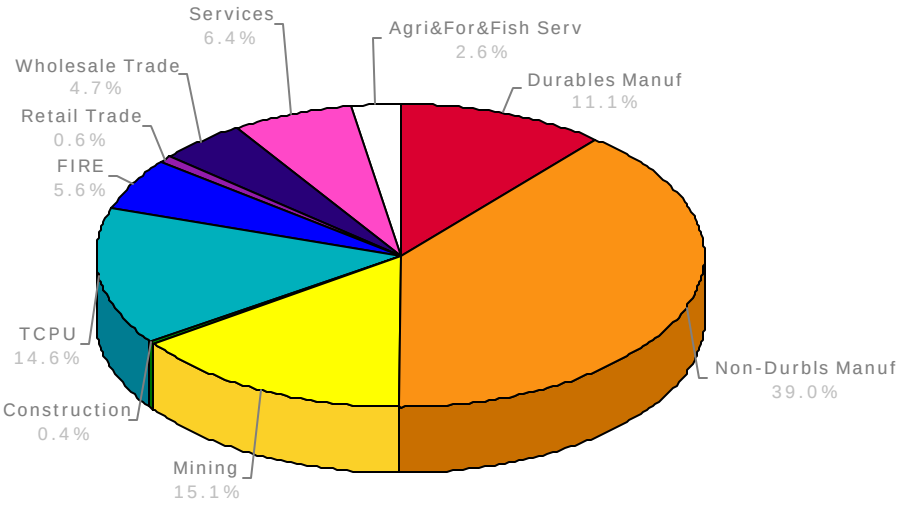



| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $26.666 billion | $26.846 billion | $179.8 million |
| State of Oklahoma | $118.695 billion | $118.872 billion | $177.3 million |

time period using the same discount rate is $1.945 billion. These figures will be used to compare imports to exports later in the conclusion of this section.

As with the other sections the figures in the graph are impacts. An example of how these impacts are calculated is shown in the table below the imports graph. The table shows that western Oklahoma is forecasted to import $26.666 billion in 2010 where everything stays the same. In the alternative forecast, the forecast where the plant is built, western Oklahoma is predicted to have $26.846 billion in imports by 2010. The difference between the two forecasts, which is $179.8 million, is the impact that the plant would have on western Oklahoma.

Average Sector Breakout of Imports, Western Oklahoma 2005-2025




The accompanying pie chart shows the average breakout by sector of the impact on imports for western Oklahoma from 2005 to 2025. Non-Durable manufacturing had the largest portion of imports with 39.0%. A majority of nondurable manufacturing imports is made up of intermediate products demanded by the plant, and the remainder is goods demanded by the increased population and new business activity.

Following nondurable manufacturing is mining with 15.1%, transportation communication and public utilities with 14.6%, and durables manufacturing with 11.1%. As with nondurable manufacturing, a portion of the average impact for these sectors is accounted for by the plant, and the remainder of the impacts is a result of increased demand by the population and new business activity.

### 5.5.2 Exports

**Exports**

The amount of local production exported out of the local region, i.e. to the rest of the US and the rest of the world. A proxy variable for the share of the international market captured by a geographic region.

**Affected By**

Production Costs (Block 4), Change in Quantity Supplied (Block 1)

**Affecting**

Net Exports (with imports), Output

Exports is an important variable to analyze when trying to determine the economic impacts of a given scenario. One reason for this is that exports in effect bring money into a region whereas imports causes money to leave a region. In the graph below we see that the building and operation of the proposed Ag ChemCo facility would have a tremendous impact on western Oklahoma's exports.

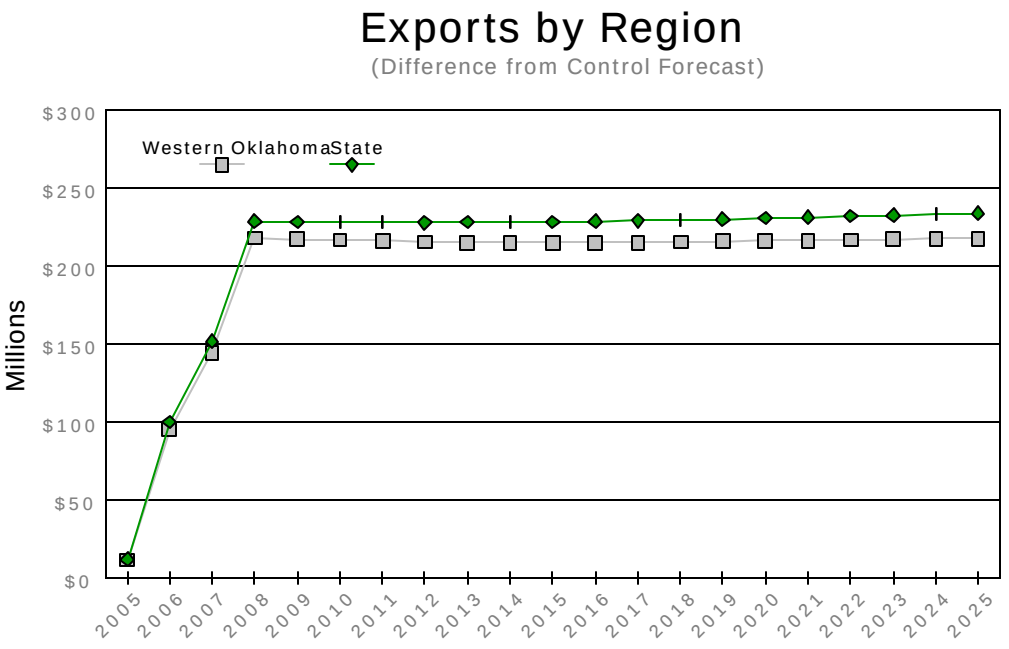
The impact on exports starts off at $11.7 million in 2005 when construction on the plant starts. This figure rises to $95.7 million in 2006 and continues to increase to $145.0 million in 2007 when operations reach two-thirds of capacity. The export impacts peak in 2008 when the impact on western Oklahoma's exports hit $218.3 million. Export impacts dip to as low $215.3 in 2015 before they start to climb again. In the last year that is graphed, the export impacts reach $218.0 million.

The impact upon Oklahoma's exports mirrors that of western Oklahoma rhroughout the modeled time frame. The impact on Oklahoma's exports peaks in 2008, similar to western Oklahoma's impact, but at a higher level ($229.0 million). Oklahoma's export impacts decrease slightly similar to western Oklahoma's before returning to growth two years before western Oklahoma in 2013. This early return to growth results in the peak year for Oklahoma's export impact to be the final year graphed with a total impact of $233.9 million.

As with the import section, the graph is based off of impact data and not the actual forecasted levels. The table below the export graph shows how these impacts are calculated from the control forecast and alternative forecasts using data from 2010. In the control forecast, western Oklahoma is predicted to have $28.852 billion in exports. The alternative forecast, where the Ag ChemCo plant is built, predicts that western Oklahoma's exports will reach $29.068 billion. The difference between the two, $216.8 million, is the economic impact that the Ag ChemCo plant would have on western Oklahoma's exports in 2010.

In the same table, we see that the control forecast predicts that Oklahoma exports will be $143.129 billion in 2010. The alternate forecast shows Oklahoma's export levels to be $143.357 billion. Subtracting the control forecast figure from the alternate forecast figure we get an economic impact of $228.3 million.

In order to compare the export impacts with the impacts on imports the net present value (NPV) of the export impacts was calculated using a interest rate of 5.0%. The NPV of western Oklahoma's export impacts from 2005 to 2025 equals $2.408 billion. The NPV of Oklahoma's exports from 2005 to 2025 equals $2.552 billion.




| Region | 2010 Control Forecast | 2010 Alternative Forecast | 2010 Economic Impact |
|---|---|---|---|
| Western Oklahoma | $28.852 billion | $29.068 billion | $216.8 million |
| State of Oklahoma | $143.129 billion | $143.357 billion | $228.3 million |

### 5.5.3 Summary of Block 5 Impacts

Building the Ag ChemCo biomass conversion plant in western Oklahoma would have tremendous impact on both western Oklahoma's and Oklahoma's imports and exports. These impacts are:

-A NPV of $1.970 billion for imports into western Oklahoma from 2005-2025
-A NPV of $1.945 billion for imports into Oklahoma from 2005-2025
-A NPV of $2.408 billion for exports out of western Oklahoma from 2005-2025
-A NPV of $2.552 billion for exports out of Oklahoma from 2005-2025

Also significant are the differences between the import and export impacts for western Oklahoma and Oklahoma. These differences amount to a net export impact from 2005 to 2025 with a NPV of $438.0 million dollars for western Oklahoma and $607.3 million. Net exports, the difference between exports and imports, has already been shown to impact GRP in block 1.

# 6 CONCLUSIONS

Throughout this report it has been shown that the proposed Ag ChemCo facility would have significant, positive impacts upon western Oklahoma and ultimately the state of Oklahoma. The impacts were shown to occur over a number of years and through a myriad of interconnected variables. Grouped by the same blocks of variables contained within the report, some of Ag ChemCo's impacts upon the state of Oklahoma were shown to be:

Block 1 - Output Variables

- An NPV economic impact of $1.520 billion upon Oklahoma's GRP
- An NPV economic impact of $439.8 million upon Oklahoma's Consumption spending
- An NPV economic impact of $251.6 million upon Oklahoma's Investment spending
- An NPV economic impact of $75.1 million upon Oklahoma's Government spending
- An NPV economic impact of $753.4 million upon Oklahoma's Net Exports
- An NPV economic impact of $75.8 million upon Oklahoma's Farm Income
- An NPV economic impact of $3.276 billion upon Oklahoma's Regional Output
- An NPV economic impact of $393.7 million upon Oklahoma's Real Disposable Income

Block 2 - Labor & Capital Demand Variables

- Additional labor productivity in the chemical industry of $1,965/worker in 2010 increasing to $3,239/worker in 2025
- Additional private nonfarm employment totaling 1,214 jobs in 2010
- Additional government employment totaling 73 jobs in 2010
- Additional farm sector jobs totaling 206 jobs in 2010
- Additional total employment gains totaling 1,493 jobs in 2010
- Additional residential capital stock totaling $78.3 million by 2025
- Additional nonresidential stock totaling $19.8 million by 2025
- Additional utility capital stock totaling $17.4 million by 2025

Block 3 - Population & Labor Supply Variables

- A positive net impact on Oklahoma's economic migration of 1,524 migrants between 2005 and 2025
- A positive impact on Oklahoma's population with the addition of 1,928 people by 2025
- A positive impact on Oklahoma's participation rate of .01% in 2010
- A positive impact on Oklahoma's labor force with the addition of 1,074 people by 2025

Block 4 - Wage, Price & Cost Variables (including income & Income adjustment variables)

- Higher average wage rates in the region's nondurable manufacturing sector
- (Slightly) higher prices paid by consumers in western Oklahoma
- (Slightly) higher production costs faced by regional businesses
- An NPV economic impact of $508.9 million upon Oklahoma's Wage & Salary Disbursements
- An NPV economic impact of $235.3 million upon Oklahoma's Proprietor's & Other Labor Income
- An NPV economic impact of $38.5 million upon Oklahoma's Social Insurance Contributions
- An NPV economic impact of $4.1 million upon Oklahoma's Transfer Payments
- An NPV economic impact of $781.3 million upon Oklahoma's Personal Income
- An NPV economic impact of $110.4 million upon Income Tax Collections in Oklahoma

Block 5 - Market Share Variables

-A NPV of $1.945 billion for imports into Oklahoma from 2005-2025
-A NPV of $2.552 billion for exports out of Oklahoma from 2005-2025

# 7 ENDNOTES

1. United States Department of Agriculture, National Agricultural Statistics Service, "Trends in US Agriculture", www.usda.gov/nass/pubs/trends/productivity.htm

2. The White House, "Hydrogen Fuel: A Clean and Secure Energy Future", Press Release, January, 2003 www.whitehouse.gov/news/releases/2003/01/20030130-20.html
3. George Treyz, Regional Economic Modeling, Kluwer Academic Publishers, 1993.

4. Statistical Policy Office, Office of Management and Budget, Metropolitan Areas 1995, Lists I-IV, www.whitehouse.gov/omb.

5. Resource Systems Group, Inc., "Economic Impact of Fuel Ethanol Facilities in the Northeast States", December, 2001, pages 5-8.

6. US Census Bureau, State & County Quickfacts, Oklahoma, http://quickfacts.census.gov/qfd/states/40000.html

# 8 APPENDIX A

This appendix covers the adjustments made to the REMI model given the more specific information provided for this project.

If detailed information is not available for expenditures, the REMI model would normally use an input-output matrix to allocate expenditures made by the Ag ChemCo facility. Therefore, REMI would normally allocate Ag ChemCo's expenditures based upon national industry averages for the agricultural chemical industry. Which means that if the average expenditure upon railroad transportation services is 2% of the expenditures in the national industry, then the model would allocate 2% of Ag ChemCo's expenditures upon railroad transportation services. Doing this requires the assumption that the Ag ChemCo facility is a fair representation of the average for the industry. However, whenever more detailed information is provided, the model can be customized to override some of the expenditures allocated by the input-output matrix. This economic impact analysis project used more specific information from the feasibility study to override the input-output matrix in order to allocate expenditures in the farm sector, the railroad industry, the trucking industry, and the agricultural services sector. For the remainder of the expenditures, it is assumed that the Ag ChemCo facility is a fair representation of the national industry.

Referring to the feasibility study, the Ag ChemCo facility is expected to require 700,000 dry tons (dt) of biomass per year for its operations and to pay $36/dt of biomass on average. Included in the $36/dt is the cost of baling and storage and the cost of delivery to the biomass facility. The cost estimate for baling and storage services in the feasibility study is $15/dt of biomass, and the remaining $21/dt is divided between the farmer and transportation services. Three estimates for the transportation cost are also provided within the feasibility study, and they range from $6.1/dt for distance closer than 15 miles and $11.5/dt for distances between 31 miles and 50 miles (distances are measured from the biomass facility or from Farmrail service area). For the purposes of this economic impact analysis, the Ag ChemCo facility will be assumed to pay the high cost estimate ($11.5/dt) for transportation. The reason for this is to provide the most conservative impact upon the region's farm sector. Therefore, farmers receive $9.5/dt of biomass.

Given the above information, the expenditures total:

$10,500,000 for the Agricultural, Forestry & Fisheries Services sector
$8,050,000 for transportation services, which is divided between the railroad and trucking industries
$6,650,000 in the Farm sector

However, these are not the amounts that would be entered into the model. In order to account for the input-output allocations, these expenditures must be adjusted. For example, the national industry would normally allocate .073% of every expenditure dollar to the Agricultural, Forestry & Fisheries sector. The expenditures listed above should therefore be adjusted downward to take into account this amount so that the impact upon this sector is not overestimated. Specifically for this sector, this translates into $7,665 (.073% x $10,500,000), which means the model's input amount is $10,492,335 ($10,500,000-$7,665) into the Agricultural, Forestry & Fisheries sector.

Additionally, the same amount that is to be directed to be spent upon the Agricultural, Forestry & Fisheries sector in this study must also be nullified in the model from occurring in the chemical industry. This prevents double counting some of the economic impacts since the modeler is taking away control of an expenditure amount from the model. These same adjustments have been made to the remaining industries for which more detailed information was provided.

# 9 APPENDIX B

## Average Occupational Employment Impacts in Oklahoma (2005-2025)

| Average Employment | Occupation |
|---|---|
| 121.0 | Agricultural workers |
| 99.6 | Management occupations |
| 85.2 | Grounds maintenance workers |
| 83.1 | Other production occupations |
| 78.1 | Construction trades and related workers |
| 54.5 | Secretaries, administrative assistants |
| 48.0 | Material moving occupations |
| 47.6 | All other sales and related workers |
| 37.7 | Motor vehicle operators |
| 36.5 | Information and record clerks |
| 33.9 | Other installation, maintenance, and repair occupations |
| 33.8 | Food and beverage serving workers |
| 30.3 | Material recording, scheduling, dispatching and distributing workers |
| 24.4 | Plant and system operators |
| 24.0 | Computer specialists |
| 23.3 | Financial clerks |
| 21.4 | Retail salespersons |
| 21.3 | Assemblers and fabricators, all other |
| 20.6 | Business operations specialists |
| 20.5 | All other farming, fishing, and forestry workers |
| 18.3 | Building cleaning workers |
| 17.1 | Healthcare support workers, all other |
| 16.7 | Engineers |
| 16.3 | Other health professionals and technicians, all other |
| 16.1 | Life, physical and social science occupations |
| 15.5 | Health diagnosing and treating practitioners |
| 14.0 | Physical scientists |
| 13.6 | Cooks and food preparation workers |
| 13.6 | Firstline supervisors/managers of production and operating workers |
| 12.7 | Vehicle and mobile equipment mechanics |
| 12.2 | Financial specialists |
| 11.7 | Law enforcement workers |
| 11.6 | Textile, apparel, and furnishings workers, all other |
| 11.1 | Animal care and service workers |
| 10.5 | Other education, training, library |
| 10.3 | Firstline supervisors/managers of office and administrative support worker |
| 9.9 | Firstline Supervisors/managers of landscaping, lawn service and groundskeeping workers |
| 9.4 | Metal workers and plastic workers |
| 8.9 | Firstline supervisors/managers of farming, fishing, and forestry workers |
| 8.8 | Supervisors, sales workers |
| 8.6 | Other protective service workers |
| 8.5 | Life scientists |
| 7.2 | Firstline supervisors/managers of construction trades & extraction workers |
| 7.1 | Drafters, engineering, and mapping |
| 6.1 | Other food preparation and serving related workers, all other |
| 5.6 | Personal appearance workers |
| 5.6 | Lawyers |
| 5.3 | Electrical and electronic equipment installers |
| 5.0 | Firstline supervisors/managers of mechanics, installers, and repairers |
| 4.0 | Firstline supervisors/managers of food preparation and serving workers |


SWOSU

Southwestern Oklahoma State University