

**APPENDIX I:
BIOFUEL INDUSTRY ECONOMIC IMPACTS AND ANALYSIS**

**RENEWABLE FUELS ROADMAP AND
SUSTAINABLE BIOMASS FEEDSTOCK SUPPLY FOR NEW YORK**
Final Report

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ABSTRACT

New biofuels industrial activity in a region or state creates an overall economic impact that is greater than the sales value of the biofuels. Advanced biofuels production in New York will create jobs at the biofuel refineries, but more importantly, it will create new jobs producing, pre-processing, and transporting feedstocks to the plants.

Commercial-scale advanced biofuels industries, however, do not currently exist in the U.S.; hence, the potential job, labor income, and value added impacts for all new sectors of productivity must be estimated using an input-output modeling process that introduces several new categories of industrial activity into the New York economy. This report relied greatly on other work conducted by the Roadmap Team to include feedstock yield, prices, transport costs, capital cost assumptions. It explains the modeling processes, the inherent assumptions deployed, and limits to the analysis, along with methods used to compile both feedstock supply shed and statewide economic impacts given the three future scenarios used in common by the Roadmap Team.

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1 INTRODUCTION

This report itemizes the procedures employed for determining the range of economic impacts of advanced biofuels production in New York and the results of that effort. The term economic impact has a relatively precise meaning in this research: it represents the net new productivity that can be attributed to the New York economy that is both a direct and indirect result of advanced biofuels production. The biofuel measured in this report is ethyl-alcohol produced from an advanced lignocellulosic biomass processing technology.

The economic impacts that are described in this section involve the economic activity that is attributable to the ethanol production facility, as well as the economic activity that is involved with all feedstock production and transport. As no industry exists in isolation from others, there are intricate inter-industrial relationships that are captured when measuring net increases or decreases in regional industrial production. The sum of all industrial interactions constitutes the sum of expected economic impacts.

Given the information processed for this task and the assumptions inherent in producing estimates for an industry that has no commercial presence, there is nonetheless the potential for robust job growth in the New York economy for direct ethanol processing as well as the production and transport of biomass feedstocks.

This research was significantly dependent on the findings and conclusions of previous tasks. In particular, research on the biomass production potential as well as future biofuel production pathways, including the development of siting regions, feedstock supply estimates, and the expected costs of transportation and processing, were all critical inputs into this research.

2 THE ECONOMIC IMPACT MODELING PROCESS

2.1 INPUT-OUTPUT MODELING

Input-Output (I-O) modeling is a standard method for estimating regional economic change due to alterations in industrial output, changes in consumer behavior, or some other pertinent alteration in an economy. I-O models are detailed accountings of inter-industrial transactions within an economy. As all industries require a range of commodity and service inputs, any change in a particular industry creates changes in the demand for all inputs. All firms that produce inputs, in turn, have their own unique production relationships with their supplying firms. When production changes in the industry being scrutinized, there are multiple rounds of industrial activity that indirectly change as a consequence. The value of that change is commonly called a multiplier or the multiplier effect.

There are standard I-O model structures that can be applied to small areas or research in individual states. The U.S. Bureau of Economic Analysis (BEA) will, for a small fee, produce sets of region- or state-specific multipliers for a schedule of nearly 500 industries (to the extent those industries are present in the region of study). A private company called Minnesota IMPLAN produces county- and state-specific I-O data that can be processed with their proprietary software. As the IMPLAN system is a completely open system that allows the researchers to modify

most components of the inter-industrial accounting process, it is highly popular among academics and state and national agencies that compile economic impact studies.

In studying advanced biofuels with existing I-O systems, researchers must work iteratively with the modeling systems and the potential production and processing systems that will evolve. There is no advanced biofuels sector, per se, in the models; therefore, the system of production that produces ethanol from advanced techniques either must be processed in part outside of the modeling system or, alternatively, an advanced ethanol production industry can be created within the modeling system.

As this research ultimately involved multiple regions of analysis, multiple scenarios, and multiple ethanol price assumptions within each scenario, a hybrid I-O system was constructed that used IMPLAN-derived multiplier tables as subsequent inputs into a spreadsheet-based impact assessment system. This resulted in an economic impact assessment process known generically as a “bill of goods” impact assessment that is based on the sum of the separate impacts of each major input (the goods) into the production process.

2.2 MULTIPLIER TABLE

The IMPLAN model was used to produce unique multiplier tables for each of the industries that are in each region and for the state as a whole. Multiplier summaries were derived for:

- Total Output – This represents the production value of an industry. That value may be sold or it may accumulate to inventory.
- Jobs – Jobs are the number of positions that are involved in some type of industrial activity expressed on an annualized basis. Jobs are not, however, expressed as Full Time Equivalents. For example, a seasonal farm job is a job, as is a full-time factory job producing ethanol.
- Labor Compensation – In this model, this represents the total compensation to wage and salary workers, including the value of all benefits.
- Proprietors Incomes – These are the normal returns to management and proprietorship for sole proprietors or simple partnerships.
- Investment Incomes – Investment incomes are the dividends, interest payments, or rents that are paid to investors or landowners.
- Indirect Taxes – All firms pay production-related sales, use, property, and excise taxes. These are all considered taxes linked to the cost of doing business.
- Value Added – The sum of labor income, proprietor income, investment income, and indirect taxes equals value added. Value added is also known as gross domestic product (GDP). Value added is the most appropriate manner in which to gauge the size and value of an industrial activity.

Each region’s seven unique multiplier tables were then inserted into the respective regional model to complete the hybrid I-O modeling structure.

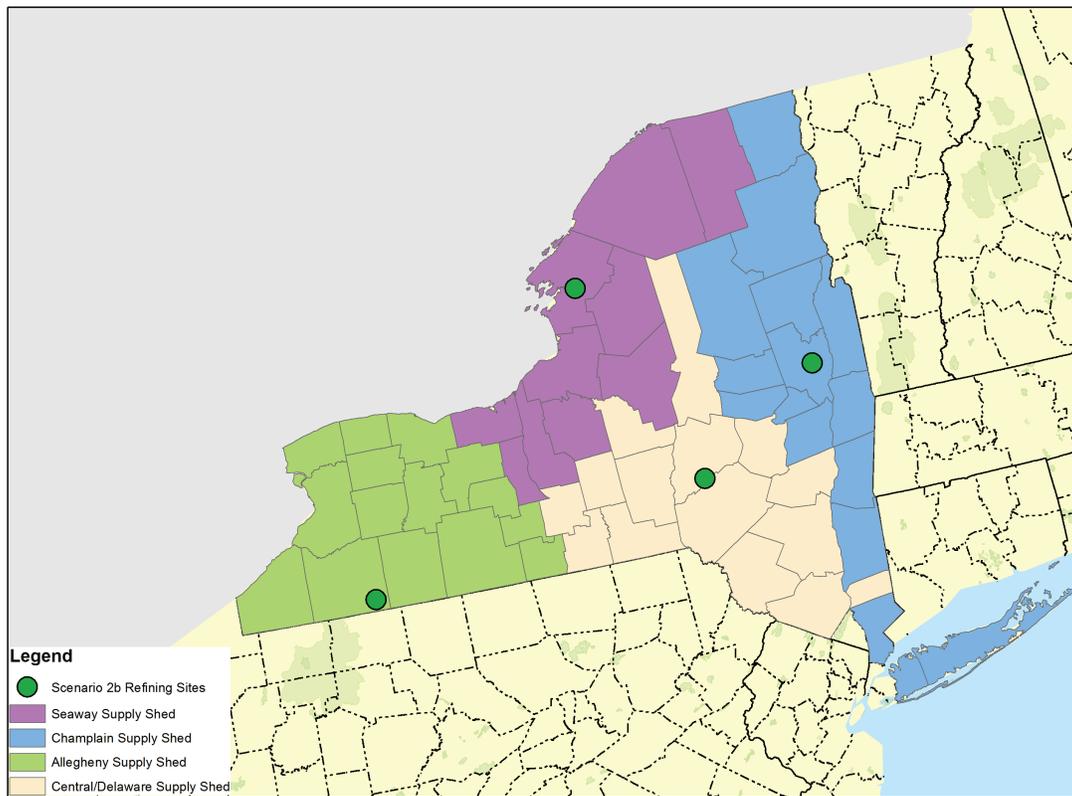
2.3 PRODUCING THE MULTIPLIER TABLES

The IMPLAN system has detail for 400 industries. The data are county specific and organized so that contiguous counties can be combined to create multi-county regions. In estimating the potential biomass supply in New York and the likely locations of potential biomass processing facilities, four candidate regions or feedstock supply sheds were identified by the Roadmap team for Scenarios 1 and 2: Seaway supply shed, Allegheny supply shed, Central/Delaware supply shed, and Champlain supply shed. The comprising counties for the four regions are shown in Table I-1, and Figure 1 illustrates the geographic locations of each region.

Table I-1. Supply Regions.

Allegheny supply shed counties	Central / Delaware supply shed counties	Champlain supply shed counties	Seaway supply shed counties
Allegany	Broome	Albany	Jefferson
Cattaraugus	Chenango	Columbia	Lewis
Chautauqua	Cortland	Essex	Oneida
Erie	Delaware	Fulton	Onondaga
Genesee	Herkimer	Greene	Oswego
Livingston	Madison	Hamilton	Rockland
Niagara	Otsego	Montgomery	Wayne
Orleans	Schoharie	Rensselaer	
Wyoming	Sullivan	Saratoga	
	Tioga	Schenectady	
	Tompkins	Warren	
	Ulster	Washington	

Figure I-1. Map Showing County Supply Sheds for the Refineries Sited in Scenario 2b.¹



Because the statewide economy must also be considered, there are five potential regions of scrutiny for the economic impact assessments. There are also multiple scenarios to be considered. The Roadmap team identified three basic scenarios:

- ***Scenario 1 - “Big Step Forward”*** This scenario places strong emphasis on maintaining current New York agricultural food and feed markets, with focus on large biofuel production plants. For this scenario, rapid development of lignocellulosic feedstock resources is assumed on a portion of suitable and available rural lands. The available land base excludes all land currently in food production. It is assumed that first generation lignocellulosic biorefineries (biochemical and thermochemical systems) are performing at their optimum potential. Total New York production of renewable gasoline substitutes would reach 508 million gallons per year (MGY). Under this scenario, New York meets about 5-6% of its projected transportation gasoline consumption with home grown biofuels in this scenario.

¹ Map courtesy of Energy and Environmental Associates, LLC; based upon Figure F-9 found in Appendix F.

- **Scenario 2 - “Giant Leap Forward”** In this scenario, some cropland is used for biofuel feedstock production,² and second generation lignocellulosic biorefineries (biochemical and thermochemical systems) are assumed ready for commercial deployment. Here, large lignocellulosic biorefinery clusters exist in a centralized collection and distribution system. Total New York liquid biofuel production including the grain derived ethanol would reach 1,449 MGY. In the Scenario 2 base case, New York could meet about 15% of its projected transportation gasoline consumption with home grown biofuels.
- **Scenario 3 - “Distributed Production”** This scenario envisions the same feedstock production and conversion technology as in Scenario 2. This scenario, however, reflects a more decentralized fuel production industry with no individual biorefinery capacity exceeding 60 MGY, except for the existing grain ethanol biorefineries.

Four regional models were constructed based on the maximum supply territory associated with Scenario 1. A model was also constructed for the entire State of New York. Once the initial five models were constructed, the IMPLAN system allows for modifying the basic production characteristics of any important industry. For the research, the Roadmap team identified five candidate feedstock sources. These were:

- Hardwoods harvested from existing forest stands
- Softwoods harvested from existing forest stands
- Willow grown as a crop and periodically harvested
- Grasses (of any kind) that are also a perennial crop and periodically harvested
- Stover, which involves the collecting of corn stalks and cobs as a remnant of corn harvesting

For the economic impact estimation process, two industrial categories were modified in the model to represent the estimated production characteristics per ton of biomass produced. The first industry was a forest products biomass sector that included all of the hardwood and softwood supply. This industry was allowed to behave very similarly to the forest products industry, but labor costs were altered as were the total schedule of mechanical inputs.

The next industry was a crop biomass sector. The production characteristics of this industry were informed using existing enterprise budget³ research for harvesting hay, supplemented in part by Iowa State University estimates of the labor involved in producing switchgrass. It was assumed in the modeling process that the sum of mechanical

² This applies only to cropland estimated to become available due to increases in crop yield and milk yield per cow such that crop and milk production could be maintained at 2009 levels.

³ An enterprise budget is a written statement of goals for a crop or livestock production activity. It lists the production goals, product mix, profits and losses, fixed and variable costs, etc.

and labor inputs per ton of biomass available for processing into ethanol were similar across grasses, willow, or stover production.

An initial baseline model was constructed for each region and the State, using the cost of production information from Scenario 1. The baseline model included the following factors or costs assumptions:

- Project Size (MGY)
- Construction Costs per Gallon
- Percent Financed
- Jobs at the Plant
- Total Labor Costs per Job
- Delivered Feedstock Cost per Oven Dry Ton (ODT)
- Conversion (gallons per ODT)
- Required Tons
- Expected Return to Equity
- Finance Rate
- In Transport Rates per Gallon (or Ton)
- Out Transport Rates per Gallon (or Ton)

The modeling system accounted for major production costs in the following major areas:

- Labor
- Materials
- Services
- Insurance/Other
- Depreciation
- Fixed Subtotal
- Waste Disposal
- Water

- Natural Gas
- Other Materials
- Enzymes
- Chemicals
- Transport Out
- Feedstock Cost
- Financing Cost
- Equity Payments
- Indirect Taxes

The model was built using in part the National Renewable Energy Laboratory (Job and Economic Development Impact - JEDI) Biofuels Economic Impact Model, (Goldberg 2009). The assumptions in that model were reconciled with research conducted by Eidman, et al (2009), in measuring the feasibility of stover and hardwood harvest in the state of Minnesota. The basic regional models were constructed so as to reconcile with I-O accounting rules and standard national income and product accounting procedures.

Once the models were built and cost-of-production factors were determined for the two feedstock supply industries – the forestry harvesting sector and the crop based sector – those factors were then entered into each IMPLAN model to produce the appropriate labor-to-output ratios and other critical social accounts, as well as to derive those industries’ actual multipliers. Additionally, as those industries rely heavily on trucking transport of feedstocks to the biofuels refinery as well as the transport of biofuels to blending terminals, the trucking sector was adjusted assuming higher average tons hauled per trucking job – in essence the industry was shifted to haul more weight with fewer jobs.

3 ESTIMATING THE ECONOMIC IMPACTS

3.1 MODELING AND ASSUMPTIONS

The economic impacts of the different scenarios were determined completely by the mix and amount of feedstocks produced under each of the three scenarios. There were two ethanol prices used for each scenario. The first assumed a \$3 price per gallon of gasoline equivalent of ethanol (\$3 gge) and the second assumed a \$4 gge price.

The lower price might be considered a price steady-state assumption, and the higher price might be analogous to an energy price shock situation. With the higher price, all things equal, there would be a profit in bringing marginal

feedstock sources into production – less efficient operations would be profitable and feedstock supply would increase.⁴

For all scenarios, the Roadmap team estimated cost per gallon assumptions for feedstock prices, in-transport costs, processing costs, and out-transport costs. The sum of those values represents the cost of production per gallon of ethanol produced. Those values vary by the amount of ethanol produced – ethanol production firms achieve economies of scale, as do suppliers, transporters, etc. The modeling system incorporated those sized-based coefficients to readjust the cost of production assumptions in each scenario.

For each scenario, then, there were three primary considerations that had to be incorporated into the final modeling estimate:

- The characteristics of all production costs – feedstocks, transport, processing
- The number and size of biorefineries required
- The sheer volume and mix of biomass feedstocks

All of these data were supplied by (1) the Roadmap team’s cost of production and supply curve estimations and (2) the resulting scenario runs that identified the amounts of feedstocks by county for each scenario along with the number and the sizes of the biofuels facilities in each of the supply shed regions.

3.1.1 Note on Effects of Selected Ethanol Price Points

Given the modeling efforts on behalf of the Roadmap Team, it is evident that high energy prices have the potential to “jump-start” the state’s advanced biofuels industrial potential. It is a basic tenet of resource extraction and processing that if prices rise sufficiently, marginal resources are brought into production. Higher prices send a strong signal to supply, and if normal supply is exhausted, those prices will induce additional production. Because biomass is an essential need for advanced biofuels production, during a period of higher energy prices, feedstock bid prices will rise until a sufficient amount is produced to accommodate existing demand. For this reason, the modeling differentiated the commodity supply between two price points. A higher wholesale bid price for energy, all things being equal, will stimulate greater biomass production and greater amounts of advanced biofuels to satisfy the higher prices. It is also generally true that as energy prices rise, the cost of production in all industries that use energy will also rise. However, these costs are not proportionate to energy price increases. They will rise proportionately to energy dependence, as well as the energy dependence of the primary inputs. Industries that have a stake in producing the raw materials and the finished energy product will continue to generate profits until supply, demand, and price equilibrate.

⁴ It is very important to note that Input-Output models are considered fixed-price models. That is, the coefficients that determine all inter-industrial transactions are fixed and remain so during the modeling process. If there is, as is the case in this scenario, an increase in the price of energy, one must assume that the prices of all inputs would be affected in all industries as their energy costs would be rising concomitantly. To accommodate that economic cognitive dissonance, the economic impacts of increases in feedstocks supplied are made by adjusting the quantity demanded using the original \$3 gge coefficients. As the only modeled shift in activity is an increase in feedstock supply and transport, plus increased biofuels production and transport, all production cost coefficients remain static and are only increased by volume changes. In effect, rather than a price shift in the modeling, a volume shift is simulated as a reasonable approximation of that shift.

Another related issue is how input-output modeling accommodates a situation where prices increase. Input-output models are fixed price models that have many rigid assumptions (see Appendix I-A), but the one fundamental assumption is that all production coefficients are constant once the model is determined. The modeling process simply simulates a volumetric shift in production to replicate the value of the economic shift caused by the price change. If prices in all industries rise due to increased energy costs, then the prices paid for all inputs will change to reflect that across all industries. New producers of biomass receive returns to labor and ownership, and those values are forced into the model as average returns to production for all biomass producers, not just the new producers. Since the economic impact modeling focuses on the production of labor income, value added (GDP), and jobs, this is an efficient way to estimate those values even though biomass prices have changed. The economic impact models that were built for the Roadmap were calibrated assuming a \$3 gge. The primary difference between the \$3 gge models and the \$4 gge models was the price and quantity of feedstocks. Return on investment percentages and payments to labor were held constant.

It is important to note that this was a very intricate and iterative modeling exercise designed to describe a production process that does not exist in the U.S., and which may not exist for many years. Because there is no ability to audit and validate the projections, the skill and reputations of the participating analysts are crucial for assurances of proper methods and procedures.

3.2 THE RESULTS

Summary economic impacts are presented for each scenario in the following tables. All of the detailed economic impacts are summarized and explained in the exhibit tables at the end of this report, but Table I-2 displays the detailed values for the Allegheny Supply Shed for Scenario 1 only. This will allow for a primer on interpreting the detailed tables that are in the appended exhibits as well as a basis for understanding the summary tables of each scenario that follows.

3.2.1 Clarification of the Terms Used In Table I-2

Column Headings: These are the categories for which multiplier tables were produced in the hybrid I-O modeling process listed above.

Row Labels: These values are sets of separate calculations in the hybrid I-O model that are summarized to arrive at the total economic impact and other summary tables.

Sum of Input Impacts: The New York hybrid I-O model is an elaborate “bill of goods” impact model using IMPLAN multipliers as adjusted, considering the need to introduce sectors that grow or otherwise process biomass feedstocks. The model was configured to summarize all inputs into 12 major categories. The actual value of the inputs for each category was multiplied by appropriate multiplier coefficients in separate tables for the regions or the State of New York for each of the column headings listed in Table I-2.

Scenario Direct Values: These are refinery plant level estimates (output, jobs, labor incomes, returns to investors, etc.). These values may diverge slightly from the values found in Appendix L, “Selected Future Production Pathways in New York,” because these accounts are constructed using income and product accounting definitions of industrial activity.

Direct Refinery Worker Household (HH) Spending Impacts: This is an estimation of refinery workers’ regional spending impacts when they convert their earnings to household spending in the region or the State. This constitutes the refinery worker-induced economic activity. The induced activities attributable to increased input demands are subsumed within the sum of impacts in Line 1.

Direct Investment Income Impacts: The model for Scenario 1 and Scenario 2 assumes that 60 % of the capital cost of biorefineries comes from investors. These coefficients are derived from region or State investors’ probabilities of realizing investment income from a regional or state enterprise. A portion of the incomes are converted to regional spending (consumption), which will have an economic impact. In Scenario 3, that percentage is lowered to 50%.

Total: Inputs + Direct Values: This value is the inputs, the direct values, plus all of the refinery worker impacts and the investment income impacts in the regions and in the State. It is the best estimate as to the total value of all rounds of economic activity stimulated by the biorefinery.

Scenario Multiplier: This is the total value divided by the direct value for all categories. The value of a multiplier is a function of the total jobs, the direct jobs, and the likelihood that a scenario will actually occur. For example, in the Allegheny Supply Shed in Scenario 1, two-thirds of the job gains are in feedstock production and transportation, which is about 45% of the labor incomes. As these plants require an entirely new-to-the-economy feedstock, the model will produce tremendously high job multipliers and very high income multipliers. Those multipliers are very high as well because refineries have relatively low job requirements at the refineries, given their gross output. It does not necessarily follow that an option with a high multiplier is more desirable to an economy or a region than an option with a lower multiplier.

The actual interpretation of Table I-2 starts with the values in Line 2. For the Allegheny Supply Shed in Scenario 1, a biofuels refinery produced \$187.05 million in total industrial output. That plant required 67 jobs paying \$4.16 million in labor incomes to those workers. The return on investment for the plant was \$29.16 million, and the plant paid \$3.61 million in indirect tax costs. In all, the plant produced \$36.93 million in value added.

Line 1 begins to build the indirect economic impacts for the plant. In producing the direct output, the plant created \$155.6 million in total indirect impacts in the region. Those impacts were created from the purchase of feedstock, transport, and all other processing-related inputs. Each of those industries has a unique total impacts multiplier, which when multiplied by the inputs value and summed, equals the respective totals. Accordingly, the total economic value of the required inputs yielded 1,014 total jobs, nearly \$30 million in labor incomes. Another \$9.2 million in incomes to proprietors, \$32.1 in investment incomes, \$5.57 million in state and local indirect tax payments, and \$76.8 million in value added is generated.

Payments to the workers and to the investors also generate regional economic impacts, and those are modeled separately in Lines 3 and 4 to round out the estimate of the likely value of a biofuels refinery to the entire region. The values in Lines 3 and 4 represent economic activity that is induced from converting earnings or investment incomes into household spending.

The sum of Lines 1 through 4 gives us the total economic values attributed to this industry in this region (Line 5). All together, \$342.7 million in total output, 1,155 jobs, \$35.51 million in labor income, and \$118.4 million in value added is generated.

Line 6 is the multiplier. It is arrived at by dividing the total value by the direct value in each category⁵. A multiplier of 1.83 means that for each dollar's worth of direct output in the ethanol refinery, there was \$.83 in additional output in the remainder of the economy. A multiplier of 17.36 for jobs is very high as the ethanol plant requires very few workers, given the amount of gross output. It means that for every job at the ethanol biorefinery, there are 16.36 jobs in the rest of the economy. The labor compensation multiplier is also very high at 8.78. It means that for every dollar's worth of labor compensation paid at the biorefinery, \$7.78 in labor compensation is sustained in the rest of the economy.

Again, Table I-2 is being displayed for instructive purposes – all detailed tables for all regions for all scenarios for each gge price level will be contained in the ending exhibits.

⁵ There is no multiplier for proprietor income because the models assumed the plants were owned by investors, not a sole proprietor.

Table I-2. Allegheny Supply Shed, Scenario 1.

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
1. Sum of Input Impacts	155.60	1,014	29.99	9.19	32.05	5.57	76.79
2. Scenario Direct Values	187.05	67	4.16	NA	29.16	3.61	36.93
3. Direct Refinery Worker HH Spending Impacts	5.82	39	1.24	0.16	0.79	0.25	2.45
4. Direct Investment Income Impacts	30.65	35	1.12	0.14	0.73	0.23	2.21
5. Total: Inputs + Direct	342.65	1,155	36.51	9.49	62.73	9.66	118.38
6. Scenario Multiplier (Total / Direct)	1.83	17.36	8.78	NA	2.15	2.68	3.21

3.3 A NOTE ON INTERPRETING MULTIPLIERS

It is frequently the case that readers infer direct causation from a multiplier. A multiplier is merely the ratio of the total economic impact measured relative to the direct amount. One does not automatically infer causation; rather, one identifies and isolates the value of the different portions of the multiplier in order to understand exactly what is stimulated in the economy, why it is stimulated, and the extent to which it can be stimulated in the future. For example, with a jobs multiplier of 16.4, as indicated above, for a biofuels plant, one does not automatically assume that biofuels plants are superior job-creating mechanisms compared to other types of economic activity. The plant exists only because of a tenuous supply-demand-technology relationship that must take into account feedstock supply, the cost of biofuels production versus other sources of fuel, and the overall price of energy. The potential for expansion is very limited; therefore, there are knowable upper boundaries on viable job growth. Because this industry must create a new resource base, i.e. feedstock supply, it would necessarily have a greater multiplier than other industries using resources that already exist. This is because the already-existing resources in the latter case are considered to be a part of the economy, meaning that they would be excluded, leading to a lower multiplier. In addition, because plants are capital intensive with lean labor needs, the denominator is comparatively small, hence the robust figure.

An illustration of this is found in Table I-3. When one separates out all inputs-related economic activity, one finds that 28% of the total industrial output is attributable to feedstock production and in-transport in order to include all of those up-stream industries' impacts in the New York economy. Nearly two-thirds of the jobs, however, are generated in the feedstock supply and transport activity, and just under half of all labor income. Were one to separate those input values from the analysis, the biofuels plant level-only multipliers are reduced sharply. Output is 1.38, labor income is 3.51, and the jobs multiplier is still a robust 4.52, a number that aligns with corn ethanol plants in the Midwest where all of the corn input activity is excluded from impact analysis as it is already in existence in those economies.

Table I-3. Comparing Multipliers With and Without Feedstock Impacts for the Allegheny Supply Shed, Scenario 1.

Category	Scenario Multiplier (Total / Direct)	Percent of Impacts Attributable to New Field Inputs	Biorefinery Only Multiplier (Excluding Feedstocks and In- Transport)
Total Industrial Output	1.91	28%	1.38
Jobs	12.78	65%	4.52
Labor Income	6.48	46%	3.51

4 SCENARIO RESULTS

4.1 SCENARIOS 1a & 1b

4.1.1 Scenario 1a

Table I-4 displays the separate regional economic impact summaries for the four regions and for the State of New York for Scenario 1 with the \$3gge price assumption.⁶ There are three initial values that are important or should be important to policy makers and to economic analysts:

- The first is the number of jobs created. Jobs are the primary measure of regional economic well-being, and they are the favored measure of State and local policy makers when gauging economic development success.
- The second is the estimate of labor income. Labor income, in this case wage and salary payments primarily, is the income that translates readily into regional household spending. It has a highly localized impact that is intuitive and meaningful to communities and regions.
- The third is the value-added projection. Value added is, as has already been noted, the same as GDP. It is the preferred method for measuring the value of an economic activity in light of all other economic activity in an area.

The values displayed are the total impacts amounts and the multipliers (i.e., Lines 5 and 6 from Table I-2, above). Under Scenario 1, the range of total job impacts is from 842 in Central / Delaware to 1,155 in the Allegheny Supply Shed. Total labor compensation and value added are lowest in Champlain and highest in the Allegheny region.

For the State, the model estimates 3,891 total job impacts and \$172.61 million in labor income – an average of \$44,361 per job. Value added impacts would be \$464.34 million. To put that value added (or GDP) amount into perspective, the State of New York GDP for 2008 was \$1.144 trillion.

⁶ Ethanol has two-thirds the energy value of an equivalent volume of unleaded gasoline. Accordingly, it takes a gallon and a half of ethanol to produce the same amount of usable energy as a gallon of unleaded gasoline when burned in a typical motor vehicle engine. The transformation of the ethanol into a gallon of gasoline equivalency simply standardizes the ethanol on a price basis. Ethanol at \$3 gge would sell for \$2.01 on the wholesale market. Ethanol at \$4 gge would sell for \$2.68, and so on.

Table I-4. Scenario 1a: \$3 gge.

	Allegheny Supply Shed		Central /Delaware Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	342.65	1.8	324.49	1.9
Jobs (Actual)	1,155	17.4	842	12.7
Labor Compensation	36.51	8.8	30.40	7.3
Proprietors Incomes	9.49	NA	6.14	NA
Investment Incomes	62.73	2.2	54.78	2.0
Indirect Taxes	9.66	2.7	8.20	2.4
Value Added	118.38	3.2	99.51	2.9

	Champlain Supply Shed		Seaway Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	316.43	1.9	383.72	1.9
Jobs (Actual)	850	12.8	1,082	16.3
Labor Compensation	26.94	6.5	34.42	8.3
Proprietors Incomes	7.96	NA	11.25	NA
Investment Incomes	55.90	2.2	51.17	1.7
Indirect Taxes	8.02	2.5	9.36	2.5
Value Added	99.10	3.0	106.24	2.7

	Statewide	
<i>All Financial Items in Millions</i>		
	Total Impacts	Scenario Multipliers
Total Output	1,514.12	2.1
Jobs (Actual)	3,891	14.2
Labor Compensation	172.61	10.4
Proprietors Incomes	44.43	NA
Investment Incomes	206.64	1.8
Indirect Taxes	38.63	2.8
Value Added	462.34	3.2

4.1.2 Scenario 1b

Table I-5 contains the regional and State summaries for a situation where the bid price for ethanol was \$4 gge. Every scenario has a \$3 gge and a \$4 gge consideration. These might be considered a baseline value (\$3 gge) and a situation with very high energy costs (\$4 gge).

Under a \$4 gge situation, it becomes profitable to harvest feedstocks from more marginal lands or at greater distances from refineries. Accordingly, there are sharp increases in the inputs impacts as the prices paid for feedstocks and the quantities demanded increase. However, all other factors, like labor, increase based on the quantity demanded only. The difference between the \$3 gge and the \$4 gge is therefore driven strongly by the quantity differences in terms of feedstock sourcing and production at the biofuels refinery.

Jobs increase markedly in the inputs sectors and in the biorefinery sector as there is a need for many more facilities. It is almost always the case that the greatest job, labor income, and value added impacts will accumulate to the Allegheny region. The Seaway Supply Shed will be second, the Central / Delaware area third, and the Champlain area fourth.

Statewide, this scenario will produce 7,780 total jobs Statewide, \$350.42 million in labor incomes, and \$931.72 million in value added. Jobs, labor incomes, and value added are double the values in the \$3 gge consideration.

Table I-5. Scenario 1b: \$4 gge.

	Allegheny Supply Shed		Central /Delaware Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,147.74	2.3	1,024.25	2.0
Jobs (Actual)	2,436	14.7	1,784	13.4
Labor Compensation	77.93	7.5	64.21	7.7
Proprietors Incomes	19.68	NA	13.07	NA
Investment Incomes	136.59	2.0	119.89	2.0
Indirect Taxes	20.92	2.5	17.86	2.4
Value Added	248.86	3.1	210.87	2.9
<hr/>				
	Champlain Supply Shed		Seaway Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	793.44	2.0	1,107.88	2.3
Jobs (Actual)	1,456	14.6	2,269	13.6
Labor Compensation	45.66	7.3	73.14	7.0
Proprietors Incomes	13.82	NA	23.14	NA
Investment Incomes	98.70	2.1	112.10	1.6
Indirect Taxes	14.09	2.4	20.18	2.3
Value Added	170.68	3.0	222.43	2.7
<hr/>				
	Statewide			
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers		
Total Output	4,457.43	2.4		
Jobs (Actual)	7,870	13.5		
Labor Compensation	350.42	9.9		
Proprietors Incomes	88.90	NA		
Investment Incomes	431.80	1.8		
Indirect Taxes	79.98	2.6		
Value Added	931.72	3.2		

4.2 SCENARIOS 2a & 2b

4.2.1 Scenario 2a

Scenario 2 with a \$3 gge price is a decidedly different and much more optimistic situation for ethanol development. The number of refineries increases, and the volume and mix of feedstocks expands. Now, in the Allegheny area, total job impacts rise sharply to 5,146 almost 4.5 times greater than in Scenario 1 at the same price. Labor incomes and value added also post similar factor increases.

Statewide, jobs climb sharply to 14,604, and labor compensation is \$640.6 million. Value added grows to \$1.73 billion.

Table I-6. Scenario 2a: \$3 gge.

	Allegheny Supply Shed		Central /Delaware Supply Shed	
<i>All Financial Items in Millions</i>	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,642.53	2.1	1,271.50	1.9
Jobs (Actual)	5,146	19.3	3,349	16.8
Labor Compensation	164.20	9.9	115.81	9.3
Proprietors Incomes	44.38	NA	26.43	NA
Investment Incomes	256.42	2.0	213.55	2.0
Indirect Taxes	41.63	2.7	32.31	2.5
Value Added	506.58	3.2	388.07	2.9

	Champlain Supply Shed		Seaway Supply Shed	
<i>All Financial Items in Millions</i>	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	905.53	2.0	1,348.50	2.0
Jobs (Actual)	2,468	18.6	3,874	19.4
Labor Compensation	75.56	9.1	121.38	9.7
Proprietors Incomes	24.39	NA	40.83	NA
Investment Incomes	155.92	2.1	182.22	1.7
Indirect Taxes	22.96	2.5	33.36	2.5
Value Added	279.59	3.1	377.95	2.8

	Statewide	
<i>All Financial Items in Millions</i>	Total Impacts	Scenario Multipliers
Total Output	5,598.68	2.2
Jobs (Actual)	14,604	18.3
Labor Compensation	640.59	12.8
Proprietors Incomes	171.59	NA
Investment Incomes	773.50	1.9
Indirect Taxes	144.71	2.8
Value Added	1,730.52	3.4

4.2.2 Scenario 2b

Scenario 2 with a \$4 gge consideration did not produce the magnitude of quantity shifts as was the case in Scenario 1 when comparing the two price levels. There is virtually no meaningful change in quantity demanded, although there are minor differences in supply among the four regions.

The primary determinants of change are therefore just the bid prices for feedstocks and for the finished ethanol product. The impacts accumulated to the four regions in the same manner as previously noted: from highest to lowest were Allegheny, Seaway, Central / Delaware, and the Champlain Supply Sheds. Statewide, the scenario generated 14,019 jobs, \$614.7 million in labor incomes, and \$1.66 billion in value added.

Even though output is substantially higher in this scenario, that is due to the price change in the main. The value-added amount needs to be looked at to determine net gains or changes to the state economy. The Statewide impacts are slightly lower in this case than the \$3 gge, owing to a trimming of returns to investors and a minor increase in scale economies in the feedstock collection and transport sectors.

Table I-7. Scenario 2b: \$4 gge.

	Allegheny Supply Shed		Central /Delaware Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,931.80	2.2	1,823.73	2.0
Jobs (Actual)	3,895	19.5	3,366	16.9
Labor Compensation	124.25	10.0	116.37	9.3
Proprietors Incomes	33.55	NA	26.57	NA
Investment Incomes	204.88	1.9	214.82	2.0
Indirect Taxes	32.87	2.5	32.50	2.5
Value Added	395.51	3.0	390.23	2.9

	Champlain Supply Shed		Seaway Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,268.57	2.1	1,912.73	2.1
Jobs (Actual)	2,466	18.5	3,874	19.4
Labor Compensation	75.48	9.1	121.38	9.7
Proprietors Incomes	24.36	NA	40.83	NA
Investment Incomes	155.79	2.1	182.21	1.7
Indirect Taxes	22.94	2.5	33.36	2.5
Value Added	279.32	3.1	377.94	2.8

	Statewide	
<i>All Financial Items in Millions</i>		
	Total Impacts	Scenario Multipliers
Total Output	7,586.62	2.3
Jobs (Actual)	14,019	19.2
Labor Compensation	614.65	13.4
Proprietors Incomes	165.71	NA
Investment Incomes	741.41	1.9
Indirect Taxes	138.94	2.9
Value Added	1,659.29	3.4

4.3 SCENARIOS 3a & 3b

4.3.1 Scenario 3a

This scenario at the \$3 gge level is a more regionally-distributed production and processing system that allows for smaller plants, shorter feedstock transport assumptions, and shorter biofuels transport distances as the biofuels are consumed in greater quantities locally.

Under a distributed production system, there are still very high numbers of jobs, labor incomes, and value added created. The overall values vary slightly from the previous scenario, but there are decidedly lower job values. As the plants are more distributed, and smaller, there is the replacement of in-transport labor for plant labor yielding slightly lower job totals.

Statewide, this scenario produces an estimated 14,189 jobs, \$608.3 million in labor incomes to those workers, and \$1.78 billion in value added or GDP. Readers will note that all multipliers are lower in this scenario. The primary reason is a multiplicity of small plants creating a slightly higher denominator as smaller plants are less labor efficient. In addition, as has been mentioned, there is a reduction in the volume and distance of feedstocks per plant that ends up reducing in-transport impacts. Lastly, out-transport is reduced as this scenario assumes local consumption of the biofuels.

Table I-8. Scenario 3a: \$3 gge.

	Allegheny Supply Shed		Central /Delaware Supply Shed	
<i>All Financial Items in Millions</i>	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,593.46	2.0	1,024.89	1.9
Jobs (Actual)	4,807	12.5	2,682	9.8
Labor Compensation	151.06	6.3	96.80	5.6
Proprietors Incomes	41.70	NA	18.49	NA
Investment Incomes	273.67	1.8	192.37	1.8
Indirect Taxes	39.67	2.6	25.96	2.5
Value Added	506.03	2.6	333.59	2.5

	Champlain Supply Shed		Seaway Supply Shed	
<i>All Financial Items in Millions</i>	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,039.37	1.9	1,469.65	2.0
Jobs (Actual)	2,767	10.1	4,181	10.9
Labor Compensation	85.91	5.0	130.60	5.4
Proprietors Incomes	25.52	NA	42.93	NA
Investment Incomes	201.11	1.9	223.83	1.5
Indirect Taxes	26.06	2.5	35.99	2.4
Value Added	339.71	2.5	433.59	2.3

	Statewide	
<i>All Financial Items in Millions</i>	Total Impacts	Scenario Multipliers
Total Output	5,520.95	2.1
Jobs (Actual)	14,189	10.7
Labor Compensation	608.27	7.4
Proprietors Incomes	162.20	NA
Investment Incomes	861.68	1.7
Indirect Taxes	142.14	2.8
Value Added	1,780.24	2.7

4.3.2 Scenario 3b

Under the \$4 gge price, there are no significant differences in total impacts but there is some shifting among the regions. Here there is a substantial gain in feedstock accumulating in the Central / Delaware Supply Shed and a reduction in the feedstocks available in the Champlain Supply Shed. In effect, at this price there is a shifting from one region to the other in Scenario 3.

Overall, the State would expect 14,236 jobs, \$616.92 million in labor incomes, and \$1.79 billion in Statewide value added.

Table I-9. Scenario 3b: \$4 gge.

	Allegheny Supply Shed		Central /Delaware Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	2,231.61	2.1	1,664.24	2.0
Jobs (Actual)	4,807	12.5	3,548	10.8
Labor Compensation	151.06	6.3	127.18	6.2
Proprietors Incomes	41.70	NA	24.92	NA
Investment Incomes	273.67	1.8	237.07	2.0
Indirect Taxes	39.67	2.6	32.61	2.7
Value Added	506.04	2.6	421.76	2.7
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	Champlain Supply Shed		Seaway Supply Shed	
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers	Total Impacts	Scenario Multipliers
Total Output	1,260.52	2.0	2,093.30	2.1
Jobs (Actual)	2,054	9.3	4,077	10.6
Labor Compensation	64.59	4.7	127.73	5.3
Proprietors Incomes	18.59	NA	41.67	NA
Investment Incomes	160.82	1.7	221.76	1.5
Indirect Taxes	20.40	2.2	35.42	2.4
Value Added	265.35	2.3	426.83	2.3
<hr/>				
	Statewide			
<i>All Financial Items in Millions</i>				
	Total Impacts	Scenario Multipliers		
Total Output	7,896.74	2.3		
Jobs (Actual)	14,236	10.8		
Labor Compensation	616.92	7.5		
Proprietors Incomes	159.99	NA		
Investment Incomes	863.75	1.7		
Indirect Taxes	142.70	2.8		
Value Added	1,788.43	2.7		

5 REFERENCES

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APPENDIX I - A: DETAILED SUPPLY SHED AND STATE LEVEL IMPACT TABLE SUMMARIES

Allegheny Supply Shed, Scenario 1

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	155.60	1,014	29.99	9.19	32.05	5.57	76.79
Scenario Direct Values	187.05	67	4.16	NA	29.16	3.61	36.93
Direct Refinery Worker HH Spending Impacts	5.82	39	1.24	0.16	0.79	0.25	2.45
Direct Investment Income Impacts	30.65	35	1.12	0.14	0.73	0.23	2.21
Total: Inputs + Direct	342.65	1,155	36.51	9.49	62.73	9.66	118.38
Scenario Multiplier (Total / Direct)	1.83	17.36	8.78	NA	2.15	2.68	3.21

Central /Delaware Supply Shed, Scenario 1

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	117.08	699	23.92	5.81	26.16	4.35	60.24
Scenario Direct Values	173.29	67	4.16	NA	27.05	3.35	34.56
Direct Refinery Worker HH Spending Impacts	5.52	35	1.08	0.15	0.74	0.23	2.20
Direct Investment Income Impacts	28.59	41	1.24	0.17	0.84	0.27	2.52
Total: Inputs + Direct	324.49	842	30.40	6.14	54.78	8.20	99.51
Scenario Multiplier (Total / Direct)	1.87	12.66	7.31	NA	2.03	2.45	2.88

Champlain Supply Shed, Scenario 1

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	117.93	709	20.19	7.62	28.43	4.53	60.76
Scenario Direct Values	165.24	67	4.16	NA	25.85	3.20	33.20
Direct Refinery Worker HH Spending Impacts	5.74	36	1.26	0.16	0.80	0.27	2.49
Direct Investment Income Impacts	27.53	39	1.34	0.18	0.83	0.03	2.64
Total: Inputs + Direct	316.43	850	26.94	7.96	55.90	8.02	99.10
Scenario Multiplier (Total / Direct)	1.91	12.78	6.48	NA	2.16	2.51	2.98

Seaway Supply Shed, Scenario 1

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	147.79	943	27.78	10.89	18.78	5.01	62.45
Scenario Direct Values	197.66	67	4.16	NA	30.75	3.81	38.71
Direct Refinery Worker HH Spending Impacts	5.86	36	1.26	0.18	0.84	0.27	2.56
Direct Investment Income Impacts	32.41	37	1.23	0.18	0.80	0.27	2.52
Total: Inputs + Direct	383.72	1,082	34.42	11.25	51.17	9.36	106.24
Scenario Multiplier (Total / Direct)	1.94	16.27	8.28	NA	1.66	2.46	2.74

Statewide, Scenario 1

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	648.52	3,341	143.54	42.77	85.94	22.12	294.36
Scenario Direct Values	719.55	275	16.63	NA	112.82	13.96	143.40
Direct Refinery Worker HH Spending Impacts	24.44	130	5.90	0.78	3.71	1.20	11.60
Direct Investment Income Impacts	121.61	147	6.54	0.88	4.17	1.35	12.97
Total: Inputs + Direct	1,514.12	3,891	172.61	44.43	206.64	38.63	462.34
Scenario Multiplier (Total / Direct)	2.10	14.18	10.38	NA	1.83	2.77	3.22

Allegheny Supply Shed, Scenario 1 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	556.64	2,093	61.87	18.96	66.12	11.49	158.44
Scenario Direct Values	506.33	166	10.39	NA	66.81	8.27	79.24
Direct Refinery Worker HH Spending Impacts	14.56	97	3.11	0.39	1.98	0.63	6.12
Direct Investment Income Impacts \$(M)	70.22	80	2.57	0.33	1.67	0.53	5.06
Total: Inputs + Direct	1,147.74	2,436	77.93	19.68	136.59	20.92	248.86
Scenario Multiplier (Total / Direct)	2.27	14.65	7.50	NA	2.04	2.53	3.14

Central /Delaware Supply Shed, Scenario 1 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	437.34	1,489	50.95	12.38	55.71	9.27	128.31
Scenario Direct Values	511.59	133	8.31	NA	60.82	7.53	72.50
Direct Refinery Worker HH Spending Impacts	11.04	71	2.15	0.30	1.47	0.47	4.40
Direct Investment Income Impacts	64.28	91	2.80	0.39	1.89	0.60	5.66
Total: Inputs + Direct	1,024.25	1,784	64.21	13.07	119.89	17.86	210.87
Scenario Multiplier (Total / Direct)	2.00	13.42	7.72	NA	1.97	2.37	2.91

Champlain Supply Shed, Scenario 1 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	343.61	1,233	35.12	13.26	49.46	7.88	105.71
Scenario Direct Values	391.64	100	6.23	NA	46.56	5.76	56.48
Direct Refinery Worker HH Spending Impacts	8.60	53.62	1.89	0.24	1.20	0.40	3.74
Direct Investment Income Impacts	49.58	70	2.42	0.32	1.49	0.05	4.75
Total: Inputs + Direct	793.44	1,456	45.66	13.82	98.70	14.09	170.68
Scenario Multiplier (Total / Direct)	2.03	14.60	7.32	NA	2.12	2.45	3.02

Seaway Supply Shed, Scenario 1 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	546.18	1,929	56.83	22.28	38.41	10.24	127.76
Scenario Direct Values	473.51	166	10.39	NA	69.77	8.63	82.56
Direct Refinery Worker HH Spending Impacts	14.65	90.40	3.14	0.46	2.10	0.69	6.39
Direct Investment Income Impacts	73.54	84	2.78	0.40	1.81	0.61	5.72
Total: Inputs + Direct	1,107.88	2,269	73.14	23.14	112.10	20.18	222.43
Scenario Multiplier (Total / Direct)	2.34	13.65	7.04	NA	1.61	2.34	2.69

Statewide, Scenario 1 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	2,269.04	6,695.02	288.52	85.34	170.98	44.20	588.43
Scenario Direct Values	1,821.04	583.31	35.33	NA	243.96	30.19	290.77
Direct Refinery Worker HH Spending Impacts	52.05	276.71	12.56	1.67	7.90	2.54	24.71
Direct Investment Income Impacts	262.88	315.10	14.01	1.89	8.96	3.05	27.81
Total: Inputs + Direct	4,405.00	7,870	350.42	88.90	431.80	79.98	931.72
Scenario Multiplier (Total / Direct)	2.42	13.49	9.92	NA	1.77	2.65	3.20

Allegheny Supply Shed, Scenario 2

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	696.99	4,575	137.79	43.13	124.80	24.12	329.84
Scenario Direct Values	790.55	266	16.63	NA	125.31	15.51	157.44
Direct Refinery Worker HH Spending Impacts	23.29	155	4.97	0.63	3.18	1.01	9.79
Direct Investment Income Impacts	131.70	150	4.81	0.61	3.13	0.99	9.50
Total: Inputs + Direct	1,642.53	5,146	164.20	44.38	256.42	41.63	506.58
Scenario Multiplier (Total / Direct)	2.08	19.35	9.88	NA	2.05	2.68	3.22

Central /Delaware Supply Shed, Scenario 2

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	473.55	2,884	95.23	25.30	101.97	17.42	239.92
Scenario Direct Values	669.25	200	12.47	NA	106.09	13.13	131.69
Direct Refinery Worker HH Spending Impacts	16.57	106	3.23	0.45	2.21	0.70	6.60
Direct Investment Income Impacts	112.14	159	4.88	0.68	3.29	1.05	9.87
Total: Inputs + Direct	1,271.50	3,349	115.81	26.43	213.55	32.31	388.07
Scenario Multiplier (Total / Direct)	1.90	16.79	9.29	NA	2.01	2.46	2.95

Champlain Supply Shed, Scenario 2

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	352.66	2,154	60.91	23.57	78.55	13.25	176.28
Scenario Direct Values	463.20	133	8.31	NA	73.43	9.09	90.83
Direct Refinery Worker HH Spending Impacts	11.47	71	2.52	0.32	1.60	0.54	4.99
Direct Investment Income Impacts	78.20	110	3.82	0.50	2.35	0.08	7.49
Total: Inputs + Direct	905.53	2,468	75.56	24.39	155.92	22.96	279.59
Scenario Multiplier (Total / Direct)	1.95	18.56	9.09	NA	2.12	2.53	3.08

Seaway Supply Shed, Scenario 2

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	537.23	3,437	100.84	39.65	69.13	18.25	227.88
Scenario Direct Values	680.10	200	12.47	NA	107.77	13.34	133.57
Direct Refinery Worker HH Spending Impacts	17.58	108	3.77	0.55	2.52	0.82	7.67
Direct Investment Income Impacts	113.59	129	4.30	0.63	2.80	0.95	8.84
Total: Inputs + Direct	1,348.50	3,874	121.38	40.83	182.22	33.36	377.95
Scenario Multiplier (Total / Direct)	1.98	19.42	9.73	NA	1.69	2.50	2.83

Statewide, Scenario 2

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	2,477.49	12,880	549.08	166.03	334.52	85.11	1,134.73
Scenario Direct Values	2,603.09	798	49.88	NA	412.60	51.06	513.53
Direct Refinery Worker HH Spending Impacts	73.32	389	17.71	2.34	11.12	3.59	34.81
Direct Investment Income Impacts	444.78	536	23.93	3.22	15.27	4.95	47.45
Total: Inputs + Direct	5,598.68	14,604	640.59	171.59	773.50	144.71	1,730.52
Scenario Multiplier (Total / Direct)	2.15	18.30	12.84	NA	1.87	2.83	3.37

Allegheny Supply Shed, Scenario 2 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	914.37	3,453	103.99	32.55	94.19	18.20	248.94
Scenario Direct Values	888.90	200	12.47	NA	105.67	13.08	131.22
Direct Refinery Worker HH Spending Impacts	17.47	116	3.73	0.47	2.38	0.76	7.34
Direct Investment Income Impacts \$(M)	111.06	127	4.06	0.52	2.64	0.83	8.01
Total: Inputs + Direct	1,931.80	3,895	124.25	33.55	204.88	32.87	395.51
Scenario Multiplier (Total / Direct)	2.17	19.52	9.96	NA	1.94	2.51	3.01

Central /Delaware Supply Shed, Scenario 2 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	796.16	2,900	95.76	25.44	102.53	17.52	241.25
Scenario Direct Values	898.15	200	12.47	NA	106.77	13.21	132.45
Direct Refinery Worker HH Spending Impacts	16.57	106	3.23	0.45	2.21	0.70	6.60
Direct Investment Income Impacts	112.86	160	4.91	0.68	3.31	1.06	9.93
Total: Inputs + Direct	1,823.73	3,366	116.37	26.57	214.82	32.50	390.23
Scenario Multiplier (Total / Direct)	2.03	16.87	9.33	NA	2.01	2.46	2.95

Champlain Supply Shed, Scenario 2 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	561.48	2,151	60.83	23.54	78.45	13.24	176.05
Scenario Direct Values	617.45	133	8.31	NA	73.40	9.08	90.80
Direct Refinery Worker HH Spending Impacts	11.47	71.49	2.52	0.32	1.60	0.54	4.99
Direct Investment Income Impacts	78.17	110	3.82	0.50	2.35	0.08	7.49
Total: Inputs + Direct	1,268.57	2,466	75.48	24.36	155.79	22.94	279.32
Scenario Multiplier (Total / Direct)	2.05	18.54	9.08	NA	2.12	2.53	3.08

Seaway Supply Shed, Scenario 2 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	875.14	3,437	100.84	39.65	69.13	18.25	227.88
Scenario Direct Values	906.43	200	12.47	NA	107.76	13.33	133.56
Direct Refinery Worker HH Spending Impacts	17.58	108	3.77	0.55	2.52	0.82	7.67
Direct Investment Income Impacts	113.58	129	4.30	0.62	2.80	0.95	8.84
Total: Inputs + Direct	1,912.73	3,874	121.38	40.83	182.21	33.36	377.94
Scenario Multiplier (Total / Direct)	2.11	19.42	9.73	NA	1.69	2.50	2.83

Statewide, Scenario 2 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	3,784.17	12,375	527.83	160.46	322.97	82.22	1,093.83
Scenario Direct Values	3,310.93	732	45.72	NA	393.60	48.71	488.03
Direct Refinery Worker HH Spending Impacts	67.12	373	17.00	2.15	10.19	3.30	31.88
Direct Investment Income Impacts	424.40	540	24.11	3.10	14.64	4.71	45.55
Total: Inputs + Direct	7,586.62	14,019	614.65	165.71	741.41	138.94	1,659.29
Scenario Multiplier (Total / Direct)	2.29	19.16	13.44	NA	1.88	2.85	3.40

Allegheny Supply Shed, Scenario 3

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	611.08	4,012	113.84	40.02	109.92	21.61	285.39
Scenario Direct Values	785.48	385	24.06	NA	155.27	15.37	194.70
Direct Refinery Worker HH Spending Impacts	33.71	224	7.19	0.91	4.60	1.47	14.17
Direct Investment Income Impacts	163.19	186	5.96	0.76	3.88	1.23	11.77
Total: Inputs + Direct	1,593.46	4,807	151.06	41.70	273.67	39.67	506.03
Scenario Multiplier (Total / Direct)	2.03	12.48	6.28	NA	1.76	2.58	2.60

Central /Delaware Supply Shed, Scenario 3

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	352.11	2,101	70.26	17.19	79.48	13.39	180.31
Scenario Direct Values	537.33	275	17.19	NA	106.54	10.55	134.28
Direct Refinery Worker HH Spending Impacts	22.84	146	4.45	0.62	3.04	0.97	9.09
Direct Investment Income Impacts	112.62	160	4.90	0.68	3.30	1.05	9.91
Total: Inputs + Direct	1,024.89	2,682	96.80	18.49	192.37	25.96	333.59
Scenario Multiplier (Total / Direct)	1.91	9.75	5.63	NA	1.81	2.46	2.48

Champlain Supply Shed, Scenario 3

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	362.05	2,183	57.95	24.12	87.39	14.24	183.70
Scenario Direct Values	539.65	275	17.19	NA	107.00	10.59	134.78
Direct Refinery Worker HH Spending Impacts	23.72	148	5.21	0.67	3.30	1.11	10.31
Direct Investment Income Impacts	113.95	160	5.56	0.73	3.42	0.12	10.91
Total: Inputs + Direct	1,039.37	2,767	85.91	25.52	201.11	26.06	339.71
Scenario Multiplier (Total / Direct)	1.93	10.06	5.00	NA	1.88	2.46	2.52

Seaway Supply Shed, Scenario 3

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	527.94	3,408	93.33	41.01	66.22	18.35	218.90
Scenario Direct Values	750.86	385	24.06	NA	148.88	14.74	187.68
Direct Refinery Worker HH Spending Impacts	33.93	209	7.27	1.06	4.86	1.59	14.80
Direct Investment Income Impacts	156.92	179	5.94	0.86	3.87	1.31	12.21
Total: Inputs + Direct	1,469.65	4,181	130.60	42.93	223.83	35.99	433.59
Scenario Multiplier (Total / Direct)	1.96	10.86	5.43	NA	1.50	2.44	2.31

Statewide, Scenario 3

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	2,129.44	10,890	434.64	146.04	278.53	74.64	933.85
Scenario Direct Values	2,613.32	1,320	82.50	NA	517.69	51.25	651.44
Direct Refinery Worker HH Spending Impacts	121.28	644	29.29	3.88	18.40	5.94	57.59
Direct Investment Income Impacts	558.07	673	30.03	4.04	19.15	6.21	59.53
Total: Inputs + Direct	5,422.10	13,527	576.45	153.96	833.78	138.04	1,702.41
Scenario Multiplier (Total / Direct)	2.07	10.2	6.99	NA	1.61	2.69	2.61

Allegheny Supply Shed, Scenario 3 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	989.80	4,012	113.84	40.02	109.92	21.61	285.39
Scenario Direct Values	1,044.91	385	24.06	NA	155.27	15.37	194.71
Direct Refinery Worker HH Spending Impacts	33.71	224	7.19	0.91	4.60	1.47	14.17
Direct Investment Income Impacts \$(M)	163.19	186	5.96	0.76	3.88	1.23	11.77
Total: Inputs + Direct	2,231.61	4,807	151.06	41.70	273.67	39.67	506.04
Scenario Multiplier (Total / Direct)	2.14	12.48	6.28	NA	1.76	2.58	2.60

Central /Delaware Supply Shed, Scenario 3 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	690.95	2,860	95.63	23.40	108.18	18.22	245.42
Scenario Direct Values	817.48	330	20.63	NA	121.48	12.03	154.13
Direct Refinery Worker HH Spending Impacts	27.40	175	5.34	0.74	3.65	1.17	10.91
Direct Investment Income Impacts	128.40	182	5.59	0.78	3.77	1.20	11.30
Total: Inputs + Direct	1,664.24	3,548	127.18	24.92	237.07	32.61	421.76
Scenario Multiplier (Total / Direct)	2.04	10.75	6.17	NA	1.95	2.71	2.74

Champlain Supply Shed, Scenario 3 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	523.90	1,578	41.89	17.43	63.16	10.29	132.77
Scenario Direct Values	619.59	220	13.75	NA	92.07	9.12	114.94
Direct Refinery Worker HH Spending Impacts	18.98	118	4.17	0.54	2.64	0.89	8.25
Direct Investment Income Impacts	98.06	138	4.79	0.63	2.95	0.10	9.39
Total: Inputs + Direct	1,260.52	2,054	64.59	18.59	160.82	20.40	265.35
Scenario Multiplier (Total / Direct)	2.03	9.34	4.70	NA	1.75	2.24	2.31

Seaway Supply Shed, Scenario 3 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	900.90	3,304	90.46	39.75	64.19	17.79	212.19
Scenario Direct Values	1,001.60	385	24.06	NA	148.84	14.73	187.64
Direct Refinery Worker HH Spending Impacts	33.93	209	7.27	1.06	4.86	1.59	14.80
Direct Investment Income Impacts	156.88	179	5.94	0.86	3.87	1.31	12.20
Total: Inputs + Direct	2,093.30	4,077	127.73	41.67	221.76	35.42	426.83
Scenario Multiplier (Total / Direct)	2.09	10.59	5.31	NA	1.49	2.40	2.27

Statewide, Scenario 3 – \$4

	Total Output (\$M)	Jobs (Actual)	Labor Compensation (\$M)	Proprietors Incomes (\$M)	Investment Incomes (\$M)	Indirect Taxes (\$M)	Value Added (\$M)
Sum of Input Impacts	2,228.28	11,552	466.46	154.28	306.44	78.74	1,011.68
Scenario Direct Values	2,613.32	1,320	82.50	NA	517.69	51.25	651.44
Direct Refinery Worker HH Spending Impacts	121.28	644	29.29	3.88	18.40	5.94	57.59
Direct Investment Income Impacts	558.07	673	30.03	4.04	19.15	6.21	59.53
Total: Inputs + Direct	5,520.95	14,189	608.27	162.20	861.68	142.14	1,780.24
Scenario Multiplier (Total / Direct)	2.11	10.75	7.37	NA	1.66	2.77	2.73