
Economic Impact Analysis of Bulk Liquid Storage Facilities at the Port of Grays Harbor

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Prepared for:

Westway Terminal Company LLC
and Imperium Renewables Inc.

Contact Information

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ECONorthwest specializes in economics, planning, and finance. Founded in 1974, we're one of the oldest independent economic consulting firms in the Pacific Northwest. ECONorthwest has extensive experience applying rigorous analytical methods to examine the benefits, costs, and other economic effects of environmental and natural resource topics for a diverse array of public and private clients throughout the United States and across the globe.

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1 Summary and Background

Executive Summary

Westway Terminal Company LLC (Westway) and Imperium Renewables Inc. are planning for expansion of their bulk liquid storage facilities at the Port of Grays Harbor. The expanded facilities will take bulk liquids from trains, store it, and then load it onto ships for distribution. Westway and Imperium Renewables engaged ECONorthwest to determine the economic impacts of expanding their storage services at the Port. This report summarizes that analysis.

ECONorthwest first calculated the overall impacts of the facilities' construction on the economy of Washington. ECONorthwest found that:

- Westway and Imperium Renewables will invest \$106.9 million in Washington to expand their facilities and \$62.2 million of that would be spent on Washington state labor and suppliers (Page 13).
- At the Port of Grays Harbor, construction will last 9-16 months and, on average, have 231 Washington residents on the job with total labor income of \$27.9 million (Page 14).
- The \$62.2 million of direct construction expenditures in Washington state will engender an additional \$81.2 million in economic output for a combined effect of \$143.3 million (Page 15).
- Statewide, the construction projects will stimulate production at many additional businesses through business purchases and consumer spending and provide the full-year equivalent of 758 jobs, with total pay and benefits of \$55.4 million (Page 15).

ECONorthwest also conducted an economic impact analysis of the first full year of operations at the Westway and Imperium Renewables facilities. In 2016, ECONorthwest estimates that the facilities will have the following impacts on the local economy.

- Operations at Westway and Imperium Renewables facilities, including supporting rail and marine services, will spend \$97.8 million on goods, services, and labor. This spending will result in an additional \$18.8 million in economic output in Grays Harbor County (Page 18).
- This operations (45 new terminal jobs), supported entirely by the transshipment of bulk liquid, will directly employ 103 people in marine and rail services. In addition, the direct expenditures will support 155 indirect and induced jobs in Grays Harbor County (Page 19).
- Direct jobs with the terminals, rail and marine support services will result in \$12.8 million in labor income in 2016 (the first year of full operations). These direct jobs will also support \$5.2 million in indirect and induced labor income as jobs are created elsewhere in the Grays Harbor economy (Page 19).

Economic Impacts

ECONorthwest estimates that the plant will create the following economic impacts:

Construction

Output: \$143.3 million

Labor Income: \$55.4 million

Jobs: 758

Annual Operations

Output: \$116.6 million

Labor Income: \$18.0 million

Jobs: 303

- The terminal expansions represent a long-term commitment to the local economy (“permanent” jobs); which can result in further economic growth and stability. These terminal, rail and marine jobs will pay substantially higher compensation rates than the average in Grays Harbor County. Average annual wages, salaries, and benefits for these jobs will be over \$84,000.

The impacts from operations, estimated in the first year, will reoccur in future years. Terminals are long term investments. They operate steadily for decades. The jobs they provide and the jobs they support are generally high paying and secure. As such, workers and area business that rely on these initial investments will make investments of their own.. Although beyond the scope of this report, these expected dynamic impacts can be nonetheless significant as the benefits from stable, long-term employment and business activity become rooted in the local economy.

In addition, Westway and Imperium Renewables will produce revenues for state and local governments in Washington. Such fiscal impacts are dependent on Westway and Imperium Renewables expanding in Grays Harbor, Washington. Market conditions are such that if not built in Grays Harbor, bulk liquid storage facilities may be constructed in another area. However, if built at the Port of Gray Harbor, the project will result in state and local taxes and other revenues increasing by \$11.1 million during construction and \$1.8 million during the first year of full operations in 2016.

Project Background

Westway and Imperium Renewables have developed plans for expanded bulk liquids storage facilities at the Port of Grays Harbor. The Port is in Grays Harbor County along the central coast of Washington State. Timing for the construction and the start of operations is similar for each project and Westway and Imperium Renewables is interested in understanding the combined economic impacts from these expanded facilities.

The proposed projects will construct expanded bulk liquid storage facilities on two separate properties at the Port of Grays Harbor. Westway and Imperium Renewables will unload bulk liquid from trains, store the liquid at the terminals, and then load it onto oceangoing ships and barges. Somewhere between 1-2 trains a day will deliver the liquid to the combined facilities. And about 260 vessels a year will deliver bulk liquid from the Port to refineries and other customers along the west coast of the U.S.

Westway and Imperium Renewables will function as terminals, and will function on behalf of buyers and sellers of bulk liquids in return for revenue and/or transshipment fees. The combined facilities will be able to store up to 1,520,000 barrels of liquid, and are expected to transship over 36 million barrels of liquid per year.

This study measures the impacts of the construction period for the combined terminal expansions, and for an operating year at their full production. ECONorthwest used an economic impact model for Washington State and Grays Harbor County based on the local spending patterns of businesses and workers. The model mathematically traces such spending as it flows through the local economy affected other businesses, households, and employment.

Construction of the projects will affect the economy through purchases from suppliers of construction goods and services, and by employing construction workers throughout Washington State.

Once operating, Westway and Imperium Renewables will employ people, and buy goods and services from the Grays Harbor County economy. So too will the supporting rail and marine businesses. Collectively, they will affect the economy and generate revenues for local government.

Westway and Imperium Renewables asked ECONorthwest to estimate the economic and fiscal impacts of the combined expansion projects. This report summarizes the findings of that work.

This rest of this section of the report provides a general overview of Westway and Imperium Renewables bulk liquid storage expansion projects. Section 2 describes the method of analysis used by ECONorthwest, limitations and some key analysis assumptions. Section 3 summarizes the economic impact of the construction of the combined bulk liquid storage facilities on the economy of Washington. Section 4 discusses the results of ECONorthwest's analysis of impacts from operating the facilities on Grays Harbor County in an average future year of operations. The last section discusses the potential fiscal impacts of the combined facilities' construction and operations.

Westway

Westway is seeking to expand their current facilities at the Port of Grays Harbor. Westway has been a part of Grays Harbor County since 2009, operating a liquid bulk storage and transport facility. Westway is seeking to expand their current facility to include an area to receive, store and ship bulk liquids. This will enable the facility to receive approximately 9.6 million barrels of bulk liquids per year and store 800,000 barrels at any point in time.

The final permits for expansion are expected to be issued by the end of 2013, with construction to begin in 2014. Under the proposed expansion, construction will take approximately 12-16 months and the expanded facility will open in 2015.

The project expands the existing Westway terminal to permit the transshipment of 9,600,000 barrels of bulk liquids on up to 60 Articulated Tug Barges (ATB) and vessels per year. The addition of rail spurs will provide a total of 80 rail loading/unloading spots to service the four 200,000 barrel capacity, internal floating roof tanks. The facilities will also include a new marine vapor combustion unit. The project will also upgrade dock capabilities in order to accommodate the loading of vessels with bulk liquids.

Westway Terminal Company LLC is a premier provider of bulk liquid storage and related services throughout the world. Westway has concentrated on the chemical and commodity markets.

Westway has 15 listed facilities in North America, 4 in Europe.

Westway's commitment to compliance on Health, Safety, Environment, Security and Quality (HSEQ) is demonstrated by their status as an OSHA Star participant, ISO and GMP accreditation in Europe, and Responsible Care in the U.S.

**Imperium
Renewables, Inc.**
(IRI) was founded in
2004 to
commercialize novel
and innovative design
for biodiesel refining,
with a focus on fuel
quality and
environmental
sustainability.

Today, Imperium
Renewables is a
national leader in
next generation
biofuel production,
driven by a single yet
ambitious goal – to
fundamentally
change the way we
fuel our cars, trucks,
ships, trains and
planes by developing
and producing clean,
renewable and
sustainable
alternative fuels, now
and into the future.

Imperium Renewables

Imperium Renewables is a leader in the renewable energy industry. Headquartered in Seattle, Washington, Imperium Renewables currently operates a 100 million gallon per year capacity production facility in Grays Harbor, Washington and is the largest pure-play producer of biodiesel on the West Coast. Imperium Renewables is planning to expand their bulk liquid storage operations on a 10.9 acre site located at the Port of Grays Harbor. This project will involve construction of a tank farm that includes storage tanks, pipelines to Terminal 1 from the tank farm, rail spurs in connection with the existing Schneider's loop rail line, and construction of new buildings to support office, laboratory, maintenance and warehousing functions of the operations.

The expansion design and permits will require all tanks and infrastructure to be designed and constructed to store both renewable and conventional fuels and liquids. It is anticipated that the products stored onsite will vary over the life of the facility, and may include biodiesel, ethanol, US crude oil, jet fuel, gasoline, diesel, vegetable oils and other biofuel feedstocks.

All of the bulk liquids received at the facility are expected to be delivered by train. The existing rail system will be expanded. Approximately 6,100 feet of track in multiple new rail spurs will be constructed on site in connection with the existing rail line, and the existing rail yard will be expanded. Rail delivery is projected to be up to one unit train per day consisting on average of 105 tank cars.

Pipelines will be installed connecting Terminal 1 with the tank farm, and a Marine Vapor Combustion Unit (MVCU) will be installed to incinerate displaced vapors during vessel loading. Based on the projections for inbound rail shipments, the need for transshipment includes up to 200 outbound vessels and barges per year.

2 Analysis Methods and Scope

Economic Impact Methodology

Researchers, policy makers, industry officials, and others are often interested in measuring the change in regional economic activity as result of an initial stimulus such as a business expansion project, changes in government policies, or the entry of an industry. Economic impact analysis provides a framework for analyzing these changes. ECONorthwest uses an expenditure approach within an input-output modeling framework to measure the economic impacts or “contributions” from an economic stimulus, in this case the combined expansion of Westway and Imperium Renewables bulk liquid storage facilities at the Port of Grays Harbor.

Input-Output Modeling

Input-output models are mathematical representations of the economy that show how different parts (or sectors) are linked to one another. The strengths of the input-output modeling framework include:

- A double-entry accounting framework that results in a model structure that is well ordered, symmetric, and where, by definition, inputs must be equal to outputs;
- A reasonably comprehensive picture of the economic activities within a region, with mathematical equations that describe the flow of commodities between producing and consuming sectors, the flow of income between businesses and institutions, and the trade in commodities between regions;
- Model construction using secondary source data that are gathered and vetted by government agencies; and
- The ability to cost-effectively create input-output or economic impact models for any region.

Input-output models that rely on survey or primary source data are expensive to construct. As a result, special modeling techniques have been developed to estimate the necessary empirical relationships. These techniques use a combination of national technological relationships and state- and county-level measures of economic activity, and have been packaged into the IMPLAN (for IMPact Analysis for PLANning) modeling software. This is the modeling system ECONorthwest used in this analysis.

IMPLAN Economic Impact Model

IMPLAN has been developed and distributed by the Minnesota IMPLAN Group, Inc., since 1993. The IMPLAN modeling system is widely used and well respected—there are currently more than 1,500 public and private users of the IMPLAN modeling software. The selection of IMPLAN by the United States Department of Agriculture (USDA) as its analysis framework for monitoring job creation associated with the American Recovery and Reinvestment Act (ARRA) of 2009 is a testament to its credibility.

In general terms, the IMPLAN model works by tracing how spending associated with an industry circulates through an economy or study area. That is, changes in one sector or multiple sectors trigger changes in demand and supply throughout the economy. Initial changes in the model propagate through the economy via supply- and demand-chain linkages, altering the equilibrium quantities of inputs and outputs and associated jobs, income, and value-added. These *multiplier effects* continue until the initial change in final demand leaks out of the economy in the form of savings, taxes, and imports.

Economic Impact Terms and Definitions

Economic impacts are classified by their relationship to the activity in question. For this analysis, the three types of impacts are defined, with regard to the terminal expansions, as follows:

- **Direct impacts** are those occurring at the terminals and include the jobs, output, and incomes earned at the terminals.
- **Indirect impacts** are production changes in backward-linked industries caused by the changing input needs of directly affected industries. Suppliers to the directly involved industry will also purchase additional goods and services; this spending leads to additional rounds of indirect impacts. Because they represent interactions among businesses, these indirect effects are often referred to as *supply-chain impacts*.
- **Induced impacts** are the changes in regional household spending patterns caused by changes in household income. The direct and indirect increases in employment and income enhance the overall purchasing power in the economy, thereby inducing further consumption- and investment-driven stimulus. Employees at the terminal, for example, will use their income to purchase groceries or take their children to the doctor. These induced effects are often referred to as *consumption-driven impacts*.

These three types of economic impacts are measured in terms of output, labor income, and employment resulting from spending in the study area:

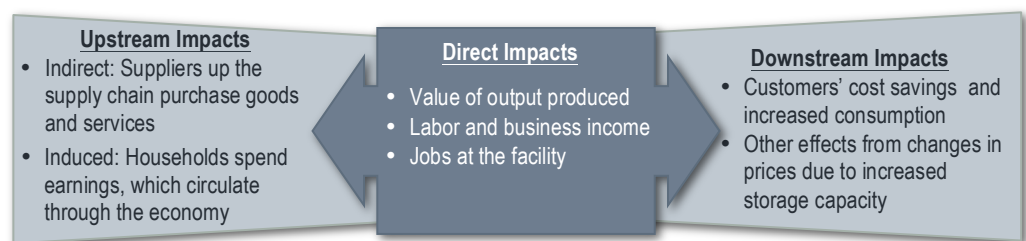
- **Output** represents the value of goods and services produced, and is the broadest measure of economic activity.
- **Labor income** consists of employee compensation and proprietary income, and is a subset of output.

- Employee compensation includes workers’ wages and salaries, as well as other benefits such as health, disability, and life insurance; retirement payments; and employer paid payroll taxes.
- Proprietary income (owner-operated business income) represents the payments received by small-business owners or self-employed workers. Business income would include, for example, income received by private business owners, doctors, accountants, and lawyers.
- **Jobs**, according to IMPLAN’s methodology, are measured in terms of full-year-equivalents (FYE). One FYE job equals work over twelve months in a given industry (this is the same definition used by the federal government’s Bureau of Labor Statistics). For example, two jobs that last six months would together count as one FYE job. A job can be full-time or part-time, seasonal or permanent; IMPLAN counts jobs based on the duration of employment, not the number of hours a week worked. Job impacts from operations are for one year of normal operations.

Scope of the IMPLAN Analysis

Economic impact analysis distinguishes between direct, upstream, and downstream impacts. Figure 1 summarizes the types of upstream and downstream impacts. In this case, the terms refer to the economic relationships between the services associated with storing and transshipping bulk liquids and the regional economy. Activities at the storage facilities themselves, including their construction and operations, count as direct impacts.

Figure 1: Types of Economic Impacts for Bulk Liquid Storage



Most commonly, economists follow the upstream impacts, which result from the projects’ spending on all the goods and services it buys locally and on the payroll for its workers. Impacts continue moving upstream as suppliers and employee households spend money, triggering more spending and employment in the local economy. Using an input-output model, we can then follow the subsequent impacts going upstream to suppliers and induced household spending in the economy. Downstream impacts are largely associated with changes in prices to goods and services as a result of the project. In the case of expanding liquid fuel storage capacity at the Port of Grays Harbor, for example, the effects on the price of fuels is assumed to be negligible (due to the global nature of the liquid fuels markets) and outside of the scope of this analysis, and therefore not estimated.

Geography

A vital element of Economic impact studies is the geography of the economy. Ideally, its boundaries should be defined such that most of the project's suppliers and workers come from within the defined region.

The construction associated with expanding Westway and Imperium Renewables storage facilities will draw mostly from construction labor within the State of Washington. This is typical of large industrial projects requiring specialized labor. Washington has a deep pool of skilled construction workers. Many of the business that would supply the development of the Westway and Imperium Renewables facilities are based inside the state. Thus, Washington was chosen for the construction impact analysis.

The economic geography of operations is different. Operating supplies, such as utilities and maintenance services, are most likely going to be locally sourced. The same is true for labor because a terminal offers long-term employment. Workers overwhelmingly will reside close by. This is normal, as evidence in Census data. U.S. Census data (2006-2010) shows that over 95% of employees working at businesses in Grays Harbor County also live in Grays Harbor County. Therefore, the economic impact analysis of Westway and Imperium Renewables facilities operations are measured for the economy of Grays Harbor County, not the entire state.

Project Elements

Construction Related Activities of the Terminal Expansions

Most impact studies of construction projects include the entire value of construction put-in-place. That is all construction and management jobs, all equipment installed, and all the building materials and services used. However, for large infrastructure developments, like Westway and Imperium Renewables, doing so overstates the true direct impacts on the economy. That is because some workers, equipment, and materials used in construction come from out of state. Their impact on the local economy is limited to whatever spending they cause in the state.

ECONorthwest chose to avoid overstating impacts. The scope of direct construction impacts is limited here to only the portion of jobs and construction spending paid to workers and businesses based in Washington State. In cases where equipment is purchased from outside Washington and installed at the terminal, the analysis here only counts the cost of installing that equipment as having a direct impact on the State of Washington.

Terminal Operations

The scope of the analysis of operations includes three elements or industries that will directly handle the bulk liquid at the Port. The first is the operations at the Westway and Imperium Renewables facilities themselves. The second is marine services. Those are the businesses associated with carrying bulk liquid on vessels. Although not directly working for Westway and Imperium Renewables, ships coming into the Port of Grays Harbor for bulk liquid would be doing so solely because of the Westway and Imperium Renewables facilities. Therefore, the work based in Grays Harbor County of tugs, pilots and others engaged in bringing ships in, loading them and providing provisions are included as contributing to the direct economic impacts of the terminal. The Port of Grays Harbor is one of the businesses that would provide services to the two facilities. The third element includes the direct impacts of the Puget Sound and Pacific Railroad at the facilities.

Time Coverage

The scope of an impact analysis is also defined by time. For construction impacts, this report condenses all the spending and employment for the entire period of development (starting in 2014 and ending in 2015 - up to 16 months of construction) into one year.

Operations at the Westway and Imperium Renewables facilities may begin in 2015. However, the anticipated first full calendar year will be the following year - 2016. Thus, the economic impact analysis is for that year.

In both analyses, monetary values are expressed in 2013 dollars (*i.e.* real or inflation adjusted terms). Doing so removes changes in value that occur over time caused merely by inflation.

Outside the Scope of Analysis

IMPLAN measures the economic impacts of a project's spending on goods, services, and labor as money flows throughout the local economy over the course of a year. Money used to produce goods and provide services within the scope of analysis (time and location) are counted towards having economic impacts. But not all uses of money cause measureable impacts. The following are not considered:

- Downstream economic activity.
- Labor, goods and services from outside the local economy, such as new business activity and employment in locations where bulk liquids originate.
- Asset transfers are not a source of economic impacts because they do not cause anything new to be produced. For example, the sale of land.
- Interest and other finance charges.
- Savings that occur when businesses and workers retain rather than spend earnings.

- Savings are often invested, but IMPLAN does not account for them since the value of investments occur in future years. Undoubtedly some employees at the terminal will buy houses, but the impacts of this investment spending are not counted by IMPLAN.

Limitations

The goal of this research is to assess how the construction and operation of expanded liquid bulk storage facilities at the Port of Grays Harbor by Imperium Renewables and Westway will contribute to the local economy. To do this, the analysis relies heavily on construction and operating cost estimates provided by Imperium and Westway, and uses economic impact modeling techniques to measure the linkages between this spending and other industry sectors in the local economy.

This analysis does not measure potential counterfactual scenarios that consider how scarce resources would have been allocated, should the storage expansion projects never occur. It does not consider how funding and operating new bulk liquid storage tanks could divert spending from other potential uses (in economics, this is termed the “substitution effect”). This analysis assumes that as the investments are undertaken willingly by private entities the investment is a first-best use of those resources. The analysis assumes that access to national and international capital markets is unrestricted and that this investment does not drive out other worthwhile investments.

Furthermore, this analysis does not measure the potential economic development impacts of construction and expanded operations at the Port of Grays Harbor. Large investments in infrastructure can start a cycle of economic expansion, which economists refer to as an expansion of the “production possibilities frontier” of the economy. Such an effect is difficult at best to quantify, though local infrastructure improvements could lead to other businesses such as manufacturers, locating in and around Grays Harbor, Washington. The analysis also does not measure non-economic and environmental costs and benefits.

Westway and Imperium Renewables are in the advanced planning stages for their expanded tank farm terminal projects. ECONorthwest has used available estimates of construction costs, operations, throughput and timing to conduct this analysis. As a result, the economic impacts reported here may be subject to later revision. The results of the projects may reveal higher or lower impacts than those predicted in this analysis. For other information about Input-Output models, including their limitations, please consult Appendix A: An Overview of Economic Multiplier Models

Key Assumptions

ECONorthwest made the following assumptions regarding the Westway and Imperium Renewables facilities for the purposes of measuring the economic impacts of their construction and operations:

1. Construction will last 9-16 months. This report represents construction spending as a one year equivalent and shows the aggregate impact construction would have on Washington’s economy.

2. All dollar values are expressed in 2013 dollars. Future price and wage increases are not reflected in any of the figures shown in this report.
3. ECONorthwest used the most current U.S. Census data on the heavy and civil engineering construction industry of Washington (2007), adjusted it to 2013 dollars, and calculated the number of construction managers per million dollars of terminal assets put in place.
4. The railroad delivering liquids to the Westway and Imperium Renewables facilities may invest in infrastructure. However, specifics are not known at this time and, therefore, not included in the economic impact analysis.
5. Operating output and employment for the railroad was limited to that which would occur in Grays Harbor County. This includes local spending (*per diems*) by engineers and local operating costs of the railroad. Base on conversations with Puget Sound and Pacific, Westway and Imperium Renewables believe that there would be 30 added FYE railroad jobs.
6. It is assumed that in 2016 the terminals will transship nearly 37 million barrels of bulk liquids per year. There will be nearly 260 oceangoing vessels loaded at the Port of Grays Harbor annually that would otherwise not come to the port but for the terminal storage facilities.
7. The terminals will handle and temporarily store bulk liquids, and this analysis assumes that Westway and Imperium Renewables will not own the product. They will transship liquid for a fee to be paid to Westway and Imperium Renewables by the owner(s) of the liquids.
8. Each vessel call would cause \$75,945 in direct economic output (in 2013 \$) and employ the FYE of 0.45 workers (data based on the “2013 Local and Regional Economic Impact of the Port of Longview”¹).

¹ ECONorthwest made use of economic impact analysis done for the Port of Longview, a recent study. No comparable estimates were available specific to the Port of Grays Harbor.

² Available at the U.S. Census website <http://www.census.gov/econ/census07/>

3 Economic Impacts from Construction

Construction Plans

Westway and Imperium Renewables provided estimates of the capital costs for building the facilities. Construction costs include installation of tank farms that include storage tanks, pipelines to terminals from the tank farms, rail spurs and bermed rail car loading facilities, and construction of new structures for office, laboratory, maintenance and warehouse functions. These estimates formed the basis of the construction impacts analysis.

Westway and Imperium Renewables estimate that the entire cost of the facilities, from pre-development through opening, will cost \$106.9 million to construct at the Port of Grays Harbor. The construction of the projects begins in 2014 and will be complete in 2015. The impacts of these construction projects on the economy of Washington State were measured and are reported in this section.

For the purpose of simplifying the presentation, the economic impacts of the project were condensed into one year. Thus, employment is shown in full year equivalents. Values are inflation adjusted and expressed in 2013 dollars.

Westway and Imperium Renewables facilities expansions are large, heavy industrial projects. As such, much of the cost goes into buying equipment, concrete, steel, and engineering. Westway and Imperium Renewables provided ECONorthwest the following construction cost schedule.

Table 1: Cost to Construct Westway and Imperium Renewables by Asset Type, in Millions of 2013 Dollars

Category	Cost in 2013\$
Total Labor	
\$ wages, salaries, and benefits	\$29,046,095
FYEs	240
Construction spending	
Architectural, engineering, and related services	\$6,500,634
Various other services	\$3,288,741
Equipment purchases	\$27,424,370
Construction of other new nonresidential structures	\$62,787,070
Sales & use taxes	\$6,921,214
Total cost	\$106,922,030

Source: Westway and Imperium Renewables, August 2013

Put-in-Place Versus Washington Sourced Construction Spending

Although under the broadest definition the direct output of construction for the combined Westway and Imperium Renewables facilities is \$106.9 million, not all of that affects the state's economy. For example, expensive pumping equipment made in another state is installed at the facility, that cost is included in the \$106.9 million construction cost. But realistically, only the costs expended installing the pumping equipment at the facility is truly construction occurring in Washington. ECONorthwest has estimated that portion of the total construction which would use Washington sourced labor, materials, equipment, and services.

Westway and Imperium Renewables identified several key construction components with regard to their sources. Since the project in the planning stage, the sources of only some components are known with certainty. Westway and Imperium Renewables also provided information about direct construction labor. ECONorthwest then used Census data on commutation and the Washington construction industry to estimate the portion of labor that would come from within the state.

For other costs IMPLANs regional purchase coefficients were used. These coefficients are based on Economic Census and other data collected by the government. The coefficients estimate the percentages of various components in detail that a heavy industrial construction project in Grays Harbor County would likely obtain from Washington.

The analysis estimates that \$62.2 million out of the entire \$106.9 million construction projects would come from Washington sources. \$34.3 million of the \$77.9 million in materials, equipment, other purchased goods, and services would be from Washington businesses and governments. Wages, salaries, and benefits earned by all those on the construction projects will total \$29.0 million and, of that, \$27.8 million would go to workers residing in Washington. The results of this analysis are shown in **Table 2**.

Table 2: Total Cost to Construct Westway and Imperium Renewables Facilities by Component, in Millions of 2013 Dollars

Components	Total cost of construction put-in-place	Sourced in Washington state
Labor: salaries, benefits*	\$29.0	\$27.8
Materials, equipment, services and other	77.9	34.3
total	\$106.9	\$62.2

Sources: Westway and Imperium Renewables, August 2013, IMPLAN, and ECONorthwest analysis of Census data.

* All labor involved in the project including management, engineering and administration.

Jobs

ECONorthwest estimated the number of full year equivalent jobs needed to build a \$106.9 million heavy industrial project in Washington. The estimate involved information about construction labor from Westway and Imperium Renewables (these projects will directly employ 185 FYE construction jobs) and an estimate of construction management and administration jobs using the 2007 Economic Census of Washington for the heavy and civil engineering construction sector.² Adjustments were necessary before the Census data could be applied to these projects.

The first adjustment was done to account for subcontractors. The Census reports that companies in the specialty subcontractor sector did about 19 percent of the work of the heavy construction industry. ECONorthwest added management and administrations jobs of specialty contractors in accordance to their share of the gross value of heavy construction. Other adjustments were made for inflation and productivity.

The construction projects themselves would last between 9 and 16 months. The jobs would not all be at the jobsite in Grays Harbor County. There will be jobs elsewhere in Washington at the offices of contractors, jobs on trucks delivering materials and equipment to the jobsite, and administrative jobs at subcontractor offices.

Results of the Construction Impact Analysis

ECONorthwest ran an IMPLAN analysis using the Washington State sourced portion of construction that would be put-in-place while building the Westway and Imperium Renewables facilities. Thus, the direct output of construction, while \$106.9 million in gross terms, is shown on **Table 3** as \$62.2 million as being sourced in Washington. Likewise, of the \$29.0 million in labor costs for the project, \$27.8 million is shown as being sourced in the Washington State. Also, 231 of the 240 FYE jobs on the project are likewise identified within state. IMPLAN measures indirect and induced impacts to Washington State that flow from the direct construction expenditures and jobs. IMPLAN accounts for out-of-state “imported” goods and services, and commuter flows, thus revealing the total impacts to Washington State alone. By taking this approach, the analysis gives a realistic perspective of what such a project means for the state’s economy.

² Available at the U.S. Census website <http://www.census.gov/econ/census07/>

Table 3: Economic Impacts on Washington Arising from the Construction of Westway and Imperium Renewables facilities at the Port of Grays Harbor

	Put-in-Place	Sourced in Washington
Output		
Direct	\$106,922,030	\$62,164,287
Indirect		\$45,577,994
Induced		\$35,607,115
Total		\$143,349,396
Labor Income		
Direct	\$29,046,095	\$27,869,915
Indirect		\$15,594,348
Induced		\$11,907,189
Total		\$55,371,452
Jobs		
Direct	240	231
Indirect		262
Induced		265
Total		758

Sources: ECONorthwest IMPLAN analysis using data from Westway and Imperium Renewables and the US Census, August 2013.

Direct construction output from Washington sources will require or cause over \$45.6 million in output from other industries within the state. Spending in Washington by jobholders of the Westway and Imperium Renewables facilities construction projects, as well as workers of other industries needed to produce the indirect output, will add \$35.6 million to the total. In aggregate, a total of \$143.3 million in output in Washington, during the construction project, would be linked to the expansion of the terminals.

In terms of labor income statewide, \$55.4 million would be associated with the construction project and its upstream effects. That income would be earned by the FYE of 758 workers. For every construction job about another 2.3 jobs would be supported by the Westway and Imperium Renewables facilities' development.

The dimensions of these economic impacts are substantial, although typical of major heavy infrastructure developments. Importantly, for the state's economy, funding for the Westway and Imperium Renewables facilities would in part come from outside of Washington and would expand operations on existing Port property that might otherwise not significantly contribute to economic activity. Therefore, the project would provide substantial economic stimulus without state and local government outlays, and in fact, would contribute to public funding through sales and business and occupation taxes.

4 Economic Impacts from Operations

Operating Plans

Westway

Westway is expanding its existing bulk liquid storage terminal to allow for the receipt of crude oil unit trains, storage of crude oil from these trains, and shipment of crude oil by vessel and/or barge from the Port of Grays Harbor Terminal #1. Four internal floating roof storage tanks will be added to the site on the south side of the existing tanks and will provide storage for crude oil. Each tank will have a capacity of 200,000 barrels (8,400,000 gallons) for a project total storage capacity of 800,000 barrels. The new tanks will be surrounded by a concrete containment wall which will have the capacity to contain the total volume of a single tank plus an allowance for rainfall.

The existing rail facility will be expanded from two short spurs with a total of 18 loading/unloading spots to 4 longer spurs with a total of 76 loading/unloading spots. It is estimated that the facility will receive 9,600,000 barrels of oil per year, equivalent to one unit train (120 cars) every three days.

Most of the oil shipments leaving the Westway terminal are expected to be aboard Articulated Tug Barges (ATB) with capacities of either 150,000 or 180,000 barrels. Westway estimates a total of 60 vessel calls per year during full operations.

Imperium

Imperium Renewables is planning to expand their bulk liquid storage operations on a 10.9 acre site located at the Port of Grays Harbor. This project will involve construction of a tank farm that includes storage tanks, pipelines to Terminal 1 from the tank farm, rail spurs in connection with the existing Schneider's loop rail line, and construction of new buildings to support office, laboratory, maintenance and warehousing functions of the operations.

The expansion design and permits will require all tanks and infrastructure to be designed and constructed to store both renewable and conventional fuel products. It is anticipated that the products stored onsite will vary over the life of the facility, and may include biodiesel, ethanol, US crude oil, jet fuel, gasoline, diesel, vegetable oils and other biofuel feedstocks.

All of the bulk liquids received at the facility are expected to be delivered by train. The existing rail system will be expanded. Approximately 6,100 feet of track in multiple new rail spurs will be constructed on site in connection with the existing rail line, and the existing rail yard will be expanded. Rail delivery is projected to be up to one unit train per day consisting on average of 105 tank cars.

Pipelines will be installed connecting Terminal 1 with the tank farm, and a Marine Vapor Combustion Unit (MVCU) will be installed to incinerate displaced vapors during vessel loading. Based on the projections for inbound rail shipments, the need for transshipment includes up to 200 outbound vessels and barges per year are projected.

Imperium's growth and expansion opportunities are made possible by the unique transportation infrastructure of the Port of Grays Harbor. Access to rail, road and marine vessel transportation options were key factors in Imperium's decision to build our existing operations here, and there are now have new growth opportunities that are focused on expanding Imperium's current capabilities. Expanding the terminal to store and transport additional products will allow Imperium to meet growing market demand for domestic energy supplies and transportation fuels on the West Coast of the United States.

Operational Dimensions of the Analysis

Once constructed, the operations of the Westway and Imperium Renewables facilities will impact the economy of Grays Harbor County. The analysis determined the likely annual economic impacts. It is based on one year of operations.

The direct impacts are the spending and payrolls at the Westway and Imperium Renewables facilities plus the incremental payrolls and spending by the railroad and the marine vessel operations that will help ship liquids to and from the terminal.

The economic impact analysis is based on volumes anticipated in 2016, which is the first full year of operation. In that year, the two facilities terminals will transship 37 million barrels of liquid. Westway and Imperium Renewables provided ECONorthwest with expected new staffing levels and operating expenses at full operations.

IMPLAN uses government data for the industry that includes oil terminal operations. That industry is a very broad category including all types of wholesaling and warehousing businesses. ECONorthwest corrected the IMPLAN model by replacing the generic dimensions of the broader industry with actual operating data specific to Westway and Imperium Renewables and its related railroad and marine services. Doing so yields more accurate impact analysis results.

Driving the economic impact forecast are the direct labor, and purchases of goods and services at the Westway and Imperium Renewables facilities in 2016. That includes the ongoing capital expenditures common to industrial businesses and the incremental expenditures of the rail and marine businesses arising from the activities of Westway and Imperium Renewables. The value, in 2013 dollars, of the expenditures and the direct jobs, as full year equivalents, are listed on **Table 4**.

Table 4: 2016 Operations Spending and Employment for Westway and Imperium Renewables, Values in Millions of 2013 Dollars and Jobs in FYEs

Sector/Direct Inputs	
Terminal Operations:	
Payroll	\$2,841,614
Electricity	367,000
Natural Gas	117,000
Water	8,000
Insurance	600,000
Tank Cleaning and Disposal	385,000
Environmental Services	180,000
Rail Services	120,000
Social Services& Education	60,000
Property Leases	365,876
Other	1,525,000
Marine and Rail Operations:	
Payroll	\$9,947,350
Other	8,467,967
Annual Operating Costs	\$24,984,808
FYE Jobs:	
Terminals	45
Marine & Rail Operations	103

Source: Westway and Imperium Renewables, and ECONorthwest, August 2013.

ECONorthwest, using data from the Port of Longview, estimated the direct impacts of vessel operations.³ Using per ship call labor and output in 2012, the value of payrolls and spending from having 260 vessels come to port for Westway and Imperium Renewables facilities were estimated. These were included in the economic impact analysis.

³ ECONorthwest made use of economic impact analysis done for the Port of Longview, a recent study. No comparable estimates were available specific to the Port of Grays Harbor. ECONorthwest calculated per vessel spending on marine services and marine services labor using data from “The Local and Regional Economic Impacts of the Port of Longview,” from Martin Associates (2013). Data were adjusted for inflation and based on 225 ship calls in 2012.

For rail operations, ECONorthwest obtained estimates directly from the projects sponsors based on their conversations with railroad officials. The analysis includes the direct output associated with 30 FYEs of railroad employment. Direct operating costs were estimated using industry averages as they compare with labor costs. Labor costs were calculated using the average pay of railroad engineers reported by the U.S. Department of Labor Occupational Employment Statistics⁴ and compared against local estimates.

Results of the Operations Impact Analysis

Table 5 shows the results of the analysis. Economic impacts for operating the Westway and Imperium Renewables facilities, including supporting rail and marine services, are substantial. In a single year of operations, the terminal will generate about \$97.8 million in economic output directly. It will purchase goods and services from within Grays Harbor County that will trigger a string of subsequent purchases from those business resulting in a total additional spending of about \$11.3 million, which is shown as an indirect output. Induced output, resulting from employee spending, could cause approximately \$7.5 million in added output by local businesses.

Table 5: The Annual Economic Impacts on Grays Harbor County by Westway and Imperium Renewables, Values in Millions of 2013 Dollars and Jobs in FYEs

Operations	Terminals	Marine	Rail	Total
Output				
Direct	\$68,180,000	\$14,973,594	\$14,600,813	\$97,754,407
Indirect	3,461,313	3,309,960	4,506,619	11,277,892
Induced	1,845,577	3,751,564	1,951,413	7,548,553
Total	\$73,486,890	\$22,035,118	\$21,058,845	\$116,580,853
Labor Income				
Direct	\$2,841,614	\$6,947,350	\$3,000,000	\$12,788,965
Indirect	1,062,777	995,231	1,100,316	3,158,325
Induced	503,939	1,024,394	532,779	2,061,112
Total	\$4,408,331	\$8,966,975	\$4,633,096	\$18,008,402
Jobs				
Direct	45	73	30	148
Indirect	27	28	32	87
Induced	17	34	18	68
Total	89	136	79	303

Sources: ECONorthwest IMPLAN analysis using data from Westway and Imperium Renewables and the US Census, August 2013.

⁴ <http://www.bls.gov/oes/home.htm>

Countywide, the total impact on jobs will be well more than six times the number (45) working directly for Westway and Imperium Renewables. Each year the terminals are operated there will be over 100 FYE jobs in direct marine and rail services, and together these direct jobs will result in an additional 155 FYE jobs in other industries. Total wages, salaries, and benefits for all those jobs in the County will be over \$18.0 million a year. The average wage and benefit across all these jobs is \$59,356.

All three industries engaged directly in delivering, storing, and loading liquids onto ships rely on highly skilled labor. Compensation is commensurate with the skills and experience required. This is evident from the direct labor income estimates. Fully loaded compensation, including overtime, healthcare, vacation pay, retirement, employer-paid payroll taxes, and wages, will average over \$84,000 per FYE in these three industries. Although combined wage and benefit data is unreported for counties, the U.S. Department of Labor does estimate that the average worker in Southwestern Washington nonmetropolitan area makes \$40,010 a year.⁵ Jobs at the Westway and Imperium Renewables facilities and the supporting rail and marine industries would be higher paying than the average in Grays Harbor County and its surrounding areas.

Westway and Imperium Renewables will bring high paying jobs to Grays Harbor County. The terminal expansions represent a long-term commitment to the local economy (“permanent” jobs); which can result in further economic growth and stability. The importance of these jobs is substantial, as evidenced when comparing recent economic conditions of county residents with those living throughout Washington. In July 2013, the unemployment rate in Grays Harbor County was 11.7 percent compared to 6.8 percent statewide. The lack of jobs affects the wellbeing of residents.

Table 6: Comparing the Economic Situation of Grays Harbor County to Washington State Residents

Statistic	Grays Harbor County	Washington State
Unemployment rates:		
July 2013, NSA	11.7%	6.8%
Annual average 2012	12.5%	8.2%
2011 per capita income \$ per resident	\$30,355	\$43,878
Sources of personal income:		
Work	50%	67%
Investments	16%	17%
Transfer* and retirement payments	33%	16%

*including unemployment and welfare disbursements

Sources: ECONorthwest analysis of Washington State Employment Security Department and U.S. Bureau of Economic Analysis data collected on August 22, 2013.

⁵ May 2012 Occupational Employment and Wage Estimates from the U.S. Department of Labor accessed August 31, 2013 at http://www.bls.gov/oes/current/oes_5300002.htm

The most recent personal income data released for Grays Harbor County by the federal government is further evidence of a need for more and higher paying jobs. In 2011, the average county resident made \$30,355 and 50 percent of that came from work (jobs, family farm income, self employment). The average resident of Washington was better off. They made \$43,878 in 2011 and earned 67 percent of that money working. They were less reliant on welfare, unemployment checks, retirement, and disability income sources than were the citizens of Grays Harbor County.

5 Fiscal Impacts

Westway and Imperium Renewables provided initial estimates of sales tax for construction. ECONorthwest estimated property taxes for the terminal and rail operations using the Washington combined trended investment table and the 2013 tax rates at Grays Harbor County. Property is the investment made through construction and tax on that property and is included as an operating cost. ECONorthwest estimated the business and occupation taxes for construction as 1.50 percent of construction. This tax was included under indirect taxes in the following table. Total taxes, fees, permits, and other revenues garnered by state and local governments during the construction period are estimated at \$12.3 million of which an estimated \$8.7 million would be directly paid by the construction project.

Table 7: Fiscal Impact Analysis for the Construction Phase and Operations in 2016, in Millions of 2013 Dollars

	Property Tax	Sales Tax	B&O and other taxes	Total
Construction				
Direct	\$223,222	\$8,123,814	303,177	\$8,650,212
Indirect	124,803	177,791	1,450,681	1,753,276
Induced	559,032	956,534	418,082	1,933,649
Total	\$907,057	\$9,258,140	\$2,171,940	\$12,337,137
Operations				
Direct	\$1,869,393	\$449,757	\$590,181	\$2,909,330
Indirect	67,398	73,424	92,164	232,987
Induced	146,015	267,805	92,112	505,932
Total	\$2,082,807	\$790,985	\$774,457	\$3,648,249

Sources: ECONorthwest IMPLAN analysis and data from taxing jurisdictions.

* Note: ECONorthwest estimates a B&O tax on construction, which is a direct cost of construction, but appears on this table as an indirect tax.

IMPLAN estimates all other taxes including those incurred indirectly and through induced spending and employment. IMPLAN has only limited fidelity for taxes rates by industrial classification, asset classes and geography for these secondary effects, and the results should be seen as illustrative and not construed to be the detailed analysis of a tax professional. Cumulatively, state and local taxes, permits, and fees would be approximately \$3.6 million in the first year of full operations in 2016.

Appendix A: Overview of Economic Multiplier Models

Input-Output Modeling

One economic modeling framework that captures the direct, indirect, and induced effects of spending on a project is called input-output modeling. Input-output models provide an empirical representation of the economy and its inter-sectoral relationships.

Because input-output models generally are either not available or affordable for state and regional economies, special data techniques have been developed to estimate the necessary empirical relationships from a combination of national technological relationships and county-level measures of economic activity. This planning framework, called IMPLAN (for Impact Analysis for PLANning), is the technique that ECONorthwest applied to the estimation of impacts.

The Origins of the IMPLAN Model

IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. U.S. government agencies, other public agencies, and private firms including ECONorthwest have applied the model to a wide variety of public and private sector projects.

The model is distinguished from typical input-output models in that it is not survey based; survey-based input-output models place significant demands on data, and are uneconomical to apply in most situations. Rather, IMPLAN employs secondary source data, available by state, county and zip code, to define a model for any region in the United States.

Two sources of data are particularly central to the IMPLAN models: the National Income and Product Accounts published annually by the Bureau of Economic Analysis (BEA) of the U.S. Commerce Department, and the BEA input-output model for the United States. The IMPLAN modeling process utilizes the national input-output model and county- and zip code-level economic activity data to derive input-output models for units as small as a zip code, but more common is the use of county level data as the smallest unit.

The process that develops the county-level input-output model generates coefficients that are internally consistent, in that county data sum to state totals and state data sum to national totals. This generally is not the case with survey-based input-output models, which limits their applicability to large-scale projects that affect a number of interrelated regions. (Arguably, however, an input-output model estimated from survey data has more accurate coefficients, because the survey can be customized to the problem at hand.

In contrast, IMPLAN derives its coefficients using a combination of the national input-output survey model and local activity data; conceivably, this will produce somewhat different results from a direct, local survey. Given the difficulty and expense of input-output surveys, however, the disadvantages of the IMPLAN approach are slight.)

Modeling

The process of modeling involves three steps:

- Creation of study area database;
- Customization of IMPLAN model and coefficients;
- Estimating the impact of an activity on the model of the study area economy.

The IMPLAN model allows substitution and incorporation of primary data at each stage of the model-building process, greatly increasing the model's accuracy and flexibility. In addition to being able to directly modify the IMPLAN database statistics, the user can alter import and export relationships, utilize modified input-output functions, and change industry groupings. IMPLAN allows the creation of aggregate models consisting of industries grouped together for a specific purpose.

Once a regional input-output model has been specified, impact analysis may be performed on that model. New industries or commodities can be introduced to “shock” the regional economy, industries or commodities may be removed or disaggregated, and reports can be generated to show the consequences (on output, employment, and value-added) of various impacts.

The key to input-output analysis is the construction of the input-output or transactions table, which shows the flow of commodities from each of a number of producing industries to all consuming industries and final demand (ultimate consumers). Given that many industries produce more than one commodity, production information is often tabulated on an industry-by-commodity basis into a “Make” matrix, containing the value of commodities produced by different industries, and a “Use” matrix, containing the value of commodities used by each industry in the production process. These matrices are combined to produce the input-output transactions table showing each industry buying and selling from other industries.

From these industry flows, two other structural tables are developed: (1) a table of technical coefficients or direct requirements and (2) a table of direct and indirect coefficients or total requirements. The entries in the former are interpreted as the dollar value of the minimal requirements from each of the contributing industries in order for each producing industry to produce one dollar's worth of output. The entries in the latter table are to be interpreted as the amount of output from the contributing industries required, both directly and indirectly, to deliver one dollar's worth of the producing industry's output to final demand.

Defining the Study Areas

The IMPLAN program uses an ordered series of steps to build the model. We describe them here to provide the interested reader with a view of the sequence of steps employed, and the types of data needed to model the impacts.

The first step is the definition of the study area or study areas. Study area Databases are created corresponding to these areas. These databases contain the representation of the behavior of the study area economies, but do not contain any information about the specific project under study.

Customizing the IMPLAN Coefficients

The process of customizing the IMPLAN model does not stop with the development of the Study Area Databases. Part of the expertise of input-output practitioners is in the customization of the model coefficients. In this section, we describe the various steps in the customization process.

Constructing the Social Accounting Matrix

From the Study Area Databases, a mathematical concept called the Social Accounting Matrix is constructed, using computer procedures incorporated in the IMPLAN modeling system. The initial study area data in this transformation can be viewed and edited in a spreadsheet-like program. The matrix is a complex table that contains an array of different transfers between market participants. The database elements are organized into five main groups: Final Demand, Sales, Value Added, Employment, and Total Industry Output. These elements can be further divided into those that are specific to commodities and those that relate to industries.

The user may edit the Regional Purchase Coefficient and the Directly Allocated Exports Coefficient for each commodity. Both of these coefficients are calculated from the Social Accounting Matrix so they may only be modified after that matrix has been constructed. The IMPLAN program contains internal checks, which enforce data integrity and will not allow values outside the specific, valid range for these coefficients to be accepted by the model.

Building the Input-Output Accounts

After creating the social accounting matrix, the input-output accounts for the model are constructed. The input-output accounts are formed by transforming parts of the social accounts from an “industry-by-commodity” format to an “industry-by-industry” format; it combines submatrices into a single “transactions” submatrix, as described in general above. The input-output accounts may be constructed with either aggregated or unaggregated industry data. The unaggregated data is made up of 440 IMPLAN-defined industries that correspond to one or more NAICS industry codes, and comprise the entirety of each economy. The creation of aggregated industries from individual industries will reduce the size of the industry matrix (and processing time).

Estimating Multipliers

The last step in building the model is to estimate the multipliers. Five different sets of multipliers are estimated by IMPLAN corresponding to five measures of regional economic activity: Total Industry Output, Personal Income, Total Income, Value Added, and Employment. Multiplier analysis is used to estimate the regional economic impacts resulting from a change in final demand. Impacts can be in terms of direct and indirect effects (commonly known as Type I multipliers), or in terms of direct, indirect, and induced effects (Type II and Type III multipliers). More specifically, direct effects are production changes associated with the immediate effects of final demand changes. Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries. Induced effects are the changes in regional household spending patterns caused by changes in household income~ generated from the direct and indirect effects.

IMPLAN calculates two types of multipliers for each of the five impact measures. The first output multiplier represents the value of production, from indirect and direct effects, required from all sectors by a particular sector in order to deliver one dollar's worth of output. The second output multiplier adds in the induced requirements. The size of the multiplier is not a measure of the amount of activity or the importance of a given industry for the economy. It is an estimation of what would happen if that industry's sales to final demand increased or decreased. In other words, output multipliers can be used to gauge the interdependence of sectors; the larger the output multiplier, the greater the interdependence of the sector on the rest of the regional economy.

Performing Impact Analysis

Once the model is complete, impact analysis can be performed on the model. Impact analysis involves posing a change in the demand for commodities and using the multiplier model to examine the effects that producing and delivering the commodities may have on a region's employment, income, and output. Several types of economic impact analyses can be carried out simply by varying structural, technological, and/or trade factors within the model. For instance, the user may add or remove sectors from the model, or change the size of an industry, or the user may change production functions, or make changes in commodity imports and exports. To perform a full economic impact analysis with IMPLAN, all of the relevant structural, technological, and trade related adjustments must already be incorporated in the regional model.

In order to keep track of and organize all of the information needed to describe a change in the final demand for commodities, IMPLAN uses the general concept of a "scenario" to capture all of the information about the change(s) in commodity demand for which impacts are being estimated. Scenarios are made up of several building blocks.

At the lowest level is a transaction; this is the actual expenditure that represents the final demand for a commodity. Descriptive information about this transaction, such as what commodity is involved, when it occurred, and how it was measured, are collectively referred to as an event. A collection of events, which have descriptive information in common, occurring together, are referred to as an activity. For instance, the group of events that make up an activity may be related to each other by what caused them to take place or why they took place.

A scenario is a collection of one or more activities (which includes, in turn, events with transactions), specifying where the activity(s) occurred and at what amount(s). A scenario may be viewed as equivalent to a management, planning, or policy alternative. Units of measure are assigned to each activity and can be in physical terms, monetary terms, household consumption, or any other terms appropriate for the problem under study. The unit price represents the transaction rate—the total amount of purchases necessary to participate in one unit of an activity.

In order to run an economic impact analysis, the user must build a datafile of changes in final demand. All activities to be included in the analysis must be defined, providing information about who initiated the demand change, the base year of the activity, the transaction basis (commodity purchase or an industry's output), conversion rate (which gives a scale of the transactions occurring in the activity), and measurement units. There is a finite list of causal agents to choose from when describing the activity, comprised of the following choices: households, federal government, state/local government, enterprises (investment), and industry. Once the activity is defined, the next step is to define events that occur in the activity, in much the same way as for the activity itself.

Model Outputs

The IMPLAN model provides estimates of impacts of the expenditures on income, and employment that follow from direct, indirect, and induced expenditures. By writing special fiscal impact modules, the model also can be used to estimate impacts on the tax revenue collected through property taxes, sales taxes, corporate income taxes, and other fiscal devices.

Limitations of Input-Output Models

Like many quantitative tools, input-output models rely on a set of assumptions. The use of simplifying assumptions imposes certain limitations on the use of input-output modeling. These limitations should be fully understood and guide its use.

Input-output models are static models that measure the flow of inputs and outputs in an economy at a point in time. With this information and the balanced accounting structure of an input-output model, an analyst can: 1) describe an economy at one time period, 2) introduce a change to the economy, and then 3) evaluate the economy after it has accommodated that change.

This type of analysis is called “partial equilibrium” analysis. Partial equilibrium analysis permits comparison of the economy in two separate states, but does not describe how the economy moves from one equilibrium to the next. In partial equilibrium analysis, other than the initial economic stimulus, the researcher assumes that all other relationships in the economy remain the same.

Contrary to dynamic models, static models assume that there are no changes in wage rates, input prices, and property values. In addition, underlying economic relationships in input-output models are assumed constant, i.e., there are no changes in the productivity of labor and capital, and no changes in population migration or business location patterns.

Input-output models have fixed production relationships, including the following assumptions:

- *Constant Returns to Scale* means that an industry's production function is linear, and an increase in output requires all inputs to increase proportionately.
- *Fixed Commodity Input Structure* means that input-output models do not allow changing input prices to affect the production decisions of businesses.
- *No Supply Constraints* means input-output models show how local industries respond to some initial change in final demand, but assume that supplies of raw materials and intermediate goods are unlimited.
- *Sector Homogeneity* means in input-output modeling, industry sectors are assumed to be homogenous. That is, all businesses within an industry sector 1) produce commodities in fixed proportions and 2) produce identical commodities that are perfectly substitutable.