Section III: Applying Knowledge

Regional Economic Impact Analysis

SUMMARY
In this activity, teachers present a lecture related to assessing regional economic impacts and students use this knowledge to calculate the impacts of a wood to energy facility on a hypothetical regional economy.

BACKGROUND
An economic impact analysis assesses the effect of a new activity, industry, or event on a regional economy. Any activity that generates payments and buys products has an effect on other parts of the local economy. Economic impact analysis measures these effects. For example, any utility that provides energy will have a regional economic impact because it hires workers, buys resources, and sells energy. A comparison between a fossil fuel utility and a woody biomass utility, however, produces a significantly different impact on the regional economy.

Consider a biomass facility where urban waste wood and logging residue are converted to electricity. If this is a new facility, there are two major types of costs: capital expenses for building the facility and annual operating expenses for its use and maintenance. This facility can have a positive impact on the local economy through job creation and the facility will purchase supplies from local businesses and pay local government taxes, thus increasing money flow in the local economy. Any payment made by the facility turns into income for another person or entity. This economic impact is like the waves that spread in all directions after throwing a stone in a lake.

The structure of a local economy with a woody biomass energy industry...
and the links to economic impacts are illustrated in Figure 1. Businesses in the energy sector, including timber growers, loggers, haulers, and electric power producers, sell their products or services to intermediate and final consumers through wholesale and retail distributors. Firms that purchase goods or services from local suppliers generate economic activity by re-circulating money in the local economy. The payments for wood fuel increase the earnings for forest workers, which increase the amount of money those workers can spend on food, clothing, housing, and transportation. That additional amount of money could enable a grocery to expand their selection of organic produce or gourmet cheese and hire another cashier, for example. In addition, businesses and households pay taxes to the local government, which in turn spend the money for the community good. This is the nature of regional economic impacts.

**INPUT-OUTPUT ANALYSIS**

Economic impact analysis is typically done using an analytical procedure known as input-output (I-O) analysis. I-O analysis quantifies the relationships and interactions between industry sectors, households, and governments within a local economy. I-O analysis is conducted with I-O models, constructed from a transactions table that reflects the value of goods and services exchanged between all sectors of the economy in a one-year base period. A simple example of a transactions table for a local economy is shown in Table 1.
In this example transactions table, the economy has five major industry sectors (agriculture, mining, manufacturing, trade, and services). Industries in the economy are listed twice in the transactions table, as both producing industries and as purchasing industries. Rows in the table reflect the output from each producing industry, including intermediate sales to other industries and to final consumers such as households, government, and exports. Columns in the table reflect inputs in the form of purchases or expenses by each producing industry from other industries, as well as value added inputs for payments to workers, taxes, owner profits, and imports. The value added section of the table shows how each sector is linked to household income in the local area, and the household component of final demand reflects how each sector is affected by local household spending. Changes in final demand from exports and local consumption by households and governments cause the producing industries to respond accordingly to meet demand. Notice that the total output of each producing industry equals the total value of purchases by that industry—inputs equal outputs. Values are usually expressed in millions of dollars.

As a specific example of an individual business within this local economy, imagine a tree seedling nursery is one of the agricultural businesses contributing to the total output and total value of the agriculture sector. The output, or production, of this individual business is included in the agriculture row of the transactions table. For example, the nursery may sell some seedlings to

<table>
<thead>
<tr>
<th>INDUSTRY SECTORS</th>
<th>PURCHASING INDUSTRIES</th>
<th>FINAL DEMAND</th>
<th>Total Output (million dollars)</th>
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<tbody>
<tr>
<td></td>
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<td>Manufacturing</td>
</tr>
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<td>2</td>
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<td>2</td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
<td>5</td>
<td>3</td>
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<tr>
<td></td>
<td>Trade</td>
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<td>3</td>
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<td></td>
<td>Services</td>
<td>7</td>
<td>10</td>
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<td>Value Added</td>
<td>Labor Earnings</td>
<td>5</td>
<td>14</td>
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<td></td>
<td>Business Profits</td>
<td>2</td>
<td>4</td>
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<tr>
<td></td>
<td>Imports</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL VALUE</td>
<td></td>
<td>39</td>
<td>40</td>
</tr>
</tbody>
</table>
reclamation purposes (mining sector),
• a drug manufacturer that uses the
  plant material to extract and refine its
  chemical constituents (manufacturing
  sector),
• a wholesale distributor for re-sale to
  landscape contractors (trade sector),
• final consumers through a retail
  garden center (households),
• the U.S. Forest Service for reforesta-
  tion projects (government), and
• companies outside of the local
  economy (exports).

The nursery purchases many products
  to produce the tree seedlings and adds
  value to the local economy through busi-
  ness profits, employee wages and benefits,
  and by importing goods into the local
  economy. For example, the nursery may
  purchase
• seeds (agriculture sector),
• lime as a soil conditioner (mining
  sector),
• fertilizers and a tractor (manufactur-
  ing sector),
• product shipping via trucks (trade
  sector), and
• crop consultants (services sector).

Note, this example describes the pat-
  terns of production and purchasing for
  a specific business, and the values given
  in the transactions table represent the
  activity of the larger industry sector.

The linkages in an I-O model are
  represented by economic multipliers that
  measure the total impact of a change
  in one or more industries on all other
  industries within the local economy. An
  economic impact analysis measures the
  impact of a change in one industry by
  assessing how all the other components
  are affected. Multipliers are derived from
  the transactions table using mathematical
  procedures.

An increase or decrease in output or
employment within a specified industry
is said to have a “multiplier effect” in the
local economy. For a given industry, the
size of the multiplier depends on the size
of the economy, the degree of economic
integration among regional businesses,
and the level of sales outside the local
region or exports.

For each industry, multipliers esti-
  mate three components of total change
  within the local area: direct, indirect,
  and induced effects.

• Direct effects represent the initial
  change that the industry proposes
  (such as opening a factory or business
  that provides goods or services not
  previously available in that com-
  munity).
• Indirect effects represent changes
  in inter-industry transactions as
  supplying industries respond to
  changes in demands from the directly
  affected industries (such as additional
  resources needed to operate the fac-
  tory or business).
• Induced effects represent the impacts
  on all local industries caused by
  the expenditures of new household
  income generated by the direct and
  indirect effects of final demand
  changes (such as the purchases made
  by the people who will work in the
  new factory or business).

These different effects are used to cal-
  culate different impacts of expenditures.
For example, money paid to workers as
wages is likely to be respent in a commu-
  nity on food, housing, and transportation
  costs. It will have a local impact in these
  sectors. Money that is spent to purchase
  resources from outside the county will
  not have any local economic impact.

The total effect is the sum of the
direct, indirect, and induced effects. Total
effect multipliers usually range from
1.5 to 2.5, meaning there will be a total
change of 1.5 to 2.5 times the original
direct change.

• Output multipliers relate the changes
  in sales to final demand by one
  industry to total changes in output
  (gross sales) by all industries within
  the local area.
• Employment multipliers relate
  changes in direct employment or
output to total employment effects, and may be stated either as a ratio of total to direct employment, or as a number of jobs per million dollars of output change.

- **Value added multipliers** are interpreted the same as employment multipliers; they relate changes in value added in the industry experiencing the direct effect to total changes in value added for the entire local economy.

**IMPLAN SOFTWARE AND DATABASES**

**IMPLAN** (*Impact Analyses for Planning*) is one of several computer software packages and associated databases that help economists construct regional I-O models for any area of the United States. **IMPLAN** has become a standard tool of economic impact analysis in the United States, with hundreds of licensed users, including universities, government agencies, and private companies.

The economic data for **IMPLAN** are compiled for 440 distinct producing industry sectors of the national economy defined by the North American Industrial Classification System (NAICS), based upon the primary commodity or service produced. Regional data sets for **IMPLAN** are updated annually for all counties in the United States. Economic impact analysis with the **IMPLAN** software is conducted by specifying changes in output or employment for particular sectors. Output and employment are interchangeable, and a change in one measure implies a change in the other according to the output per employee ratio.

Values for commodities in **IMPLAN** are stated in producer prices—the prices of goods at the factory or production point. For manufactured goods, the price paid by final consumers equals the producer price plus marketing margins that are paid to the wholesale, retail, and transportation sectors. For example, consumers pay transportation, wholesale, and retail margins when purchasing bread or gasoline at the store. Large commercial buyers, such as governments, may pay little or no retail margin because they have more buying power. They may be able to purchase gasoline, for example, in bulk quantities directly from the manufacturer. For service businesses, such as restaurants or hotels, the producer and purchaser prices are equivalent because services are “produced” at the point of sale. **IMPLAN** contains information on typical margins for many different sectors, which may be used to more accurately capture the effects of marketing chains.

**IMPLAN** multipliers are available for all of the basic impact measures, including output, employment, value added, labor income, employee compensation, other property income, and indirect business taxes. When used with all parameters set at default levels, **IMPLAN** models reflect prevailing national relationships and regional industry activity.

Input-output models are constructed for an explicitly defined geographic area, so the definition of the region can be an important issue that may dramatically affect the results. Typically, the region for impact analysis within a small to medium sized municipality would be the surrounding county, whereas an analysis of a large city or metropolitan area would probably include a group of several counties. Also, the particular location of a facility may affect the definition of an appropriate regional model. For example, if a new plant is to be located near a county boundary, the neighboring county should probably be included in the regional model since it will be influenced by the facility.
Teacher Instructions

Assessment Suggestions

OBJECTIVE 1: Review student answers to Student Worksheet 1.

OBJECTIVE 2: Review student answers to Student Worksheet 2 and completed Student Table.

Extensions

• Invite a regional planner to speak to your class about a recent development project in your community and how they calculated economic impact, what questions they had, what assumptions they made, and what difference it made to the people who had to approve the project.

• Have students write a one-page report on the regional economic impacts of a wood to energy facility. Encourage students to include data and calculations.

Preparation

1. Review the Background Information and Regional Economic Impact Analysis Presentation to prepare for leading a lecture and discussion to introduce the activity. For additional background information, review the fact sheet Economic Impacts of Generating Electricity found in the Supplemental Reading section.

2. Review Student Worksheet 1 and 2, Data Table, and Student Table to familiarize yourself with the activity.

3. Make copies of Student Worksheet 1 and 2, Data Table, and Student Table (one copy of each per student).

4. Download the presentation onto classroom computer.

Procedure

1. Use the provided Regional Economic Impact Analysis Presentation and Background Information to give a lecture to introduce regional economic analysis of using wood for energy.

2. Distribute Student Worksheet 1 and instruct students to complete the worksheet as you lecture. They will be practicing skills in note taking and listening. Make sure to include the answers to the worksheet questions in your presentation.

3. After you complete the presentation, distribute the Data Table, Student Table, and Student Worksheet 2, and help students complete the table and answer the questions.

Resources

As you follow along with the presentation and lecture, answer the questions on this worksheet.

1. How is a local economy structured?

2. What are the measures of economic activity?

3. Explain value added.

4. What does an input-output model convey?

5. What are multipliers?

6. What is the difference between direct, indirect, and induced effects?

7. What does IMPLAN help people do?
Let’s practice estimating the economic impact of a 20 megawatt (MW) wood-fueled facility on a local economy. To do this, you will use the multiplier figures found in the Data Table and follow the instructions below. Record your calculations in the Student Table and then answer the Summary Questions.

Instructions

1. First, review both the Data Table and the Student Table to become familiar with the multiplier types, economic sectors, expense items, and costs.
   a. Notice that the Data Table includes figures for three types of multipliers (output, employment, and value added) and that each multiplier contains figures for three different effects on the local economy (direct, indirect, and induced). Also note that each economic sector contains different multipliers. These multipliers were generated using the IMPLAN program.
   b. Review Columns A through C in the Student Table. In Column A contains 13 expense items that are typical of a wood to energy facility. Column B shows the cost of each item, and Column C organizes these items by economic sector. These sectors all have an impact on the local economy.

2. Next, add the direct effect, indirect effect, and induced effect to determine the total effect for each multiplier type. Make sure to use the multipliers for the appropriate economic sector.
   a. To determine the total output multiplier effect for each expense item, sum together the direct, indirect, and induced effects found in the Output Multipliers section of the Data Table. Record these figures in Column D of the Student Table.
   b. To determine the total employment multiplier effect for each expense item, sum together the direct, indirect, and induced effects found in the Employment Multipliers section of the Data Table. Record these figures in Column F of the Student Table.
   c. To determine the total value added multiplier effect for each expense item, sum together the direct, indirect, and induced effects found in the Value Added Multipliers section of the Data Table. Record these figures in Column H of the Student Table.

3. Now, using typical expenses for a wood-fueled facility and the total multiplier effect, calculate the impacts that could result from a 20 MW wood-fueled facility (in dollars and number of jobs).
   a. Multiply the Total Output Multiplier Effect (Column D) by the Expense (Column B), for each expense item. Write these figures in Column E of the Student Table.
   b. Multiply the Total Employment Multiplier Effect (Column F) by the Expense (Column B), for each expense item. Because jobs are per million dollars of expenditure, divide by one million. Record these figures in Column G of the Student Table.
   c. Multiply the Total Value Added Multiplier Effect (Column H) by the Expense (Column B), for each expense item. Write these figures in Column I of the Student Table.

4. Finally, sum the Output Impact, Employment Impact, and Value Added Impact, for all expense items to get a total economic impact. Record the totals and answer the questions below.
Summary Questions

1. How many new jobs would be created by operating this facility?

2. What is the total value added impact of operating this facility for one year? What are some examples of value added impacts?

3. What is the total output impact of operating this facility?

4. What are the output, employment, and value added impacts of wood fuel supply operations? Hint: These are the impacts generated when the facility buys wood fuel from the logging sector.
   
   Output: ____________ Employment: ____ Value added: ____

5. If you were going to propose that this facility be built in your community, how would you describe the benefits to the local economy?

6. The purchase of electricity, the manager’s salary, and office expenses are each expected to cost the facility $100,000 per year. Does each item create the same economic impact in the region? Why?

7. What would be different in your analysis if the power plant burned coal instead of wood? Assume this county does not produce coal. Which would have a greater regional economic impact and why: a power plant burning local woody biomass resources or a power plant burning coal? Explain your answer.
### Student Table

#### Operating expenditures and impact estimation for a 20 megawatt wood power facility

<table>
<thead>
<tr>
<th>Expense Items</th>
<th>Economic Sector</th>
<th>Total Output Multiplier Effect</th>
<th>Output Impact ($)</th>
<th>Total Employment Multiplier Effect</th>
<th>Total Employment Impact (# jobs)</th>
<th>Total Value Added Multiplier Effect</th>
<th>Total Value Added Impact ($)</th>
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</thead>
<tbody>
<tr>
<td>Wood Fuel Costs</td>
<td>Logging</td>
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<td>Power Generation &amp; Supply</td>
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<tr>
<td>Maintenance of Power Plant</td>
<td>Power Generation &amp; Supply</td>
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<td>Insurance</td>
<td>Insurance Agencies, Brokerages, and Related</td>
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<td>Mobile Equipment Lease</td>
<td>Machinery and Equipment Rental and Leasing</td>
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<tr>
<td>Environmental Consulting Costs</td>
<td>Environmental and Other Consulting Services</td>
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<tr>
<td>Manager's Salary</td>
<td>Management of Companies and Enterprises</td>
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<td>Office Expenses</td>
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<td>Ash Disposal</td>
<td>Waste Management and Remediation Services</td>
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<td>Property Tax</td>
<td>State and Local Government Taxes</td>
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<td>Employee Salaries and Benefits</td>
<td>Household Wage Earner Salary</td>
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</table>
### Economic Sectors and Multipliers

<table>
<thead>
<tr>
<th>Economic Sector</th>
<th>Output Multipliers</th>
<th>Employment Multipliers (jobs/million dollars output)</th>
<th>Value Added Multipliers</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Direct Effect</td>
<td>Indirect Effect</td>
<td>Induced Effect</td>
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