NETL's mission is to implement a research, development, and demonstration program to resolve the environmental, supply, and reliability constraints of producing and using fossil resources.

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National, State, and Regional Economic and Environmental Impacts of NETL: *Overview*

As part of the University Partnership program at the National Energy Technology Laboratory (NETL), NETL collaborated with Carnegie Mellon University (CMU) and West Virginia University (WVU) on a project assessing the laboratory's national, state, and regional economic and environmental impacts.

This project's final report, *National, State, and Regional Economic and Environmental Impacts of NETL*, documents—

- Development of state-level input-output (IO) models for Pennsylvania and West Virginia.
- Development of a regional Pennsylvania/West Virginia (PA/WV) model.
- Augmentation of the national IO model with employment data.

The models were developed to assess the impacts of expenditures and employment at NETL and research and development (R&D) awards originating from the NETL sites located in Pittsburgh, PA and Morgantown, WV. The scope of the project did not extend to the impacts related to market adoption of NETL-sponsored technologies, nor did it include induced impacts. Therefore, NETL's impacts, as represented in the study, are considered to be a conservative estimate.

The primary goal of the project was to develop a fully defensible and transparent means for routinely estimating national, state, and regional economic and environmental impacts derived from NETL employment and activity. The development of the methodology and models allows NETL to assess its influence with respect to the various economic regions and to evaluate scenarios that represent alternative activity levels and expenditure allocations.

NETL is an important component of the PA/WV economy, and the laboratory's focus on fossil fuels is of critical national importance given the challenges of balancing energy demand with global climate change. The models developed in the project help to assess the regional impact of NETL activity as an

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economic catalyst. Additionally, and perhaps of greater importance, the models provide the platform from which NETL could develop future model versions that could be used to evaluate the impact of technology developed by NETL.

The models constructed are available to users via two easily accessible means: a web-based model and MatLab. This accessibility allows target audiences such as governmental decision-makers, industry experts and researchers, and the general public to use the models for their own environmental and economic impact analyses related to the Nation and the states of Pennsylvania and West Virginia.

Model Development

Constructing new models for an economic and environmental analysis presented four primary challenges which led to the identification of several key decision points:

1. Identifying quality data sets for economic and environmental parameters.
2. Selecting a methodology for regionalizing the national model.
3. Identifying and collecting NETL data sets.
4. Defining sensible approaches to implementing the model.

The principles guiding the decisions for which data sets to use and which regionalization method to employ were driven by the objective to develop a methodology that is complete, consistent, and theoretically sound.

This project uses IO models to derive the economy-wide impacts of NETL's activity. IO models were chosen for this project because they represent the economic relationships between all sectors of the economy, and the underlying theory of IO models has been well tested and documented.

The IO construct used for the models was CMU's National Economic Input-Output (EIO) model, which allows for the estimation of both economic and environmental impacts of a supply-side change in the economy. While other economic-environmental IO models exist, such as those from the International Input-Output Association and Britain's National Statistics Online, those projects are done at the national or multi-national region level. It is believed that this project represents the first-ever sub-national regional level model of its kind.

The data used to represent NETL's 2006 activity at the Pittsburgh, PA and Morgantown, WV sites include the following:

- Federal employment: 510 employees.
- Federal wages and salaries: $56.4 million.
- Federal operational expenditures: $80.8 million.
- Federal R&D award obligations: $752.4 million (all NETL sites).
- Federal R&D award costs: $535.0 million (all NETL sites).
- Site support contractor employment: 668 employees.
- Site support contractor wages and salaries: $40.2 million.
- Site support contractor expenditures: $13.6 million.

This data represents the entire value of activities at the Pittsburgh and Morgantown sites, regardless of the state in which the expenditure was made or the award was granted. Thus, the total is greater than the value of the activities that directly impact Pennsylvania and West Virginia.

Results

Having constructed the models, it was important to conduct some analyses to test their robustness and demonstrate their utility. NETL activity in the Pittsburgh, PA and Morgantown, WV facilities during 2006 was the basis of the data used for the test cases.

The first step in the analysis of NETL impacts was to establish a baseline. NETL activity was represented in the IO model as sector "Scientific Research and Development Services." Collected data were categorized by the state impacted by the economic activity. For example, if the Pittsburgh site expended $45 million on operations and $7 million of that was paid to vendors within the state of Pennsylvania, then $7 million was used as part of the total in determining the impact of NETL's Pittsburgh site on the state of Pennsylvania. Similarly, when determining the impact of NETL's Pittsburgh and Morgantown sites on the PA/WV region, the value of expenditures paid to vendors in both states was used as the value of the combined sites' impact.

Baseline impacts were established for the impact of the Pittsburgh and Morgantown sites on four regions: Pennsylvania, West Virginia, the combined Pennsylvania and West Virginia region, and the Nation. Abbreviated results are shown in the table below.

The results show that the economic output multiplier for the two-state regional model is 1.47. Therefore, for every $1 million of NETL final demand that remains within Pennsylvania and West Virginia, the regional economy grows by $1.47 million.

Economic output multipliers reflect the region's ability to fulfill the requirements of an industry's supply chain. The table shows that the output multiplier for the state of West Virginia is lower than those for the other regions. This implies that the state economy of West Virginia is less able than the state of Pennsylvania to supply the direct and indirect inputs required by the Scientific Research and Development Services sector.

Table 1. Baseline Scenarios

	Combined States of PA and WV	West Virginia	Pennsylvania	Nation
Federal, Contractor, and R&D Awards/Grants (2006$)	$192.4 million	$74.8 million	$117.5 million	$726 million
Federal and Contractor Employment (2006 jobs)	1,166	537	629	1,178
Direct & Indirect Impact (2006$)[1]	$283 million	$100 million	$173.0 million	$1,171 million
Employment (jobs)	3,180	1,150	1,940	7,610
Emissions (metric tonnes)	1,567	602	885	2,339
Economic Output Multiplier[2]	1.47	1.34	1.47	1.61
Employment Multiplier[3]	2.7	2.1	3.1	6.5
Employment per Million $[2]	20.2	18.7	20.1	12.8

[1] 2006$ impacts calculated using deflator of 0.82

[2] Multiplier calculated using results from inputs run in 1997$.

[3] Multiplier calculated using number of NETL Federal and Contractor employees living in respective state in 2006.

The economic output multipliers generated in this study suggest opportunities for the region to expand through backward linkages so that the region may be more able to provide a greater proportion of regional industries' input needs in the future.

The regional employment multiplier of 2.7 indicates that for every one employee at NETL, an additional 1.7 employees are needed throughout the two-state economy. Similarly, employment increases by about 20 persons for each $1 million that remains in the region.

For more details about the economic theory underlying the study, project methodology, and analysis and results, please read the full report, *National, State, and Regional Economic and Environmental Impacts of NETL*, which is online at http://www.netl.doe.gov/energy-analyses/pubs/NETLimpactsPAandWV.pdf.

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