

ECONOMIC IMPACT AND WORKFORCE ANALYSIS OF THE H₂ TEAM PROJECT

OHIO
UNIVERSITY

Voinovich School of
Leadership and Public Service

IMPLAN OVERVIEW:

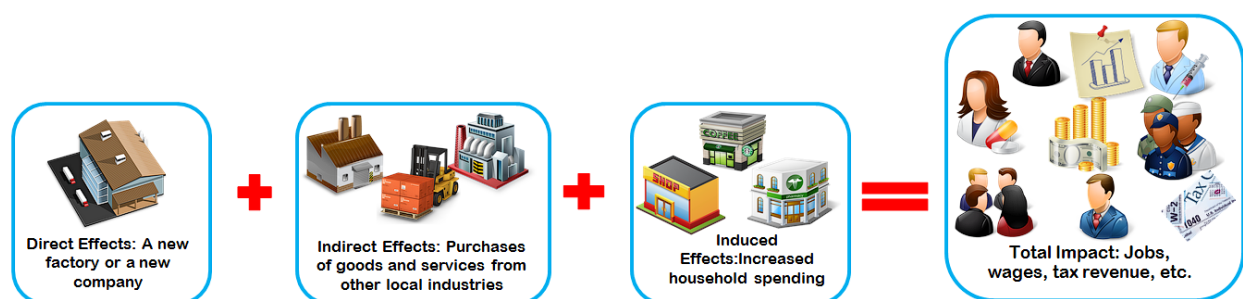
IMPLAN is an acronym for IMpact analysis for PLANing and is a widely used tool for economic impact analyses. IMPLAN uses a general input-output model that uses secondary data from the BEA, BLS, and Census.

KEY DEFINITIONS:

The Multiplier is the ratio of the Total Effect to the Direct Effect. The employment multiplier equals 1.34 means that for every three jobs in a hydrogen production facility, 1 additional full-time job would be supported in related industries. Employment in the construction phase is the total number of jobs needed in the entire construction period. Labor Income is composed of both the wages and benefits paid to employees and the profits earned by self-employed people. Value Added (or Gross Regional Product) is the combination of Labor Income plus corporate profits, interest income, rental payments, sales tax, excise tax, property tax, fees, fines, and licenses. Finally, Output is the combination of Value Added plus the materials and services (other than employment) required by an industry to create its products.

IMPLAN LIMITATIONS:

Since economic structures change over time, the indirect effects that are quantified for one year may decrease or increase over the period of the analysis. It is also possible that as new activity, starts, another activity disappears, meaning jobs are not created but shift from one industry to another. The indirect and induced effects depend explicitly on the magnitude of the direct effect, so fluctuations or errors in the direct effect data are reflected in the total effects. This analysis uses the most conservative estimates to obtain a lower bound of effect.



EXECUTIVE SUMMARY

The US Department of Energy (DOE) former Portsmouth Gaseous Diffusion Plant (PORTS) facility near Piketon, Ohio employed over 20,000 people during the site's construction in the 1950s. Employment during operations of the facility was approximately 2,500 per annum. Following a cold shutdown in 2005, in 2010, DOE awarded a \$2.1 billion contract to Fluor B&W to conduct site cleanup activities. As this process continues, remediated land is being deeded to a local nonprofit known as the Southern Ohio Diversification Initiative (SODI) for private-sector economic development use. Ohio University's PORTSfuture Program is partnering with SODI to facilitate reindustrializing the site into an Integrated Energy System-Closed Loop Manufacturing (IES-CLM) facility. The PORTS site's unique assets will be leveraged for the synergistic production and use of energy with added efficiency and reduced greenhouse gas (GHG) emissions.

The desired future use focuses on utilizing the site location and infrastructure assets to develop a regional energy transmission and distribution hub, engaging in power generation to include all-of-the-above energy strategies, and collocating sustainable manufacturing initiatives. These energy and manufacturing initiatives will include, but not be limited to, 1. Decarbonized hydrogen to power generation for 240 Megawatts annually (500 metric tons of hydrogen per day (methane reformer)), 2. 2,140 metric tons of oxygen per day, 3. Carbon sequestration of 4,240 metric tons per day, 4. 350 metric tons per day of ammonia production, and 5. 200 metric tons per day of silicon metal refining activity. This analysis seeks to quantify the workforce required to support construction and operational activities for each component and to quantify the economic impact of these initiatives on the Ohio Valley Regional Development Commission (OVRDC) region which serves as the primary labor market for new development.

Table 1 and Table 2 show the economic impact of construction and operations of the proposed activities on the economy of the OVRDC region. The construction of facilities will support about 2,615 jobs during the construction period, and about 778 jobs during the operations and maintenance phase. One note of importance, the hydrogen to power, air separation, carbon capture and sequestration, and ammonia production activities will be integrated in this project and thus realize economies of scale and reduce job duplication, yielding an aggregate job number of 275.95 for those four activities as shown on page 13 below. Those jobs coupled with the silicon activities, would result in the final job tally of 532.27 operational jobs under the integrated approach as shown in the table on page 16. Additionally, the construction of facilities will generate about \$346 million in economic activity during the construction phase and generate an additional \$316 million annually through operations in a nonintegrated setting.

Table 1: Total Economic Impact of Construction Phase of the Activities

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,925.00	\$109,427,536	\$112,491,182	\$233,051,841
Indirect Effect	261.75	\$16,812,181	\$26,678,223	\$52,774,054
Induced Effect	428.67	\$17,535,034	\$34,374,954	\$60,885,201
Total Effect	2,615.42	\$143,774,752	\$173,544,361	\$346,711,099
Multiplier	1.34	1.30	1.52	1.48

Table 2: Total Economic Impact of Operational Phase of the Activities

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	292.00	\$50,705,794	\$87,997,487	\$209,000,073
Indirect Effect	251.41	\$19,592,827	\$37,098,112	\$73,785,249
Induced Effect	235.00	\$9,612,895	\$18,844,716	\$33,377,915
Total Effect	778.42	\$79,911,517	\$143,940,315	\$316,163,238
Multiplier	3.73	2.07	1.70	1.48

Table 3 and Table 4 present the results of the workforce analysis for the construction and the operations phase of the proposed projects in a nonintegrated setting. For example, out of 1,925 direct jobs created during the construction phase, 1,075 will be in construction and extraction occupations. Out of 292 direct jobs created during the operations phase, 80.5 jobs will be created in production occupations.

Table 3: Workforce Analysis for Construction Phase of the Activities

CONSTRUCTION		
Occupation	Total Ohio	Percentage of Project
Construction and Extraction Occupations	171,950	1,075.4
Management Occupations	278,880	264.0
Business and Financial Operations Occupations	319,410	160.0
Office and Administrative Support Occupations	674,570	156.5
Architecture and Engineering Occupations	87,420	67.9
Installation, Maintenance, and Repair Occupations	203,870	59.0
Transportation and Material Moving Occupations	508,580	53.4
Production Occupations	466,570	35.7
Sales and Related Occupations	457,930	17.2
Building and Grounds Cleaning and Maintenance Occupations	141,740	12.5

Table 4: Workforce Analysis for Operational Phase of the Activities

OPERATIONS		
Occupation	Total Ohio Workforce	Operations Jobs
Production Occupations	466,570	80.5
Life, Physical, and Social Science Occupations	34,740	47.3
Architecture and Engineering Occupations	87,420	45.5
Office and Administrative Support Occupations	674,570	27.8
Management Occupations	278,880	24.7
Business and Financial Operations Occupations	319,410	14.4
Installation, Maintenance, and Repair Occupations	203,870	15.7
Transportation and Material Moving Occupations	508,580	8.7
Computer and Mathematical Occupations	162,510	6.8
Sales and Related Occupations	457,930	6.0

DEFINITIONS

PROJECT STUDY AREA: The project's goal was to define a study area around Piketon, Ohio, within a 50-mile radius. However, IMPLAN and workforce analysis require well-defined regions, so we use the 12-county Ohio Valley Regional Development Commission region. These counties form a regional partnership dedicated to the development of Southern Ohio and thus have close economic ties. The 12 counties consist of Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

SIMULACRUM: Because each activity in this project represents a facility that doesn't exist, the researchers do not have information on the employment requirements for operations and construction. Instead, each activity includes a simulacrum for each facility to estimate the economic impacts of the proposed facility. A simulacrum represents a similar facility and what the researchers expect the proposed facility to look like using a similar facility that currently operates within the same industry. For example, suppose the aim is to estimate the employment required to operate and produce one metric ton of hydrogen per year, assuming the production technology stays the same. In that case, the researchers use an existing facility that produces two metric tons of hydrogen per year and divides their operational employment in half to get the result. Researchers can also apply similar logic to estimate construction employment requirements.

IMPLAN OVERVIEW: IMPLAN, or Impact analysis for PLANing, is a widely used tool for economic impact analyses. IMPLAN uses a general input-output model that uses secondary data from the Bureau of Economic Analysis (BEA), Bureau of Labor Statistics (BLS), and Census. The main difference between a general equilibrium model, which the input-output model is derived from, and a partial equilibrium model is that, unlike a partial equilibrium model that focuses only on one industry, the general equilibrium model captures all monetary market transactions between industries. Among four main sources of commercial input-output-based tools, IMPLAN is best equipped to handle modeling multiple regions as well as smaller regions (Khalaf, Jolley, and Clouse, 2021).¹

KEY DEFINITIONS: The economic impact is derived directly through a firm or industry operation called the direct effect. When a firm buys goods and services from another local firm, the latter firm pays its employees in wages and makes subsequent purchases to additional firms. In an input-output model, the impacts generated by these activities are referred to as indirect effects. These firms in turn make purchases of goods and services from other firms, and so on. In other words, the indirect effect is generated through the supply chain and supporting industries' operations. In addition to direct and indirect effects, employees of these simulated firms will spend their wages on other industries in the region, which also creates ripple effects on the region's economy. These additional ripple effects are referred to as induced effects. In other words, the induced effect is the

¹ For more information, see Khalaf, C., Jolley, G. J., & Clouse, C. (2021). The Economic Impact of Small Colleges on Local Economies: A Guide to Attainable Data and Best Practices. Economic Development Quarterly, 08912424211033655.

economic impact through local re-spending of income by direct and indirect employees. The total effect is the summation of direct, indirect, and induced effects. As a result, each initial dollar spent on activities supporting the operations and construction of firms may be circulated several times within the region.

KEY DEFINITIONS: The economic impact is derived directly through a firm or industry operation called the direct effect. When a firm buys goods and services from another local firm, the latter firm pays its employees in wages and makes subsequent purchases to additional firms. In an input-output model, the impacts generated by these activities are referred to as indirect effects. These firms in turn make purchases of goods and services from other firms, and so on. In other words, the indirect effect is generated through the supply chain and supporting industries' operations. In addition to direct and indirect effects, employees of these simulated firms will spend their wages on other industries in the region, which also creates ripple effects on the region's economy. These additional ripple effects are referred to as induced effects. In other words, the induced effect is the economic impact through local re-spending of income by direct and indirect employees. The total effect is the summation of direct, indirect, and induced effects. As a result, each initial dollar spent on activities supporting the operations and construction of firms may be circulated several times within the region.

The concept of multipliers derived from input-output tables is the key to economic impact analyses. The Multiplier is the ratio of the "Total Effect" to the "Direct Effect". In other words, multipliers measure the ripple effect of a change (or contribution) of an industry (or firm) in a region. For instance, the employment multiplier equals 1.34 in the hydrogen production facility, indicating that for every three jobs in a hydrogen production facility, the facility would support one additional full-time job in related industries. When it comes to Labor income, value added and output multipliers, instead of discussing the number, they need to be interpreted as the dollar value. For instance, an output multiplier of 1.48 implies that each dollar supporting the operations of the hydrogen production facility will generate an additional 48 cents for the regional economy. IMPLAN reports an economic impact analysis of activities through several economic indicators. Employment is the total annual average number of jobs, including all full-time, part-time, and seasonal workers. Labor Income is composed of both the wages and benefits paid to employees and the profits earned by self-employed people. Value Added (or Gross Regional Product) is the combination of Labor Income plus corporate profits, interest income, rental payments, sales tax, excise tax, property tax, fees, fines, and licenses. Finally, the output is the combination of Value Added plus the materials and services (other than employment) required by an industry to create its products.

IMPLAN ASSUMPTIONS: IMPLAN is built based on the input-output model. Thus, its assumptions follow the input-output model assumptions, which include a constant return to scale, fixed input structure, industry homogeneity, no supply constraints, fixed technology, constant byproduct coefficients, static model, measuring only backward linkages, and an unclear time dimension for the region to settle at its new equilibrium after the change.²

In this report, the researchers report two sets of economic impacts for each activity: 1) the economic impacts of the operations phase of the activity; 2) the economic impacts of the construction phase of the activity. While the economic impact of the operation phase is on an annual basis, the economic impact of the construction phase occurs only one time (during the construction period). Therefore, impacts will be reported in 2022 dollars but will be calculated using 2019 data. While IMPLAN has recently included 2020 data, this was an uncommon year due to the COVID-19 pandemic and can be viewed as an outlier.

WORKFORCE OVERVIEW: Researchers include a workforce analysis for each project's operations and construction phases. Workforce analysis is essential for identifying skill and occupational gaps between current and future employment needs. These analyses are organized by occupation title, retrieved from the nationally expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES). The Workforce analysis report includes the top ten largest occupations by representation within an industry (when possible). Each Workforce table displays total Ohio jobs for each occupation, which are reported from the Bureau of Labor Statistics' May 2021 State Occupational Employment and Wage Estimates data for Ohio. These numbers are then rounded, which may lead to percentages of project sums being less than 100, and sums of occupations being less than the total number of jobs.

² For more information see <https://support.implan.com/hc/en-us/articles/115009505587-Detailed-Key-Assumptions-of-IMPLAN-Input-Output-Analysis>

ECONOMIC IMPACT ANALYSIS FOR PROPOSED

500 METRIC TONS OF HYDROGEN PER DAY (METHANE REFORMER)

PROJECT SIMULACRUM: Nutrien, Lima, Ohio

PROJECT STUDY AREA: Ohio Valley Regional Development Commission region: Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

Activity 1: 500 Metric Tons of Hydrogen per Day

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	394.00	\$22,395,579	\$22,787,284	\$45,884,621
Indirect Effect	48.07	\$3,153,449	\$4,979,151	\$9,930,932
Induced Effect	86.72	\$3,547,331	\$6,954,034	\$12,317,024
Total Effect	528.79	\$29,096,359	\$34,720,469	\$68,132,577
Multiplier	1.34	1.30	1.52	1.48

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	74.00	\$13,878,136	\$40,019,541	\$110,799,421
Indirect Effect	121.10	\$11,598,780	\$21,497,384	\$41,903,262
Induced Effect	80.84	\$3,310,174	\$6,487,627	\$11,488,160
Total Effect	275.95	\$28,787,091	\$68,004,552	\$164,190,843
Multiplier	3.73	2.07	1.70	1.48

FINDINGS:

- During the construction period, IMPLAN estimates a 500 metric tons of hydrogen per day project would create:
 - 529 total annual jobs;
 - \$29,096,359 in total value paid to local workers;
 - \$34,720,469 in industry's contribution to regional GDP;
 - \$68,132,577 in industry sales.
- During the operational period, IMPLAN estimates a 500 metric tons of hydrogen per day project would create:
 - 276 total annual jobs;
 - \$28,787,091 in total value paid to local workers;
 - \$68,004,552 in industry's contribution to regional GDP;
 - \$164,190,843 in industry sales.

FOOTNOTE: The employment needed for the operations phase is based on Nutrien in Lima, Ohio. The researchers adjusted the number of jobs based on the proposed facility capacity.

Employment needed for the construction phase is based on a report of new construction of an ammonia facility in Pennsylvania. The researchers adjusted the number of jobs based on the proposed facility's capacity.

WORKFORCE ANALYSIS FOR PROPOSED

500 METRIC TONS OF HYDROGEN PER DAY (METHANE REFORMER)

CONSTRUCTION			
Occupation	Total Ohio Workforce	Percentage of Project	Construction Jobs
Construction and Extraction Occupations	171,950	55.41	218
Management Occupations	278,880	14.61	58
Business and Financial Operations Occupations	319,410	8.91	35
Office and Administrative Support Occupations	674,570	8.43	33
Architecture and Engineering Occupations	87,420	3.57	14
Installation, Maintenance, and Repair Occupations	203,870	2.77	11
Transportation and Material Moving Occupations	508,580	1.96	8
Production Occupations	466,570	1.61	6
Sales and Related Occupations	457,930	0.94	4
Building and Grounds Cleaning and Maintenance Occupations	141,740	0.59	2
OPERATIONS			
Occupation	Total Ohio Workforce	Percentage of Project	Operations Jobs
Production Occupations	466,570	43.46	32
Installation, Maintenance, and Repair Occupations	203,870	8.72	6
Architecture and Engineering Occupations	87,420	8.19	6
Office and Administrative Support Occupations	674,570	7.64	6
Management Occupations	278,880	7.5	6
Life, Physical, and Social Science Occupations	34,740	7.43	5
Transportation and Material Moving Occupations	508,580	6.69	5
Business and Financial Operations Occupations	319,410	4.92	4
Sales and Related Occupations	457,930	2.44	2
Computer and Mathematical Occupations	162,510	1.35	1

FOOTNOTE: Underlying industry, occupation, and employment data are derived using nationally and state expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES) survey and 2020 Industry-occupation matrix data, by industry tables. Occupations that constitute less than 0.1 percent of the industry, have fewer than 50 jobs, are confidential, or include poor quality data are not displayed. Post analysis occupations that constitute less than 1 percent of any particular project and account for less than 1 job are omitted. Jobs numbers are then rounded. These compounding suppression effects cause the percentages to add to less than 100 and the sum of occupations to be less than the total number of jobs.

Total Ohio Workforce shows the total number of employees in each occupation in Ohio in 2021.

Percentage of Project shows the percent of jobs in the hydrogen production facility that will be employed by each occupation in the U.S.

Operation Jobs shows the total number of employees that are directly created by the hydrogen production facility in each occupation assuming the percentage of employees in each occupation in Ohio follows the U.S.

ECONOMIC IMPACT ANALYSIS FOR PROPOSED

2,014 METRIC TONS OF OXYGEN PER DAY (FROM AIR SEPARATION UNIT)

PROJECT SIMULACRUM: Pengerang Gas Solutions Sdn. Bhd (PGSSB), a joint venture between Petronas Gas Bhd and Linde Johor, Malaysia

PROJECT STUDY AREA: Ohio Valley Regional Development Commission region: Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

Activity 2: 2,014 Metric Tons of Oxygen per Day

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	222.00	\$12,618,829	\$12,839,536	\$25,853,771
Indirect Effect	27.08	\$1,776,881	\$2,805,601	\$5,595,762
Induced Effect	48.86	\$1,998,809	\$3,918,378	\$6,940,264
Total Effect	297.95	\$16,394,519	\$19,563,515	\$38,389,798
Multiplier	1.34	1.30	1.52	1.48

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	41.00	\$3,849,966	\$10,448,851	\$38,889,476
Indirect Effect	55.16	\$3,854,593	\$9,063,911	\$19,018,959
Induced Effect	24.33	\$996,503	\$1,952,887	\$3,457,835
Total Effect	120.49	\$8,701,062	\$21,465,649	\$61,366,270
Multiplier	2.94	2.26	2.05	1.58

FINDINGS:

- During the construction period, IMPLAN estimates a 2,014 metric tons of oxygen per day project would create:
 - 298 total annual jobs;
 - \$16,394,519 in total value paid to local workers;
 - \$19,563,515 in industry's contribution to regional GDP;
 - \$38,389,798 in industry sales.
- During the operational period, IMPLAN estimates a 2,014 metric tons of oxygen per day project would create:
 - 120 total annual jobs;
 - \$8,701,062 in total value paid to local workers;
 - \$21,465,649 in industry's contribution to regional GDP;
 - \$61,366,270 in industry sales.

FOOTNOTE: The employment needed for the operations phase is based on Pengerang Gas Solutions Sdn. Bhd (PGSSB), a joint venture between Petronas Gas Bhd and Linde Johor, Malaysia. The researchers adjusted the number of jobs based on the proposed facility capacity.

Researchers calculated the employment needed for the construction phase based on the assumption that the hydrogen production facility has a similar production function as the construction of an oxygen production facility.

WORKFORCE ANALYSIS FOR PROPOSED

2,014 METRIC TONES OF OXYGEN PER DAY (FROM AIR SEPARATION UNIT)

CONSTRUCTION			
Occupation	Total Ohio Workforce	Percentage of Project	Construction Jobs
Construction and Extraction Occupations	171,950	55.41	123
Management Occupations	278,880	14.61	32
Business and Financial Operations Occupations	319,410	8.91	20
Office and Administrative Support Occupations	674,570	8.43	19
Architecture and Engineering Occupations	87,420	3.57	8
Installation, Maintenance, and Repair Occupations	203,870	2.77	6
Transportation and Material Moving Occupations	508,580	1.96	4
Production Occupations	466,570	1.61	4
Sales and Related Occupations	457,930	0.94	2
Building and Grounds Cleaning and Maintenance Occupations	141,740	0.59	1
OPERATIONS			
Occupation	Total Ohio Workforce	Percentage of Project	Operations Jobs
Production Occupations	466,570	43.46	17.8
Installation, Maintenance, and Repair Occupations	203,870	8.72	3.6
Architecture and Engineering Occupations	87,420	8.19	3.4
Office and Administrative Support Occupations	674,570	7.64	3.1
Management Occupations	278,880	7.5	3.1
Life, Physical, and Social Science Occupations	34,740	7.43	3.0
Transportation and Material Moving Occupations	508,580	6.69	2.7
Business and Financial Operations Occupations	319,410	4.92	2.0
Sales and Related Occupations	457,930	2.44	1.0
Computer and Mathematical Occupations	162,510	1.35	0.6

FOOTNOTE: Underlying industry, occupation, and employment data are derived using nationally and state expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES) survey and 2020 Industry-occupation matrix data, by industry tables. Occupations that constitute less than 0.1 percent of the industry, have fewer than 50 jobs, are confidential, or include poor quality data are not displayed. Post analysis occupations that constitute less than 1 percent of any particular project and account for less than 1 job are omitted. Jobs numbers are then rounded. These compounding suppression effects cause the percentages to add to less than 100 and the sum of occupations to be less than the total number of jobs.

Total Ohio Workforce shows the total number of employees in each occupation in Ohio.

Percentage of Project shows the percent of jobs in the oxygen production facility that will be employed by each occupation in the U.S.

Operation Jobs shows the total number of employees that are directly created by the oxygen production facility in each occupation assuming the percentage of employees in each occupation in Ohio follows the U.S.

ECONOMIC IMPACT ANALYSIS FOR PROPOSED

4,240 METRIC TONS OF CARBON SEQUESTRATION PER DAY (CO₂)

PROJECT SIMULACRUM: Port Arthur Hydrogen Production Facility (Air Products), Port Arthur, TX

PROJECT STUDY AREA: Ohio Valley Regional Development Commission region: Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

Activity 3: 4,100 metric tons of carbon sequestration per day (CO₂)

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	259	\$14,729,479	\$16,136,829	\$39,032,099
Indirect Effect	58.5	\$3,477,990	\$5,624,161	\$10,781,679
Induced Effect	61.98	\$2,535,347	\$4,970,218	\$8,803,357
Total Effect	379.48	\$20,742,816	\$26,731,208	\$58,617,136
Multiplier	1.47	1.41	1.66	1.50

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	5.00	\$21,676,189	\$22,083,679	\$23,522,854
Indirect Effect	6.19	\$332,711	\$510,197	\$1,005,676
Induced Effect	80.91	\$3,303,486	\$6,478,879	\$11,480,744
Total Effect	92.1	\$25,312,385	\$29,072,755	\$36,009,274
Multiplier	18.42	1.17	1.32	1.53

FINDINGS:

- During the construction period, IMPLAN estimates a 4,240 metric tons of CO₂ per day project would create:
 - 379 total annual jobs;
 - \$20,742,816 in total value paid to local workers;
 - \$26,731,208 in industry's contribution to regional GDP;
 - \$58,617,136 in industry sales.
- During the operational period, IMPLAN estimates a 4,240 metric tons of CO₂ per day project would create:
 - 92 total annual jobs;
 - \$25,312,385 in total value paid to local workers;
 - \$29,072,755 in industry's contribution to regional GDP;
 - \$36,009,274 in industry sales.

FOOTNOTE: The employment needed for the carbon sequestration facility's operations and construction phases is provided by Newpoint Gas, LLC.

The employment multiplier for the operations phase is larger than usual. While there could be several explanations for that, the main driver of the large employment multiplier for a carbon sequestration facility might be that a pipeline transportation industry does not buy a lot of inputs to create its output.

WORKFORCE ANALYSIS FOR PROPOSED

4,240 METRIC TONS OF CARBON SEQUESTRATION PER DAY (CO₂)

CONSTRUCTION			
Occupation	Total Ohio Workforce	Percentage of Project	Construction Jobs
Construction and Extraction Occupations	171,950	58.72	152
Transportation and Material Moving Occupations	508,580	7.85	20
Management Occupations	278,880	7.71	20
Office and Administrative Support Occupations	674,570	6.41	17
Installation, Maintenance, and Repair Occupations	203,870	5.00	13
Business and Financial Operations Occupations	319,410	4.68	12
Production Occupations	466,570	3.40	9
Architecture and Engineering Occupations	87,420	3.06	8
Building and Grounds Cleaning and Maintenance Occupations	141,740	1.10	3
Sales and Related Occupations	457,930	0.55	1
OPERATIONS			
Occupation	Total Ohio Workforce	Percentage of Project	Operations Jobs
Production Occupations	466,570	31.62	1.6
Installation, Maintenance, and Repair Occupations	203,870	17.26	0.9
Transportation and Material Moving Occupations	508,580	8.58	0.4
Architecture and Engineering Occupations	87,420	7.89	0.4
Management Occupations	278,880	7.84	0.4
Business and Financial Operations Occupations	319,410	7.69	0.4
Construction and Extraction Occupations	171,950	7.26	0.4
Office and Administrative Support Occupations	674,570	5.88	0.3
Computer and Mathematical Occupations	162,510	2.87	0.1
Life, Physical, and Social Science Occupations	34,740	1.56	0.1

FOOTNOTE: Underlying industry, occupation, and employment data are derived using nationally and state expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES) survey and 2020 Industry-occupation matrix data, by industry tables. Occupations that constitute less than 0.1 percent of the industry, have fewer than 50 jobs, are confidential, or include poor quality data are not displayed. Post analysis occupations that constitute less than 1 percent of any particular project and account for less than 1 job are omitted. Jobs numbers are then rounded. These compounding suppression effects cause the percentages to add to less than 100 and the sum of occupations to be less than the total number of jobs.

Total Ohio Workforce shows the total number of employees in each occupation in Ohio.

Percentage of Project shows the percent of jobs in the carbon sequestration facility that will be employed by each occupation in the U.S.

Operation Jobs shows the total number of employees that are directly created by the carbon sequestration facility in each occupation assuming the percentage of employees in each occupation in Ohio follows the U.S.

ECONOMIC IMPACT ANALYSIS FOR PROPOSED

350 METRIC TONS OF AMMONIA PER DAY

PROJECT SIMULACRUM: Nutrien's facility in Lima, Ohio

PROJECT STUDY AREA: Ohio Valley Regional Development Commission region: Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

Activity 4: 350 Metric Tons of Ammonia per Day

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	250.00	\$14,210,392	\$14,458,936	\$29,114,607
Indirect Effect	30.50	\$2,000,919	\$3,159,359	\$6,301,352
Induced Effect	55.03	\$2,250,844	\$4,412,458	\$7,815,370
Total Effect	335.52	\$18,462,156	\$22,030,754	\$43,231,330
Multiplier	1.34	1.30	1.52	1.48

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	9.00	\$1,687,881	\$4,867,241	\$13,475,605
Indirect Effect	14.73	\$1,410,662	\$2,614,546	\$5,096,342
Induced Effect	9.83	\$402,588	\$789,035	\$1,397,208
Total Effect	33.56	\$3,501,132	\$8,270,823	\$19,969,156
Multiplier	3.73	2.07	1.70	1.48

FINDINGS:

- During the construction period, IMPLAN estimates a 350 metric tons of biomass per day project would create:
 - 336 total annual jobs;
 - \$18,462,156 in total value paid to local workers;
 - \$22,030,754 in industry's contribution to regional GDP;
 - \$43,231,330 in industry sales.
- During the operational period, IMPLAN estimates a 350 metric tons of biomass per day project would create:
 - 34 total annual jobs;
 - \$3,501,132 in total value paid to local workers;
 - \$8,270,823 in industry's contribution to regional GDP;
 - \$19,969,156 in industry sales.

FOOTNOTE: The employment needed for the operations phase is based on Nutrien's facility in Lima, Ohio. The researchers adjusted the number of jobs based on the proposed facility capacity.

Employment needed for the construction phase is based on a report of new construction of an ammonia facility in Pennsylvania. The researchers adjusted the number of jobs based on the proposed facility's capacity.

WORKFORCE ANALYSIS FOR PROPOSED

350 METRIC TONS OF AMMONIA PER DAY

CONSTRUCTION			
Occupation	Total Ohio Workforce	Percentage of Project	Construction Jobs
Construction and Extraction Occupations	171,950	55.41	139
Management Occupations	278,880	14.61	37
Business and Financial Operations Occupations	319,410	8.91	22
Office and Administrative Support Occupations	674,570	8.43	21
Architecture and Engineering Occupations	87,420	3.57	9
Installation, Maintenance, and Repair Occupations	203,870	2.77	7
Transportation and Material Moving Occupations	508,580	1.96	5
Production Occupations	466,570	1.61	4
Sales and Related Occupations	457,930	0.94	2
Building and Grounds Cleaning and Maintenance Occupations	141,740	0.59	1
OPERATIONS			
Occupation	Total Ohio Workforce	Percentage of Project	Operations Jobs
Production Occupations	466,570	43.46	3.9
Installation, Maintenance, and Repair Occupations	203,870	8.72	0.8
Architecture and Engineering Occupations	87,420	8.19	0.7
Office and Administrative Support Occupations	674,570	7.64	0.7
Management Occupations	278,880	7.5	0.7
Life, Physical, and Social Science Occupations	34,740	7.43	0.7
Transportation and Material Moving Occupations	508,580	6.69	0.6
Business and Financial Operations Occupations	319,410	4.92	0.4
Sales and Related Occupations	457,930	2.44	0.2
Computer and Mathematical Occupations	162,510	1.35	0.1

FOOTNOTE: Underlying industry, occupation, and employment data are derived using nationally and state expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES) survey and 2020 Industry-occupation matrix data, by industry tables. Occupations that constitute less than 0.1 percent of the industry, have fewer than 50 jobs, are confidential, or include poor quality data are not displayed. Post analysis occupations that constitute less than 1 percent of any particular project and account for less than 1 job are omitted. Jobs numbers are then rounded. These compounding suppression effects cause the percentages to add to less than 100 and the sum of occupations to be less than the total number of jobs.

Total Ohio Workforce shows the total number of employees in each occupation in Ohio.

Percentage of Project shows the percent of jobs in the biofuel production facility that will be employed by each occupation in the U.S.

Operation Jobs shows the total number of employees that are directly created by the ammonia production facility in each occupation assuming the percentage of employees in each occupation in Ohio follows the U.S.

Effect of Integrated System Design and Operation: The hydrogen plant with electrical power generation, air separation unit (2,014 MT/day oxygen), and the carbon sequestration system, and ammonia production are individually assessed and predicted jobs are given. By combining the operations of these individual facilities and their close proximity, significant efficiencies are realized. Staffing for each of these units requires very similar skill sets. Therefore, each unit does not require separate operation and maintenance personnel. The control room can also be integrated so that facility operators and management can safely monitor, optimize, and troubleshoot all three units. Maintenance personnel are also cross trained on each of the units as each requires similar safety training programs, technical expertise, and experience. This type of integration applies to transportation and material moving, management occupations and much more. The overall effect is that the total number of jobs for operations and maintenance of these three units is optimized, requiring approximately the same as for the stand-alone hydrogen power facility. The economic impact analysis of the operational phase of integrated activity is presented below:

The Economic Impact of Integrated System Design

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	74.00	\$13,878,136	\$40,019,541	\$110,799,421
Indirect Effect	121.1	\$11,598,780	\$21,497,384	\$41,903,262
Induced Effect	80.84	\$3,310,174	\$6,487,627	\$11,488,160
Total Effect	275.95	\$28,787,091	\$68,004,552	\$164,190,843
Multiplier	3.73	2.07	1.70	1.48

ECONOMIC IMPACT ANALYSIS FOR PROPOSED

200 METRIC TONS OF SILICON PER DAY

PROJECT SIMULACRUM: Mississippi Silicon facility in Burnsville, Mississippi

PROJECT STUDY AREA: Ohio Valley Regional Development Commission region: Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

Activity 5: 200 Metric Tons of Silicon per Day

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	800.00	\$45,473,257	\$46,268,597	\$93,166,743
Indirect Effect	97.60	\$6,402,942	\$10,109,951	\$20,164,329
Induced Effect	176.08	\$7,202,703	\$14,119,866	\$25,009,186
Total Effect	1,073.68	\$59,078,902	\$70,498,415	\$138,340,258
Multiplier	1.34	1.30	1.52	1.48

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	163.00	\$9,613,622	\$10,578,175	\$22,312,717
Indirect Effect	54.23	\$2,396,081	\$3,412,074	\$6,761,010
Induced Effect	39.09	\$1,600,144	\$3,136,288	\$5,553,968
Total Effect	256.32	\$13,609,847	\$17,126,536	\$34,627,695
Multiplier	1.57	1.42	1.62	1.55

FINDINGS:

- During the construction period, IMPLAN estimates a 200 metric tons of biomass per day project would create:
 - 1,074 total annual jobs;
 - \$59,078,902 in total value paid to local workers;
 - \$70,498,415 in industry's contribution to regional GDP;
 - \$138,340,258 in industry sales.
- During the operational period, IMPLAN estimates a 350 metric tons of biomass per day project would create:
 - 256 total annual jobs;
 - \$13,609,847 in total value paid to local workers;
 - \$17,126,536 in industry's contribution to regional GDP;
 - \$34,627,695 in industry sales.

FOOTNOTE: The employment needed for the operations phase is based on Mississippi Silicon facility in Burnsville, Mississippi. The researchers adjusted the number of jobs based on the proposed facility capacity.

Employment needed for the construction phase is based on a report of construction of Mississippi Silicon facility. The researchers adjusted the number of jobs based on the proposed facility's capacity.

WORKFORCE ANALYSIS FOR PROPOSED

200 METRIC TONS OF SILICON PER DAY

CONSTRUCTION

Occupation	Total Ohio Workforce	Percentage of Project	Construction Jobs
Construction and Extraction Occupations	171,950	55.41	443
Management Occupations	278,880	14.61	117
Business and Financial Operations Occupations	319,410	8.91	71
Office and Administrative Support Occupations	674,570	8.43	67
Architecture and Engineering Occupations	87,420	3.57	29
Installation, Maintenance, and Repair Occupations	203,870	2.77	22
Transportation and Material Moving Occupations	508,580	1.96	16
Production Occupations	466,570	1.61	13
Sales and Related Occupations	457,930	0.94	8
Building and Grounds Cleaning and Maintenance Occupations	141,740	0.59	5

OPERATIONS

Occupation	Total Ohio Workforce	Percentage of Project	Operations Jobs
Life, Physical, and Social Science Occupations	34,740	23.42	38
Architecture and Engineering Occupations	87,420	21.28	35
Production Occupations	466,570	15.64	25
Office and Administrative Support Occupations	674,570	10.89	18
Management Occupations	278,880	9.35	15
Business and Financial Operations Occupations	319,410	5.15	8
Computer and Mathematical Occupations	162,510	3.09	5
Installation, Maintenance, and Repair Occupations	203,870	2.52	4
Construction and Extraction Occupations	171,950	2.21	4
Sales and Related Occupations	457,930	2.01	3

FOOTNOTE: Underlying industry, occupation, and employment data are derived using nationally and state expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES) survey and 2020 Industry-occupation matrix data, by industry tables. Occupations that constitute less than 0.1 percent of the industry, have fewer than 50 jobs, are confidential, or include poor quality data are not displayed. Post analysis occupations that constitute less than 1 percent of any particular project and account for less than 1 job are omitted. Jobs numbers are then rounded. These compounding suppression effects cause the percentages to add to less than 100 and the sum of occupations to be less than the total number of jobs.

Total Ohio Workforce shows the total number of employees in each occupation in Ohio.

Percentage of Project shows the percent of jobs in the biofuel production facility that will be employed by each occupation in the U.S.

Operation Jobs shows the total number of employees that are directly created by the silicon production facility in each occupation assuming the percentage of employees in each occupation in Ohio follows the U.S.

ECONOMIC IMPACT ANALYSIS FOR PROPOSED

COMBINED FIVE ACTIVITIES AND THE INTEGRATED SYSTEM DESIGN

PROJECT STUDY AREA: Ohio Valley Regional Development Commission region: Adams, Brown, Clermont, Fayette, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties.

Activity 7: Summation of All Five Activities

CONSTRUCTION				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,925.00	\$109,427,536	\$112,491,182	\$233,051,841
Indirect Effect	261.75	\$16,812,181	\$26,678,223	\$52,774,054
Induced Effect	428.67	\$17,535,034	\$34,374,954	\$60,885,201
Total Effect	2,615.42	\$143,774,752	\$173,544,361	\$346,711,099
Multiplier	1.34	1.30	1.52	1.48

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	292.00	\$50,705,794	\$87,997,487	\$209,000,073
Indirect Effect	251.41	\$19,592,827	\$37,098,112	\$73,785,249
Induced Effect	235.00	\$9,612,895	\$18,844,716	\$33,377,915
Total Effect	778.42	\$79,911,517	\$143,940,315	\$316,163,238
Multiplier	1.57	1.42	1.62	1.55

FINDINGS:

- During the construction period, IMPLAN estimates a 200 metric tons of biomass per day project

Operations with integrated systems design- This analysis takes advantage of integrated system design and operations. The combining of operations for the hydrogen plant with electrical power generation, air separation unit (2,014 MT/day oxygen), the carbon sequestration system, and ammonia production plus the silicon activities are shown below.

Operations with integrated systems design- This analysis takes advantage of integrated system design and operations. The combining of operations for the hydrogen plant with electrical power generation, air separation unit (2,014 MT/day oxygen), the carbon sequestration system, and ammonia production plus the silicon activities are shown below.

OPERATIONS				
Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	237.00	\$23,491,758	\$50,597,716	\$133,112,138
Indirect Effect	175.33	\$13,994,861	\$24,909,458	\$48,664,272
Induced Effect	119.93	\$4,910,318	\$9,623,915	\$17,042,128
Total Effect	532.27	\$42,396,938	\$85,131,088	\$198,818,538
Multiplier	1.57	1.42	1.62	1.55

FINDINGS:

- During the construction period, IMPLAN estimates all five projects would create:
 - 2,615 total annual jobs;
 - \$143,774,752 in total value paid to local workers;
 - \$173,544,361 in industry's contribution to regional GDP;
 - \$346,711,099 in industry sales.
- During the operational period, IMPLAN estimates all five projects would create:
 - 532.27 total annual jobs;
 - \$42,396,938 in total value paid to local workers;
 - \$85,131,088 in industry's contribution to regional GDP;
 - \$198,818,538 in industry sales.

FOOTNOTE: To report the total impact of the construction and operations phase of all five proposed activities, researchers combined the values listed in each table for five proposed activities. Since the combined impact includes five different activities, the multipliers would not be calculated.

WORKFORCE ANALYSIS FOR PROPOSED

COMBINED FIVE ACTIVITIES AND THE INTEGRATED SYSTEM

CONSTRUCTION		
Occupation	Total Ohio Workforce	Construction Jobs
Construction and Extraction Occupations	171,950	1,075.4
Management Occupations	278,880	264.0
Business and Financial Operations Occupations	319,410	160.0
Office and Administrative Support Occupations	674,570	156.5
Architecture and Engineering Occupations	87,420	67.9
Installation, Maintenance, and Repair Occupations	203,870	59.0
Transportation and Material Moving Occupations	508,580	53.4
Production Occupations	466,570	35.7
Sales and Related Occupations	457,930	17.2
Building and Grounds Cleaning and Maintenance Occupations	141,740	12.5
OPERATIONS		
Occupation	Total Ohio Workforce	Operations Jobs
Production Occupations	466,570	57.2
Life, Physical, and Social Science Occupations	34,740	43.5
Architecture and Engineering Occupations	87,420	41.1
Office and Administrative Support Occupations	674,570	23.7
Management Occupations	278,880	20.6
Business and Financial Operations Occupations	319,410	11.6
Installation, Maintenance, and Repair Occupations	203,870	10.5
Computer and Mathematical Occupations	162,510	6.0
Transportation and Material Moving Occupations	508,580	5.0
Sales and Related Occupations	457,930	4.8

FOOTNOTE: Underlying industry, occupation, and employment data are derived using nationally and state expected averages from the Bureau of Labor Statistics' May 2021 Occupational Employment Statistics (OES) survey and 2020 Industry-occupation matrix data, by industry tables. Occupations that constitute less than 0.1 percent of the industry, have fewer than 50 jobs, are confidential, or include poor quality data are not displayed. Post analysis occupations that constitute less than 1 percent of any particular project and account for less than 1 job are omitted. Jobs numbers are then rounded. These compounding suppression effects cause the percentages to add to less than 100 and the sum of occupations to be less than the total number of jobs.

To report the total impact of the construction and operations phase of all five proposed activities, researchers combined the values listed in each table for five proposed activities.

Since the combined impact includes five different activities, the "percentage of the project" column would not be calculated.

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