

# **NAVAJO GENERATING STATION & KAYENTA MINE**

## ***An Economic Impact Analysis for the Navajo Nation***



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## Executive Summary

- This study estimates the economic impact of Navajo Generating Station (NGS) and Kayenta Mine, individually and jointly, by employment and labor income for the Navajo Nation, and gross Navajo Nation product (GNNP), assuming continuance of current operations through 2044.
- Estimated impacts include both the direct effects of the two facilities’ operations and the indirect and induced effects that arise when income is recycled within the Navajo Nation economy.
- The study uses the latest version of IMPLAN at zip code level to estimate multiplier effects for the Navajo Nation,<sup>1</sup> in conjunction with a Navajo Nation Household Survey implemented by the Seidman Institute in partnership with the Navajo Nation Division of Economic Development in 2012.
- The individual economic impact analyses for NGS and Kayenta Mine for 2020 presented in this study assume that each facility operates independently of the other. The combined economic impact of both the generating station and the mine assumes that NGS and Kayenta Mine operate effectively as a single, combined entity.

**Table 1: Economic Impact of NGS and Kayenta Mine for the Navajo Nation, 2020<sup>2</sup>**

Economic Impacts	Employment (Jobs)	Labor Income (Millions 2020 \$)	GNNP (Millions 2020 \$)
Economic impact of NGS <sup>3</sup>	1,508	123.6	308.5
Economic impact of Kayenta Mine <sup>4</sup>	1,455	113.0	209.2
<b>Combined Economic Impact<sup>5</sup></b>	<b>2,963</b>	<b>236.6</b>	<b>517.6</b>

*Source: L. William Seidman Research Institute, W. P. Carey School of Business, Arizona State University*

<sup>1</sup> The latest IMPLAN version uses a 2011 economic database.

<sup>2</sup> Numbers may not completely tally due to rounding-up.

<sup>3</sup> This assumes NGS operates independently of Kayenta Mine.

<sup>4</sup> This assumes Kayenta Mine operates independently of NGS.

<sup>5</sup> This assumes that NGS and Kayenta Mine is a single, combined entity.

- In 2020, NGS is estimated to generate 1,508 jobs and \$123.6 million in labor income for the Navajo Nation, and \$308.5 million GNNP (both 2020 \$).
- In 2020, Kayenta Mine is estimated to generate 1,455 jobs and \$113.0 million in labor income for the Navajo Nation, and \$209.2 million GNNP (both 2020 \$).
- In 2020, NGS and Kayenta Mine (combined) are estimated to generate 2,963 jobs and \$236.6 million labor income for the Navajo Nation, and \$517.6 million GNNP (both 2020 \$).

**Table 2: Combined Economic Impact of NGS and Kayenta Mine  
for the Navajo Nation, 2020-2044<sup>6</sup>**

<b>Economic Impacts</b>	<b>Employment (Job Years)</b>	<b>Labor Income (Billions 2020 \$)</b>	<b>GNNP (Billions 2020 \$)</b>
Economic impact of NGS <sup>7</sup>	37,695	3.09	7.71
Economic impact of Kayenta Mine <sup>8</sup>	36,385	2.82	5.23
<b>Combined Economic Impact<sup>9</sup></b>	<b>74,081</b>	<b>5.91</b>	<b>12.94</b>

*Source: L. William Seidman Research Institute, W. P. Carey School of Business, Arizona State University*

- From 2020 to 2044, NGS is cumulatively estimated to have an employment impact of 37,695 job years and generate \$3.09 billion labor income for the Navajo Nation. NGS is also cumulatively estimated to generate \$7.71 billion GNNP (both 2020 \$).
- From 2020 to 2044, Kayenta Mine is cumulatively estimated to have an employment impact of up to 36,385 job years and generate \$2.82 billion in labor income for the Navajo Nation. Kayenta Mine is also cumulatively estimated to generate \$5.23 billion GNNP (both 2020 \$).
- From 2020 to 2044, NGS and Kayenta Mine (combined) are cumulatively estimated to have an employment impact of up to 74,081 jobs years and generate \$5.91 billion in labor

<sup>6</sup> Numbers may not completely tally due to rounding-up.

<sup>7</sup> This assumes NGS operates independently of Kayenta Mine.

<sup>8</sup> This assumes Kayenta Mine operates independently of NGS.

<sup>9</sup> This assumes that NGS and Kayenta Mine is a single, combined entity.

income for the Navajo Nation. They are also estimated to cumulatively generate \$12.94 billion GNNP (both 2020 \$).

- Caution should be exercised when comparing results reported in the current study to those reported in an earlier Seidman REMI study dated February 2012<sup>10</sup> for four reasons:
  - The geographic areas examined by both reports are very different. The 2012 report was concerned with the economic effects for Coconino County, Navajo County and the State of Arizona as a whole. The current study examines the economic effects exclusively for the Navajo Nation.
  - The use of different economic modeling software will yield different results, despite the use of broadly similar inputs. The current study uses IMPLAN while the original 2012 study used REMI.
  - Several modifications have been made to the latest modeling, including the regional purchase coefficients (RPCs) and trade flows based on the consumption patterns identified in the household expenditure survey. This has resulted in a greater use of detailed local information in the current study, compared to the REMI 2012 study.
  - The REMI 2012 study did not include the Navajo Nation as a government entity. As a result, the impact of NGS and Kayenta Mine payments to the Navajo Nation were not evaluated in the original study.

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<sup>10</sup> *Navajo Generating Station and Kayenta Mine: An Economic Impact Study* (February 2012), Dr. Matthew Croucher, Dr. Anthony Evans and Dr. Timothy James, Seidman Research Institute.

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## 1. Introduction

Navajo Generating Station (NGS) is a coal-fired power plant serving electric customers in Arizona, Nevada and California, and energy to pump water through the Central Arizona Project. Located on the Navajo Indian Reservation near Page, AZ., the station's first unit began producing electricity in 1974, and currently has a capacity of 2,250MW from three 750MW units. NGS annually uses 8 million tons of low sulfur bituminous coal from Peabody Western Coal Company's Kayenta Mine, 78 miles to the southeast, which is hauled to the station by the Black Mesa and Lake Powell Railroad.

To minimize its environmental impact, NGS has invested over \$420 million in sulfur dioxide (SO<sub>2</sub>) scrubbers, and a further \$45 million to reduce nitrous oxide (NO<sub>x</sub>) emissions. NGS also implements a waste minimization program. However, over the past 18 months, the power plant has faced a number of difficult issues that threaten its future viability. These have included:

- The need to extend the site lease and rights-of-way for the NGS plant, railroad, transmission, and water lines beyond 2019.
- The need to also extend the Coal Supply Agreement with Peabody Energy beyond 2019.
- A January 2013 proposed rule from the Environmental Protection Agency to install additional emission control technology at NGS as early as 2023, potentially costing in excess of \$1.1 billion.

In fall 2011, prior to the EPA ruling, SRP and the Navajo Nation commissioned The Seidman Research Institute, W. P. Carey School of Business at ASU, to investigate the economic impact of Navajo Generating Station (NGS) and Kayenta Mine. The primary purpose of this commission was to assist with the lease and right of way negotiations. The resulting 2012 study used secondary data in a REMI economic impact model to estimate the direct, indirect and induced effects of NGS and Kayenta Mine individually and in aggregate for Coconino County, Navajo County and the State of Arizona for the period 2011-2044.

Seidman's independent 2012 report concluded that during the period 2011-2044, the operation of both facilities could account for approximately 112,720 full-time or equivalent jobs years throughout the State of Arizona, including 32,912 direct job years. Real gross state product for NGS and Kayenta Mine combined during 2011-2044 would be higher relative to the baseline (of no operations at NGS and Kayenta Mine) by almost \$20.5 billion (2011 \$) throughout the state, and real disposable personal income would be higher relative to the baseline by over \$11 billion (2011 \$).

However, when the results were presented to Navajo Nation and SRP representatives in January 2012, a request was made to exclusively quantify the impacts for the Navajo Nation. The REMI model used for the original state and county economic impact study does not allow for this type of custom geographic analysis. The current study therefore uses IMPLAN data for 57 zip codes collectively assumed by Seidman to represent the Navajo Nation, supplemented by household expenditure survey data,<sup>11</sup> to estimate the impact of NGS and Kayenta Mine exclusively for the Navajo Nation.

The objectives of this study are to:

- Individually quantify the *direct* economic impacts and *indirect/induced* effects of NGS and the Kayenta Mine exclusively for the Navajo Nation in 2020.
- Calculate the total contribution of NGS and Kayenta Mine (combined) to the Navajo Nation economy in 2020.
- Estimate the total impact of NGS and Kayenta Mine (combined) exclusively for the Navajo Nation, 2020-2044.

Estimated impacts in the current report include the direct effects of NGS and Kayenta Mine's operations, and the indirect and induced effects that arise when income is recycled within the Navajo Nation's economy. Any impacts extending beyond the Navajo Nation's borders, or involving non-Navajo workers, vendors, state and federal governments, are excluded from the analyses.

Section 2 summarizes the method and the primary data used in the calculations.

Sections 3 and 4 present the estimates of the impact of NGS and Kayenta Mine's operations individually on the Navajo Nation's economy in 2020.

Section 5 estimates the combined contribution of NGS and Kayenta Mine for the Navajo Nation economy in 2020.

Section 6 concludes with some comments about the robustness of IMPLAN analysis and the total economic impact of NGS and Kayenta Mine for the period 2020-2044 (expressed in 2020 \$). Section 6 also states the need for caution when making comparisons with the 2012 study.

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<sup>11</sup> Seidman's Navajo Nation Household Expenditure Survey was conducted between July 2012 and December 2012 at over 200 households. The purpose of this survey was to understand the extent to which Navajo residents spent their income within the Nation, plus leakages outside the Nation.



## 2. Data and Method

Economic impact analysis traces the full impact - direct, indirect and induced - of an economic activity on jobs and incomes in a defined economy. Operations at companies such as NGS and Kayenta Mine directly affect an economy through the jobs provided to company workers. Indirect effects arise when a company makes purchases from suppliers to support its operation. Induced effects occur when workers either directly or indirectly associated with the operations spend their incomes in the local economy, when suppliers place upstream demands on other producers, and when governments spend new tax revenues. The cumulative changes in jobs and incomes are a multiple of the initial direct effects.

Economic impacts in this study are estimated using zip code modules from the latest version of IMPLAN,<sup>12</sup> an input-output model developed and maintained by the Minnesota IMPLAN Group, Inc., amended in line with a Navajo Nation Household Expenditure Survey conducted by the Seidman Research Institute. The economic impacts are measured by three variables:

- **Employment:** this is a count of full- and part-time jobs. It includes both wage and salary workers, and the self-employed.
- **Labor Income:** this includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income.
- **Gross Navajo Nation Product (GNNP):** this is synonymous with value added, and is usually referred to as Gross State Product (GSP) or Gross Domestic Product (GDP). It represents the dollar value of all goods and services produced for final demand in the Navajo Nation. It excludes the value of intermediate goods and services purchased as inputs to final production. It can also be defined as the sum of employee compensation (wages, salaries and benefits, including employer contributions to health insurance and retirement pensions), proprietor income, property income, and indirect business taxes.

Primary company-level data is provided by SRP and Peabody Energy for total wage and salary payments, benefits, and employment at NGS and Kayenta Mine. SRP and Peabody Energy also provided a complete record of payments made to suppliers for goods and services, and taxes and royalties paid to federal, state, tribal, and local governments. The data used is for the year 2020. All monetary amounts in this report are expressed in 2020 dollars (2020 \$).

A technical appendix at the end of this report provides additional details on the data and estimation procedures used in this analysis.

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<sup>12</sup> The latest IMPLAN model uses a 2011 survey of the economy.

### 3. Economic Impact of NGS for the Navajo Nation, 2020

In 2020, NGS is forecast to employ 538 workers, of which 446 are Navajo in origin.<sup>13</sup> Total wages and salaries are estimated at \$62.3 million, including \$50.1 million paid to Navajo workers (both 2020 \$). When health and retirement benefits and government social insurance are included, the total employee compensation in 2020 is estimated at \$81.7 million, including \$65.7 million for Navajo workers (both 2020 \$).

NGS also makes significant contributions to the local economy through the purchase of goods and services from local suppliers. Based on the 2011 supplier purchase profile, total NGS transactions with Navajo Nation-based vendors (excluding coal purchases) is forecast at approximately \$5.7 million in 2020.<sup>14</sup>

Table 3 summarizes the total economic impact of NGS for the Navajo Nation in 2020, based on the assumption that NGS operates independently of Kayenta Mine.

The first line of the table estimates the direct contribution of NGS operations to employment, labor income in the Navajo Nation for 2020, and GNNP. These direct effects in 2020 are estimated at 446 jobs, \$65.7 million labor income, and \$230.5 million GNNP.

The second line of Table 3 shows the indirect impacts that could be generated in the Navajo Nation economy because of NGS's 2020 vendor purchases. In purchasing \$5.7 million of non-coal goods and services from Navajo Nation-based suppliers, NGS in 2020 could indirectly generate 25 jobs, create \$1.2 million labor income, and \$2.8 million GNNP.

In economic impact analysis, estimates are also made of the induced effects that arise when workers either directly or indirectly associated with a company's operations spend a portion of their incomes in the state, and when first-tier suppliers place upstream demands on other producers. These effects are shown on lines three and four of Table 3.

The third line of Table 3 estimates the potential induced effects associated with the consumer spending of NGS employees in 2020: 142 jobs, \$5.3 million labor income, and \$10.7 million GNNP.

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<sup>13</sup> This is the current 2012 employment level and number of Navajo workers.

<sup>14</sup> Coal purchases from Peabody Energy are excluded from the supplier expenditure to demonstrate the impact of NGS separate to Kayenta Mine. The \$5.7 million (2020 \$) supplier expenditure also includes a payment to NTUA in lieu of supplying power to the Railroad.

**Table 3: Economic Impact of NGS for the Navajo Nation, 2020<sup>15</sup>**

<b>Economic Impacts</b>	<b>Employment (Jobs)</b>	<b>Labor Income (Millions 2020 \$)</b>	<b>GNNP (Millions 2020 \$)</b>
Direct effects from NGS' operations	446	65.7	230.5
Indirect effects from NGS' supplier purchases	25	1.2	2.8
Induced effects from consumer spending by NGS employees	142	5.3	10.7
Induced effects related to NGS' supplier purchases	8	0.4	0.8
Induced effects from spending of Navajo Nation tax revenues	887	51.1	63.6
<b>Total Economic Impact</b>	<b>1,508</b>	<b>123.6</b>	<b>308.5</b>

*Source: L. William Seidman Research Institute, W. P. Carey School of Business, Arizona State University*

The fourth line of Table 3 shows the potential induced effects stemming from NGS supplier purchases in 2020: 8 jobs, \$0.4 million labor income, and \$0.8 million GNNP. These could arise when the local vendors engage in additional local spending.

NGS in 2020 is estimated to generate approximately \$52.2 million (2020 \$) in additional payments, lease payments, and a scholarship fund for the Navajo Nation.<sup>16</sup> The spending of these 2020 tax dollars could be responsible for 887 jobs and \$51.1 million labor income in the Navajo Nation, and \$63.6 million GNNP.

The total impact of NGS operations on the Navajo Nation economy in 2020 could therefore be 1,508 jobs, \$123.6 million labor income, and \$308.5 million GNNP.

<sup>15</sup> Numbers may not completely tally due to rounding-up.

<sup>16</sup> A total estimate was initially by SRP in 2011 \$, and transformed into 2020 \$ using IMPLAN's CPI forecast for future years. A full breakdown of these figures is not possible due to commercial sensitivities.

#### 4. Economic Impact of Kayenta Mine for the Navajo Nation, 2020

In 2020, Kayenta Mine is forecast to employ 432 workers, of which 411 are Native American in origin.<sup>17</sup> Total wages and salaries are estimated at \$45.2 million, including \$42.1 million paid to Navajo workers (both 2020 \$). When health and retirement benefits and government social insurance are included, the total employee compensation in 2020 is estimated at \$64.3 million, including \$60.3 million for Navajo workers (both 2020 \$).

Kayenta Mine also makes significant contributions to the local economy through the purchase of goods and services from local suppliers. Based on the 2011 supplier purchase profile, total Kayenta Mine transactions with Navajo Nation-based vendors is forecast at approximately \$27.7 million in 2020.

Table 4 summarizes the total economic impact of Kayenta Mine for the Navajo Nation in 2020, based on the assumption that Kayenta Mine operated independently of NGS.

**Table 4: Economic Impact of Kayenta Mine for the Navajo Nation, 2020<sup>18</sup>**

<b>Economic Impacts</b>	<b>Employment (Jobs)</b>	<b>Labor Income (Millions 2020 \$)</b>	<b>GNNP (Millions 2020 \$)</b>
Direct effects from Kayenta Mine's operations	411	60.3	131.8
Indirect effects from Kayenta Mine's supplier purchases	209	7.3	15.8
Induced effects from consumer spending by Kayenta Mine employees	119	4.4	9.0
Induced effects related to Kayenta Mine's supplier purchases	30	1.4	3.4
Induced effects from spending of Navajo Nation tax revenues	686	39.5	49.2
<b>Total Economic Impact</b>	<b>1,455</b>	<b>113.0</b>	<b>209.2</b>

*Source: L. William Seidman Research Institute, W. P. Carey School of Business, Arizona State University*

<sup>17</sup> This is the current 2012 employment level and number of Native American workers. For the purpose of this analysis, all Native American workers are assumed to be Navajo.

<sup>18</sup> Numbers may not completely tally due to rounding-up.

The first line of Table 4 provides estimates of the direct contribution of Kayenta Mine operations to employment and labor income for the Navajo Nation in 2020, and GNNP. These direct effects could be 411 jobs, \$60.3 million labor income, and \$131.8 million GNNP.

The second line of Table 4 estimates the indirect impacts that could be generated in the Navajo Nation economy because of Kayenta Mine's 2020 vendor purchases. In purchasing \$27.7 million of goods and services from Navajo Nation-based suppliers, Kayenta Mine could in 2020 indirectly generate 209 jobs, \$7.3 million labor income, and \$15.8 million GNNP.

The third line of Table 4 estimates the potential induced effects associated with the consumer spending of Kayenta Mine employees in 2020: 119 jobs, \$4.4 million labor income, and \$9.0 million GNNP.

The fourth line of Table 4 estimates the potential induced effects stemming from Kayenta Mine's 2020 supplier purchases: 30 jobs, \$1.4 million labor income, and \$3.4 million GNNP. These effects arise when the local vendors engage in additional local spending.

Kayenta Mine in 2020 is estimated to generate \$39.5 million (2020 \$) in tribal royalties and taxes for the Navajo Nation.<sup>19</sup> The spending of these 2020 tax dollars could be responsible for 686 jobs and \$39.5 million labor income in the Navajo Nation, and \$49.2 million GNNP.

The total impact of Kayenta Mine operations for the Navajo Nation economy in 2020 could therefore be 1,455 jobs, \$113 million labor income, and \$209.2 million GNNP.

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<sup>19</sup> This estimate is derived from data supplied by Peabody Energy in 2011 \$, and transformed into 2020 \$ using IMPLAN's CPI forecast for future years.

## 5. Combined Economic Impact of NGS and Kayenta Mine on the Navajo Nation, 2020

Table 5 estimates the combined economic impact of NGS and Kayenta Mine for the Navajo Nation in 2020. This assumes that NGS and Kayenta Mine operate as a single, combined entity.

The combined employment of both facilities in 2020 is estimated at 970 workers, including 857 employees of Navajo origin.<sup>20</sup> The combined labor income of the Navajo workers alone could be \$126 million (2020 \$). GNNP directly associated with Navajo employees at NGS and Kayenta Mine could be \$362.4 million (2020 \$).

**Table 5: Combined Economic Impact of NGS and Kayenta Mine for the Navajo Nation, 2020<sup>21</sup>**

<b>Economic Impacts</b>	<b>Employment (Jobs)</b>	<b>Labor Income (Millions 2020 \$)</b>	<b>GNNP (Millions 2020 \$)</b>
Direct effects from NGS and Kayenta Mine operations	857	126.0	362.4
Indirect effects from NGS and Kayenta Mine supplier purchases	234	8.6	18.6
Induced effects from consumer spending by NGS and Kayenta Mine employees	261	9.7	19.7
Induced effects related to NGS and Kayenta Mine supplier purchases	38	1.8	4.1
Induced effects from spending of Navajo Nation tax revenues	1,573	90.6	112.8
<b>Total Economic Impact</b>	<b>2,963</b>	<b>236.6</b>	<b>517.6</b>

*Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University*

NGS and Kayenta Mine's 2020 purchases from Navajo Nation-based vendors could amount to approximately \$33.4 million (excluding coal purchases). The indirect employment impacts

<sup>20</sup> This assumes that the 2012 ethnic profile remains constant.

<sup>21</sup> Numbers may not completely tally due to rounding-up.

associated with all Navajo Nation-based vendor purchases in 2020 could be 234 jobs, \$8.6 million labor income, and \$18.6 million GNNP.

The consumer spending of NGS and Kayenta Mine employees in 2020 could generate 261 jobs, \$9.7 million labor income, and \$19.7 million GNNP.

The induced effects stemming from NGS and Kayenta Mine's Navajo Nation-based estimated supplier purchases in 2020 could generate 38 jobs, \$1.8 million labor income, and \$4.1 million GNNP.

NGS and Kayenta Mine are estimated to generate \$91.6 million (2020 \$) in tribal taxes, royalties and payments for the Navajo Nation in 2020. The spending of these dollars could generate 1,573 jobs, \$90.6 million labor income, and \$112.8 million GNNP in that year.

The total impact of the combined operations of NGS and Kayenta Mine for the Navajo Nation economy in 2020 could be 2,963 jobs, \$236.6 million labor income, and \$517.6 million GNNP.

## 6. Combined Economic Impact of NGS and Kayenta Mine for the Navajo Nation, 2020-2044

This study has used an IMPLAN input-output model to estimate the economic impact of NGS and Kayenta Mine, individually and jointly, by GNNP, employment and labor income for the Navajo Nation. The findings are heavily reliant on the reliability of the IMPLAN zip code model, the validity of the Navajo Nation Household Expenditure Survey data, and the quality of the data inputs provided by SRP and Peabody Energy. The impacts described in this report therefore represent estimates based on best available information and assumptions, rather than definitive, actual economic impacts.

An IMPLAN analysis usually provides a snapshot estimate of economic impacts for one year. It is a static, linear model which does not capture the dynamics of how a regional economy might change over time, because it assumes that wage levels, prices, property values, input costs, labor supply, productivity and other key variables remain constant. IMPLAN also fails to take into account how an economy can compensate over time for the loss of a particular business or industry, by attracting new business to the region of study. Nevertheless, Table 6 provides a simplistic, cumulative estimate of the economic impacts of NGS and Kayenta Mine for the Navajo Nation, 2020-2044.<sup>22</sup>

**Table 6: Combined Economic Impact of NGS and Kayenta Mine for the Navajo Nation, 2020-2044<sup>23</sup>**

<b>Economic Impacts</b>	<b>Employment (Job Years)</b>	<b>Labor Income (Billions 2020 \$)</b>	<b>GNNP (Billions 2020 \$)</b>
Economic impact of NGS <sup>24</sup>	37,695	3.09	7.71
Economic impact of Kayenta Mine <sup>25</sup>	36,385	2.82	5.23
<b>Combined Economic Impact<sup>26</sup></b>	<b>74,081</b>	<b>5.91</b>	<b>12.94</b>

*Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University*

<sup>22</sup> The period of study has been suggested by the client, consistent with contractual intentions.

<sup>23</sup> Numbers may not completely tally due to rounding-up.

<sup>24</sup> This assumes NGS operates independently of Kayenta Mine.

<sup>25</sup> This assumes Kayenta Mine operates independently of NGS.

<sup>26</sup> This assumes that NGS and Kayenta Mine is a single, combined entity.



Table 6 suggests that NGS and Kayenta Mine could cumulatively generate over \$5.9 billion labor income for the Navajo Nation, 2020-2044, and over \$12.9 billion GNNP (both 2020 \$). The cumulative employment impact for the same time period could be 74,081 job years in the Navajo Nation.

The label “job year” is important and should not be simplified or abbreviated to “job”. A “job year” is defined as one person having a full-time job for exactly one year. This means, for example, that one NGS employee based at the plant throughout 2020-2044 will account for 25 job years. NGS and Kayenta Mine combined actually generate 857 jobs for Navajos as a result of their electricity generation operation and associated coal production, based on the 2012 ethnicity profile of their employees, which would account for 21,425 of the job years.

The cumulative impacts summarized in Table 6 do not take into account the additional state tax payments made by NGS and Kayenta Mine, or the economic impact of non-Navajo workers and non-Navajo Nation vendor purchases.

Caution should also be exercised in any comparison of these results with those reported in an earlier Seidman REMI study dated February 2012<sup>27</sup> for four reasons:

- The geographic areas examined by both reports are very different. The 2012 report was concerned with the economic effects for Coconino County, Navajo County and the State of Arizona as a whole. The current study examines the economic effects exclusively for the Navajo Nation.
- The use of different economic modeling software will yield different results, despite the use of broadly similar inputs. The current study uses IMPLAN while the original 2012 study used REMI.
- Several modifications have been made to the latest modeling, including the regional purchase coefficients (RPCs) and trade flows based on the consumption patterns identified in the household expenditure survey. This has resulted in a greater use of detailed local information in the current study, compared to the REMI 2012 study.

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<sup>27</sup> *Navajo Generating Station and Kayenta Mine: An Economic Impact Study* (February 2012), Dr. Matthew Croucher, Dr. Anthony Evans and Dr. Timothy James, Seidman Research Institute.

- The original REMI 2012 study did not include the Navajo Nation as a government entity. As a result, the impact of NGS and Kayenta Mine payments to the Navajo Nation were not evaluated in the original study.

This study therefore suggests that NGS and Kayenta Mine exert a significant impact in the economy of the Navajo Nation.

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## Technical Appendix: Data and Economic Impact Method

### *TA1: The IMPLAN model*

Seidman used the IMPLAN economic model to assess the impacts of NGS and Kayenta Mine on the economy of the Navajo Nation.

IMPLAN is maintained and licensed by the Minnesota IMPLAN Group, Inc. (MIG). The IMPLAN model organizes the economy into 440 separate industries and has comprehensive data on every area of the United States. It is widely used by economists to assess impacts of economic activities on the local economy. Version 3.0 of the software was used.

The specific model used by Seidman in this study was based on IMPLAN's 2011 economic database for 57 zip codes, which the authors accepted as a representation of the Navajo Nation. The 57 zip codes represented parts of Apache, Navajo, and Coconino Counties in Arizona; McKinley, San Juan, Cibola, Socorro, and Sandoval Counties in New Mexico; and San Juan County in Utah.

Consultation with the Navajo Nation's Division of Economic Development initially identified 59 zip codes within the Navajo Nation, illustrated in Table 7; and American FactFinder states that most of these 59 zip codes are majority inhabited by members of the Navajo Nation. However there are exceptions:

- Page - where approximately 46% of the population of 10,373 are Navajo.
- Winslow – where 38% of the 15,195 inhabitants are Navajo.
- Canoncito – where 23% of 4,288 inhabitants are Navajo.
- Bloomfield – where 19% of the population of 15,891 are Navajo.

To compensate for this, and avoid any over-representation of non-Navajo residents, Page and Bloomfield were excluded from Seidman's economic impact calculations in the current study. Winslow and Canoncito were included in Seidman's economic impact calculations in the current study.

**Table 7: Navajo Nation Zip Codes**

Zip	State	County	City
86020	AZ	Coconino	Cameron
86031	AZ	Navajo	Indian Wells
86033	AZ	Navajo	Kayenta
86034	AZ	Navajo	Keams Canyon
86035	AZ	Coconino	Leupp
86039	AZ	Navajo	Kykotsmovi
86040	AZ	Coconino	Page
86044	AZ	Coconino	Tonalea
86045	AZ	Coconino	Tuba City
86047	AZ	Navajo	Winslow
86053	AZ	Coconino	Kaibeto
86054	AZ	Navajo	Shonto
86502	AZ	Apache	Chambers
86503	AZ	Apache	Chinle
86504	AZ	Apache	Fort Defiance
86505	AZ	Apache	Ganado
86506	AZ	Apache	Houck
86507	AZ	Apache	Lukachukai
86508	AZ	Apache	Lupton
86510	AZ	Navajo	Pinon
86511	AZ	Apache	St. Michael
86512	AZ	Apache	Sanders
86514	AZ	Apache	Tecnospos
86515	AZ	Apache	Window Rock
86520	AZ	Navajo	Blue Gap
86535	AZ	Apache	Dennehotso
86538	AZ	Apache	Many Farms
86540	AZ	Apache	Nazlini
86544	AZ	Apache	Red Valley
86545	AZ	Apache	Rock Point
86547	AZ	Apache	Round Rock
86556	AZ	Apache	Tsaile
87013	NM	Sandoval	Cuba
87018	NM	Sandoval	Counselor
87026	NM	Cibola	Canoncito
87037	NM	San Juan	Nageezi
87045	NM	McKinley	Prewitt
87305	NM	McKinley	Gallup
87310	NM	McKinley	Brimhall
87311	NM	McKinley	Churchrock
87313	NM	McKinley	Crownpoint
87316	NM	McKinley	Fort Wingate
87319	NM	McKinley	Mentmore
87320	NM	McKinley	Mexican Springs
87321	NM	McKinley	Ramah
87323	NM	McKinley	Thoreau
87325	NM	McKinley	Tohatchi
87328	NM	McKinley	Navajo
87364	NM	San Juan	Sheep Springs
87365	NM	McKinley	Smith Lake
87375	NM	McKinley	Yahtahey
87413	NM	San Juan	Bloomfield
87416	NM	San Juan	Fruitland
87420	NM	San Juan	Shiprock
87455	NM	San Juan	Newcomb
87461	NM	San Juan	Sanostee
87825	NM	Socorro	Magdalena
84531	UT	San Juan	Monument Valley
84534	UT	San Juan	Montezuma Creek

Source: Navajo Nation Division of Economic Development

## *TA 2: Data*

SRP in association with Peabody Energy supplied Seidman with total annual wage and salary payments, benefits, and employment data for NGS and Kayenta Mine for the years 2010-2044, including the number of Native American workers. SRP and Peabody Energy also provided detailed taxes, royalties and fees paid to federal, state and local/tribal governments for the same time horizon.

Total vendor purchase data was supplied for 2011, specifying the name and location of the vendors and the amount of purchase, as well as the type of service/product being purchased. Seidman's analyses assumed that the 2011 vendor purchase transactions are mirrored in 2020. For the purpose of this study, Navajo Nation-based vendor data alone was used.

To incorporate vendor information into IMPLAN, a detailed industry code was assigned to each transaction indicating the nature of the good or service purchased and produced. Seidman assigned NAICS (North American Industry Classification) codes to each vendor transaction category, which was then linked to an IMPLAN code using a correspondence table provided by the IMPLAN group.

Another important aspect of economic impact analysis is the indirect effects of a company's payroll. These are generated when employees spend a portion of their incomes on goods and services produced within the local economy. The detailed commodity make-up of these expenditures was drawn from a Navajo Nation Household Expenditure Survey conducted by Seidman at over 200 homes on the Navajo Nation between July and December 2012.

Tribal tax revenues, fees and royalties generated during the economic impact process were also assumed to be spent and included in the results. However, Seidman's calculations for these areas were performed outside of IMPLAN, and then added to the latter's results.

## *TA 3: Changes made to the IMPLAN model*

Several changes were made to the standard IMPLAN model to make it more specific to the Navajo Nation. Following the construction of a specific zip code-based geographic area for the impact analysis, Seidman modified IMPLAN's default regional purchase coefficients (RPCs) and trade flows based on the consumption patterns identified by the Navajo Nation Household Expenditure Survey implemented by the authors in 2012.

#### *TA 4: Differences between IMPLAN and REMI*

Caution needs to be exercised when comparing results reported in the current study to those reported in an earlier Seidman REMI study dated February 2012.<sup>28</sup>

First, although there were considerable similarities between the data inputs used in both studies, the use of different economic modeling software will yield different results. The current study used IMPLAN while the original 2012 study used REMI.

Second, the geographic areas examined by either report were very different. The 2012 report was concerned with the economic effects for Coconino County, Navajo County and the State of Arizona as a whole. The current study examined the economic effects exclusively for the Navajo Nation.

Third, Seidman has made several modifications to the standard IMPLAN package, modifying regional purchase coefficients (RPCs) and trade flows based on the consumption patterns identified by a consumer expenditure survey conducted on the Navajo Nation, July – December 2012. Although IMPLAN allows for this type of customization, REMI does not and will always use the standard RPCs. As a result, the current study draws from more detailed local information than the original 2012 REMI study.

Finally, the original 2012 study did not include the Navajo Nation as a government entity. As a result, the impact of NGS and Kayenta Mine's payments to the Navajo Nation were not evaluated in the 2012 REMI study.

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<sup>28</sup> *Navajo Generating Station and Kayenta Mine: An Economic Impact Study* (February 2012), Dr. Matthew Croucher, Dr. Anthony Evans and Dr. Timothy James, Seidman Research Institute.



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