

**NAVAJO GENERATING STATION
AND KAYENTA MINE:
*An Economic Impact Study***



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- *Science Foundation Arizona (SFAZ)*
- *Turf Paradise Valley METRO Light Rail*
- *Waste Management Inc*

Executive Summary

- This report, prepared for the Salt River Project (SRP) and the Navajo Nation, examines the direct, indirect and induced economic impact of Navajo Generating Station (NGS) and Kayenta Mine, individually and in aggregate, for the period 2011-2044, at county and state level.
- NGS currently employs 538 regular workers, of which 83% are Navajo in origin.
- Kayenta Mine currently employs 320 union-represented and 110 non-represented company workers. Approximately 93% of the union workers are Native American, primarily drawn from the Navajo Nation, although no specific number is available. An estimated 20-40% of company employees are also Native American but no specific estimate of Navajo Nation employees is available.
- During the period 2011-2044, the operation of both facilities accounts for approximately 112,720 full-time or equivalent jobs years throughout Arizona, including 32,912 direct job years.
- Retail trade (11.9%), health care (11.5%) and construction (10.4%) also enjoy significant indirect job creation.

Overview of NGS and Kayenta Mine's Cumulative State-Wide Total Economic Impact

	Cumulative Impact 2011-2044
Total Private Non-Farm Employment	112,720 full-time or equivalent job years
Gross State Product	\$20.46 billion (2011\$)
Real Disposable Personal Income	\$11.16 billion (2011\$)

Source: Authors' Calculations

- Real GSP for the Generating Station and Mine combined during 2011-2044 is higher relative to the baseline by almost \$20.5 billion (2011\$) throughout the state.
- Real disposable income during 2011-2044 is higher relative to the baseline by over \$11 billion (2011\$) for the Generating Station and Mine combined throughout the state.
- The principal beneficiary of the economic impacts is the host county for each facility.

Cumulative Adjusted State Revenues for NGS and Kayenta Mine, 2011-2044

Category	Cumulative Impact 2011-2044 (Millions 2011\$)¹
Income Tax	203.72
General Sales Tax	276.25
Selective Sales Tax	80.13
Corporate Income Tax	119.47
Total	679.58

Source: Authors' Calculations

- Both facilities cumulatively account for over \$679 million (2011\$) in adjusted state tax revenues throughout the period, of which 40.7% is general sales tax, 30% is income tax, 17.6% corporate income tax, and 11.8% selective sales tax.
- Coconino County benefits from 39.7% of the 2011-2044 adjusted state tax revenues, equating to \$269.5 million (2011\$).
- Navajo County benefits from 34.6% of the 2011-2044 adjusted state tax revenues, equating to \$234.8 million (2011\$).
- The continued operation of NGS and Kayenta Mine therefore exerts *significant* positive economic impact for the host counties and Arizona as a whole.
- Throughout the period, NGS and Kayenta Mine will also make a number of direct payments to the Navajo Nation.
- No additional quantification of the economic impact of NGS and Kayenta Mine exclusively for the Navajo Nation is possible using the current REMI model.
- Additional research is recommended, consisting of a survey of Navajo expenditure patterns and the development of a bespoke Navajo-specific IMPLAN impact analysis for 2011, to arrive at a robust estimate of the economic impacts of NGS and Kayenta Mine exclusively for the Navajo Nation.

¹ General State Sales Tax includes authors' estimates of revenue from Prop 100 temporary tax.

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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 (SO₂) scrubbers, and a further \$45 million to reduce nitrous oxide (NO_x) emissions. NGS also implements a stringent waste minimization program. However, the power plant is currently facing a number of difficult issues that may threaten its future viability. These include:

- A potential ruling from the Environmental Protection Agency to install additional emission control technology at the plant costing in excess of \$1.1 billion.
- The expiration of a site lease and rights-of-way for the NGS plant, railroad, transmission and water lines in 2019.
- The expiration of the Coal Supply Agreement with Peabody Energy in 2019.

NGS' management and SRP are currently working to avoid a facility shutdown, which could become a reality if the EPA imposes the \$1.1 billion emission controls before the lease and rights-of-way can be renewed with the Navajo Nation. To assist with the negotiations, SRP and the Navajo Nation has therefore asked The Seidman Research Institute, W. P. Carey School of Business at ASU, to:

- Quantify the *direct* economic impacts and *indirect* effects of NGS and the Kayenta Mine individually, at both a county and state level.
- Compile additional information concerning the state and local tax revenues associated with the direct, indirect and induced economic effects of both operations.
- Calculate a cumulative figure for the total contribution of NGS and Kayenta Mine to the Arizona economy.

Direct impacts are generally relatively easy to understand and calculate. For example, whenever a business decides to locate in Arizona, there is a resulting increase in capital expenditures as new buildings are constructed and/or old buildings are remodeled. Also, industry specific expenditures may be required to ensure the facility is fit-for-purpose. Coupled with this initial capital investment, there are on-going jobs created once the business begins operation.² The direct economic impacts of NGS and Kayenta Mine in Arizona therefore include employment, income payments, the purchase of goods and services from local businesses, and tax payments to state and local governments.

Indirect or induced impacts are less obvious but no less significant. For example, the income that an NGS employee receives and then spends in the local economy will in turn create revenues and/or income for a variety of different businesses. Additional indirect impacts arise when firms that supply goods and services to NGS or Kayenta Mine place upstream demands on other producers, or increase their number of employees as the generating station or mine's purchasing increases. Whenever local governments spend tax revenues, this too has an indirect impact.

These latter rounds of expenditures are not self-perpetuating. Instead, through time, the rounds of expenditures become smaller as more of the income/expenditure "leaks" out of the local economy.³ The cumulative impacts of these rounds of expenditure or "ripple effects" are known as the multiplier effect within economics. Importantly, there is no one "magic" multiplier number for every conceivable scenario. Due to the inter-linked nature of the Arizona economy both within itself and its links to the rest of the US (and world), the eventual ripple effects depend on a variety of factors including the size of the direct impact, its location in terms of county and economic sector, and its duration. A thorough analysis of the total impact of a business or industry upon the Arizonan economy therefore requires a sum of the direct and indirect/induced impacts.

Section 2 describes the economic impact method adopted for this analysis. Economic impact results specific to NGS and Kayenta Mine are presented in Section 3, along with a cumulative assessment of their total economic impact at a county and state level. Section 4 discusses direct payments to the Navajo Nation. Conclusions and recommendations for future research are offered in Section 5.

² There are also on-going (operations) capital expenditures throughout the lifetime of the business.

³ For example, in the form of savings, payments on goods and services produced outside of the state etc.

2. Report Method

This report uses an Arizona-specific version of the REMI regional forecasting model to produce numeric estimates of the impact of a business upon the Arizona economy. REMI models are sometimes referred to as “econometric models” due to their underlying equations and statistical response estimations. However, REMI also integrates three additional modeling approaches, incorporating the strengths of all four methodologies while overcoming their limitations, to comprehensively answer “what if ...?” questions about the economy. These are Input-Output, General Equilibrium and Economic Geography.

The REMI model contains detailed industries, capturing the industry structure of a particular region and transactions between industries. However, unlike most other regional economic impact models, REMI is also dynamic, producing integrated, multi-year forecasts and feedback among its economic and demographic variables. This ability to track variations within the economic impact of a business enables that firm or industry to change their behavior in response to changing economic conditions.

The spatial dimension of the economy is addressed by productivity and competitiveness benefits, through the concentration or agglomeration of economic activity in cities and metropolitan areas, and the clustering of industries.

REMI is also an open model in that it explicitly accounts for trade and migration flows in and out of the state, and between counties. The use of a county level model enables a more detailed disaggregation of results to occur, thereby estimating the economic impacts that “leak” into other counties in Arizona.

Seidman’s operation of the REMI model has been developed to facilitate the simulation of policy changes, via a large set of modifiable policy variables. To simulate the impact of a policy change or event, a change in one or more variables is entered into the model and a new forecast generated. The REMI model then automatically produces a detailed set of simulation results showing the differences in the values of each economic variable between the control and the alternative forecast.

A complete explanation of the model and discussion of the empirical estimation of the parameters/equations is found at www.remi.com.

3. Simulation Results

This section examines the direct economic impacts during 2011-2044 associated with the operations of Navajo Generating Station and Kayenta Mine, and any potential indirect impacts that may occur due to their increased economic activity. The following figures are provided for each operation:

- Standard macroeconomic variables such as total employment, gross state product (GSP) and real disposable income.
- A forecast for employment impacts and adjusted state revenue at a disaggregated level.

The figures presented for each operation are always relative to a baseline forecast in which the facility does not exist or operate.⁴ The report period for this economic impact analysis is 2011-2044. This assumes a continuation of operations beyond the expiration of the current agreements. Results are presented at county level and for Arizona as a whole. All dollar amounts are measured in 2011 dollars (2011\$).⁵

The section concludes with a cumulative assessment of the total economic impact of the generating station and mine in their host counties and for Arizona as a whole.

3.1 Navajo Generating Station (NGS)

NGS is a coal-fired generating station, operated by SRP, serving electricity customers in Arizona, Nevada and California. The station also supplies energy to pump water through the Central Arizona Project.

NGS currently has 538 regular employees, of which 147 are salaried staff, and 391 paid by the hour. These latter hourly employees include apprentices, office specialists, operations and maintenance staff, specialist skilled craftsmen and warehouse specialists. Navajos account for the greatest proportion of this workforce – 446 employees or 83%. Table 1 estimates NGS' impact on selected standard macroeconomic variables.

⁴ For instance, if GSP is estimated to be x dollars higher than the baseline case, this does not mean it is x dollars higher than what GSP is *today*. It simply means that it is x dollars higher than what GSP is forecast to be in that given year if the new business had not located in Arizona.

⁵ The report refers to real, rather than nominal, values to allow for comparisons across years.

Table 1: Overview of NGS' Economic Impact, 2011-2044

Total Private Non-Farm Employment (Full-Time Job Years)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
Arizona	1,617	1,750	1,810	1,830	1,823	1,799	1,774	1,750	1,726	1,651	1,643	1,665	1,699	1,749	57,793
Coconino County	1,296	1,368	1,391	1,388	1,370	1,345	1,317	1,292	1,268	1,187	1,154	1,142	1,141	1,149	41,090
Host County % of Total	80.1%	78.2%	76.8%	75.9%	75.2%	74.8%	74.3%	73.9%	73.5%	71.9%	70.3%	68.6%	67.2%	65.7%	71.1%

Gross State Product (Millions 2011\$)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
Arizona	234	254	266	276	283	289	295	299	304	329	360	397	437	484	12,161
Coconino County	204	217	225	232	237	242	246	250	253	273	296	322	349	381	9,947
Host County % of Total	87.0%	85.5%	84.6%	84.0%	83.8%	83.7%	83.6%	83.5%	83.4%	83.0%	82.1%	81.1%	79.9%	78.7%	81.8%

Real Disposable Personal Income (Millions 2011\$)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
Arizona	81	92	100	106	111	116	119	123	126	140	157	179	206	241	5,352
Coconino County	63	69	75	79	82	84	86	88	90	98	107	119	133	151	3,633
Host County % of Total	77.3%	75.7%	74.5%	73.8%	73.3%	72.9%	72.5%	71.9%	71.6%	70.2%	68.3%	66.5%	64.6%	62.6%	67.9%

State Revenue (Millions 2011\$)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
From activity across Arizona	6.71	7.46	7.81	7.98	8.29	8.56	8.81	9.05	9.26	10.25	11.4	12.69	14.2	16.02	382.96
From activity based in Coconino County	5.35	5.79	5.93	5.96	6.13	6.25	6.38	6.48	6.57	7.04	7.58	8.22	8.96	9.85	255.78
Host County % of Total	79.7%	77.6%	75.9%	74.7%	73.9%	73.0%	72.4%	71.6%	71.0%	68.7%	66.5%	64.8%	63.1%	61.5%	66.8%

Source: Authors' Calculations

Table 1 estimates that Arizona-wide employment is approximately 1,617 higher relative to the baseline in 2011. Real GSP is higher relative to the baseline by approximately \$234 million (2011\$). Real disposable income is higher relative to the baseline by approximately \$81 million (2011\$) and state revenues higher by approximately \$7 million (2011\$). The main beneficiary of these positive economic impacts is Coconino County (ranging from 77% to 87% for the variables examined).

In 2019, Arizona-wide employment is forecast to be approximately 1,726 higher relative to the baseline, of which 1,268 job years are located in Coconino County. Real GSP is higher relative to the state's baseline by approximately \$304 million (2011\$). Real disposable income is higher relative to the state's baseline by approximately \$126 million (2011\$) and state revenues higher by approximately \$9.26 million (2011\$). Again, the vast majority of these positive economic impacts are forecast to occur within Coconino County (ranging from 71% to 83% for the variables examined). However, a slight increase in economic activity is also forecast to occur outside the host county.⁶

If an agreement is reached and production continues until 2044, in aggregate terms and for the report period 2011-2044, NGS accounts for 57,793 total private non-farm job years, 71.1% of which is based in Coconino County. Total real GSP in the state is cumulatively higher by \$12.16 billion (2011\$). Total real disposable income is cumulatively higher by \$5.35 billion (2011\$), and total state revenues cumulatively higher by \$383 million (2011\$).

Economic impact assessment reports usually disaggregate employment or job years into direct and indirect/induced jobs, and this is illustrated in Table 2.⁷ This suggests that Navajo Generating Station accounts for more than twice as many indirect/induced jobs for every person employed at NGS for the reporting period 2011-2044.

⁶ This is expected as some of the economic activity "ripples" into other counties.

⁷ It is a standard output in another economic impact program called IMPLAN.

Table 2: NGS' Direct and Indirect/Induced Job Years for Private Non-Farm Employment, 2011-2044

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact 2011-2044 (Job Years)
Direct Full-Time Job Years	538	538	538	538	538	538	538	538	538	538	538	538	538	538	18,292
Indirect/Induced Full-Time Job Years	1,079	1,212	1,272	1,292	1,285	1,261	1,236	1,212	1,188	1,113	1,105	1,127	1,161	1,211	39,501
Indirect/Induced as a Percentage of Direct	201%	225%	236%	240%	239%	234%	230%	225%	221%	207%	205%	209%	216%	225%	216%

Source: Authors' Calculations

Table 3 estimates non-farm private sector employment. This suggests that the biggest indirect beneficiaries of NGS from an employment perspective are the construction, retail trade, health care and administration/waste services sectors. The biggest direct beneficiary is obviously the utilities sector.

Tables 4 to 6 forecast employment and state revenues at a more disaggregated level.

Tables 4 and 5 show NGS to cumulatively generate approximately \$383 million (2011\$) in adjusted state revenues during the period 2011-2044. Coconino, as the host county, benefits the greatest (66.8%). However, Maricopa (16.7%) and Yavapai (11.1%) also receive a significant proportion of the adjusted state revenues generated.

Table 6 provides a breakdown by tax revenue source for the period 2011-2044. The table excludes intergovernmental revenue, charges, insurance trust revenue, and other miscellaneous revenue, as these are of no relevance when examining the fiscal impact of NGS. Table 6 suggests that general sales tax cumulatively accounts for 34.5% of adjusted state revenues throughout the period, income tax 31.5% and corporate income tax 11.68%.

The continued operation of the Navajo Generating Station is therefore forecast to result in a significant increase in economic activity, both in Coconino County and the state of Arizona as a whole.

Table 3: NGS' Private Non-Farm Employment across Sectors, 2011-2044 (Full-Time Job Years)

Sector	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044
Forestry, Fishing, Related Activities, & Other	1.76	1.96	2.06	2.08	2.05	2	1.95	1.91	1.87	1.78	1.85	1.99	2.18	2.45
Mining	5.47	5.39	5.26	5.1	4.92	4.75	4.59	4.45	4.33	3.86	3.5	3.19	2.86	2.51
Utilities	539.39	541.74	541.74	541.67	541.54	541.4	541.27	541.14	541.01	540.55	540.27	540.04	539.81	539.64
Construction	190.02	256.16	287.75	298.54	296.02	286.29	273.48	259	244.78	186.16	154.54	138.43	129.46	124.39
Manufacturing	12.85	12.6	11.2	9.19	7	4.79	2.91	1.4	0.12	-2.76	-2.81	-2.15	-1.45	-0.69
Wholesale Trade	25.96	27.58	28.08	27.88	27.27	26.48	25.7	24.99	24.21	21.22	19.19	17.75	16.52	15.6
Retail Trade	168.21	184.33	193.7	198.61	200.81	201.02	200.62	200.29	199.22	195.19	194.49	196.87	200.38	205.32
Transportation & Warehousing	14.87	15.41	15.27	14.77	14.01	13.14	12.51	11.95	11.45	9.9	9.52	9.66	9.87	10.42
Information	8.59	9.37	9.7	9.76	9.66	9.45	9.22	9	8.79	7.98	7.68	7.55	7.45	7.45
Finance & Insurance	69.08	70.01	68.48	65.73	62.29	58.44	55.11	52.14	49.36	40.12	35.45	32.76	30.69	29.16
Real Estate, Rental & Leasing	74.16	83.5	88.99	91.37	91.8	90.94	89.84	88.81	87.89	86.58	90.03	94.02	97.84	103.88
Professional & Technical Services	91.14	100.28	104.51	106.03	105.61	103.93	103	101.99	100.77	96.37	94.54	93.11	91.06	89.26
Management of Companies & Enterprises	2.99	3.2	3.21	3.14	2.98	2.79	2.7	2.61	2.53	2.33	2.33	2.29	2.18	2.05
Administrative & Waste	106.14	112.95	115.45	115.66	114.29	111.82	109.56	107.3	105.22	96.74	91.49	86.88	82.09	77.7
Educational Services	10.69	12.23	13.21	13.87	14.29	14.58	14.89	15.27	15.64	17.95	20.73	23.8	26.25	27.4
Health Care & Social Assistance	121.49	128.78	133.24	135.86	137.73	138.85	140.08	142.06	143.98	160	185.12	215.52	251.16	292.85
Arts, Entertainment, & Recreation	23.9	25.99	27.37	28.22	28.75	29.07	29.43	29.91	30.39	34.02	39.05	43.78	47.97	52.58
Accommodation & Food Services	65.16	69.49	71.47	72.24	72.11	71.56	70.37	69.82	69.12	69	70.16	70.74	69.82	68.51
Other Services, except Public Administration	85.04	88.85	90.19	90.24	89.26	87.72	86.79	86.26	85.51	84.09	85.78	88.68	92.22	97.9
<i>Yearly Total</i>	<i>1,617</i>	<i>1,750</i>	<i>1,811</i>	<i>1,830</i>	<i>1,822</i>	<i>1,799</i>	<i>1,774</i>	<i>1,750</i>	<i>1,726</i>	<i>1,651</i>	<i>1,643</i>	<i>1,665</i>	<i>1,698</i>	<i>1,748</i>

Source: Authors' Calculations

Table 4: NGS' Cumulative Adjusted State Tax Revenues by County, 2011-2044

Region	Cumulative Impact 2011-2044 (Millions 2011\$)	Percentage
Apache County	1.18	0.3%
Cochise County	0.31	0.1%
Coconino County	255.8	66.8%
Gila County	0.77	0.2%
Graham County	0.18	0.05%
Greenlee County	0.08	0.02%
La Paz County	0.06	0.01%
Maricopa County	64.07	16.7%
Mohave County	2.04	0.5%
Navajo County	6.11	1.6%
Pima County	3.85	1%
Pinal County	5.56	1.5%
Santa Cruz County	0.16	0.04%
Yavapai County	42.42	11.1%
Yuma County	0.39	0.1%
<i>All Regions</i>	<i>382.96</i>	<i>100%</i>

Source: Authors' Calculations

Table 5: NGS' Aggregate Adjusted State Tax Revenues for Arizona, 2011-2044

Region	Year (Millions 2011\$)														Cumulative Impact 2011-2044
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	
Arizona	6.71	7.46	7.81	7.98	8.29	8.56	8.81	9.05	9.26	10.25	11.4	12.69	14.2	16.02	382.96

Source: Authors' Calculations

Table 6: NGS' Adjusted State Tax Revenues by Tax Type, 2011-2044⁸

Category	Year (Millions 2011\$)														Cumulative Impact 2011-2044
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	
Income Tax	2.04	2.28	2.47	2.61	2.7	2.78	2.85	2.92	2.97	3.22	3.56	3.96	4.46	5.06	120.55
General Sales Tax	2.51	2.83	2.84	2.76	2.88	2.98	3.07	3.16	3.23	3.58	3.94	4.34	4.81	5.37	132.09
Selective Sales Tax	0.62	0.7	0.76	0.81	0.84	0.87	0.9	0.92	0.94	1.05	1.15	1.27	1.4	1.57	38.28
Corporate Income Tax	1.54	1.64	1.73	1.8	1.86	1.93	1.99	2.05	2.11	2.41	2.75	3.13	3.54	4.02	92.03
<i>Total</i>	6.71	7.46	7.81	7.98	8.29	8.56	8.81	9.05	9.26	10.3	11.4	12.7	14.2	16.0	382.96

Source: Authors' Calculations

⁸ General State Sales Tax includes authors' estimates of revenue from Prop 100 temporary tax.

3.2 Kayenta Mine

Kayenta Mine, located 10 miles southwest of Kayenta, in Navajo County, AZ., has been operated by Peabody Western Coal Company since 1973 through lease agreements with the Navajo Nation and Hopi Tribe. The 40,000-acre mine produces approximately 8 million tons of coal annually, which it ships by rail to the Navajo Generating Station.

Peabody currently employs 320 union-represented workers at Kayenta, plus 110 company workers. Approximately 93% of the union workers are Native American, primarily drawn from the Navajo Nation. SRP estimates that 20-40% of company employees are also Native American.

Table 7 estimates Kayenta Mine's impact on selected standard macro-economic variables. This suggests that Arizona-wide employment in 2011 is approximately 1,046 higher, relative to the baseline, due to the operation of the mine. Real GSP is higher relative to the state baseline by approximately \$136 million (2011\$). Real disposable income is \$49 million higher (2011\$) and state revenues \$4.3 million (2011\$) higher. Navajo County benefits the most from these positive economic impacts (greater than 77% for each variable).

In 2019, Arizona-wide employment is forecast to be approximately 1,382 higher relative to the baseline. Real GSP is \$185 million (2011\$) higher. Real disposable income is approximately \$105 million (2011\$) higher, and state revenues \$6.2 million (2011\$) higher. Again, the vast majority of these positive economic impacts are forecast to occur within Navajo County (ranging from 74% to 79% of the variables examined). However, over the period of report, there is also a slight increase in economic activity occurring outside of the host county.⁹

If an agreement is reached and production continues until 2044, in aggregate terms and for the report period 2011-2044, Kayenta Mine accounts for 54,927 total private non-farm job years, 72.5% of which is based in Navajo County. Total real GSP in the state is cumulatively higher by \$8.3 billion (2011\$). Total real disposable income is cumulatively higher by \$5.8 billion (2011\$), and total state revenues cumulatively higher by almost \$297 million (2011\$).

⁹ This is expected as some of the economic activity "ripples" into other counties.

Table 7: Overview of Kayenta Mine's Economic Impact, 2011-2044 ¹⁰

Total Private Non-Farm Employment (Full-Time Job Years)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
Arizona	1,046	1,148	1,215	1,261	1,295	1,319	1,340	1,361	1,382	1,493	1,633	1,796	1,959	2,141	54,927
Navajo County	853	909	945	969	986	1,000	1,011	1,023	1,034	1,101	1,183	1,276	1,369	1,468	39,834
Host County % of Total	81.5%	79.2%	77.8%	76.8%	76.1%	75.8%	75.4%	75.2%	74.8%	73.7%	72.4%	71.0%	69.9%	68.6%	72.5%

Gross State Product (Millions 2011\$)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
Arizona	136	146	155	161	167	172	176	180	185	210	242	282	328	384	8,296
Navajo County	117	123	127	130	134	137	139	142	145	161	180	204	232	265	6,158
Host County % of Total	86.0%	84.2%	81.9%	80.7%	80.2%	79.7%	79.0%	78.9%	78.4%	76.7%	74.4%	72.3%	70.7%	69.0%	74.2%

Real Disposable Personal Income (Millions 2011\$)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
Arizona	49	58	67	74	81	87	93	100	105	135	169	212	265	334	5,811
Navajo County	38	44	50	55	60	65	69	74	78	100	123	154	191	238	4,232
Host County % of Total	77.6%	75.9%	74.6%	74.3%	74.1%	74.7%	74.2%	74.0%	74.3%	74.1%	72.8%	72.6%	72.1%	71.3%	72.8%

State Revenue (Millions 2011\$)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact
From activity across Arizona	4.34	4.78	4.95	5.05	5.31	5.57	5.78	6.01	6.22	7.34	8.67	10.31	12.23	14.64	296.63
From activity based in Navajo County	3.55	3.86	3.97	4.03	4.23	4.43	4.60	4.77	4.93	5.78	6.73	7.90	9.24	10.86	228.70
Host County % of Total	81.8%	80.7%	80.1%	79.8%	79.7%	79.6%	79.5%	79.4%	79.3%	78.7%	77.7%	76.6%	75.5%	74.1%	77.1%

Source: Authors' Calculations

¹⁰ Figures may not add up exactly due to rounding-up.

Table 8 disaggregates employment or job years into direct and indirect/induced jobs. This table suggests that for every full-time or equivalent job created at Kayenta Mine between 2011 and 2044, an additional 2.75 full-time or equivalent jobs are generated in other industries.

Table 9 estimates non-farm private sector employment. This suggests that the main indirect beneficiaries of Kayenta Mine in terms of employment are the retail trade, health care and construction sectors. The mining sector is obviously the main direct beneficiary.

Tables 10 to 12 forecast employment and state revenues at a disaggregated level.

Tables 10-11 show Kayenta Mine to generate \$296.6 million in total, adjusted state revenues during the period 2011-2044. Navajo, as the host county, benefits the greatest (77.1%). Maricopa (11.9%) and Coconino (4.6%) also receive a significant proportion of these adjusted state revenues. Two counties experience insignificant negative effects. These are Greenlee and Yuma.

Table 12 provides a breakdown by tax revenue source for the period 2011-2044. The table excludes intergovernmental revenue, charges, insurance trust revenue, and other miscellaneous revenue, as these are of no relevance when examining the fiscal impact of Kayenta Mine. This suggests that general sales tax cumulatively accounts for 48.6% of adjusted state revenues throughout the period, income tax 28%, selective sales tax 14.1% and corporate income tax 9.3%.

The continued operation of Kayenta Mine is therefore forecast to result in a relatively significant increase in economic activity in Navajo County and the state of Arizona as a whole.

Table 8: Kayenta Mine’s Direct and Indirect/Induced Job Years for Private Non-Farm Employment, 2011-2044

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	Cumulative Impact 2011-2044 (Job Years)
Direct Full-Time Job Years	430	430	430	430	430	430	430	430	430	430	430	430	430	430	14,620
Indirect/Induced Full-Time Job Years	616	718	785	832	865	889	910	931	952	1,063	1,203	1,366	1,528	1,711	40,306
Indirect/Induced as a Percentage of Direct	143%	167%	183%	193%	201%	207%	212%	217%	221%	247%	280%	318%	355%	398%	276%

Source: Authors’ Calculations

Table 9: Kayenta Mine's Private Non-Farm Employment across Sectors, 2011-2044 (Full-Time Job Years)

Sector	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044
Forestry, Fishing, Related	0.56	0.60	0.58	0.53	0.47	0.39	0.33	0.27	0.23	0.12	0.17	0.28	0.42	0.62
Mining	408.16	406.04	404.31	402.92	401.77	400.84	400.09	399.42	398.88	397.45	396.93	396.70	396.62	396.65
Utilities	6.32	6.61	6.78	6.90	6.96	7.01	7.06	7.13	7.18	7.45	7.71	7.92	8.03	8.08
Construction	104.42	148.35	173.54	186.71	191.96	192.29	190.22	186.43	182.42	162.43	152.44	152.07	153.44	158.23
Manufacturing	8.61	8.91	8.67	8.09	7.43	6.61	5.98	5.49	5.04	4.12	4.41	5.17	6.04	7.22
Wholesale Trade	17.48	18.42	18.94	19.07	19.04	18.88	18.78	18.68	18.52	17.81	17.22	16.92	16.65	16.69
Retail Trade	96.07	108.58	118.41	126.46	133.39	139.62	144.99	150.39	155.61	180.08	204.59	231.75	258.36	286.93
Transportation & Warehousing	15.05	15.33	15.27	15.08	14.79	14.43	14.32	14.24	14.18	14.48	15.50	16.78	18.05	19.61
Information	5.60	6.00	6.19	6.25	6.24	6.16	6.10	6.03	6.01	6.07	6.46	6.95	7.36	7.87
Finance & Insurance	31.66	32.46	32.26	31.54	30.49	29.21	28.18	27.25	26.37	23.88	23.39	23.90	24.44	25.24
Real Estate, Rental & Leasing	60.58	70.98	78.80	84.78	89.63	93.63	97.41	101.14	104.80	124.02	146.03	168.61	190.12	213.81
Professional & Tech Services	43.32	48.57	52.06	54.47	56.30	57.42	58.72	60.09	61.22	66.86	73.15	79.04	83.59	87.86
Management of Companies & Enterprises	12.32	12.21	11.97	11.68	11.33	10.96	10.86	10.78	10.68	10.20	9.64	8.83	7.79	6.79
Administrative & Waste Services	57.01	62.26	65.49	67.44	68.82	69.46	70.19	70.77	71.44	74.62	78.31	81.67	83.47	84.99
Educational Services	6.55	7.87	8.91	9.79	10.63	11.46	12.34	13.26	14.27	19.85	26.05	32.73	38.83	43.58
Health Care & Social Assistance	64.79	71.17	76.90	82.09	87.46	92.80	98.08	104.00	110.23	146.51	191.53	244.75	303.71	373.11
Arts, Entertainment, & Recreation	15.76	17.88	19.81	21.61	23.35	25.10	26.82	28.70	30.59	41.26	54.02	68.21	83.11	99.78
Accommodation & Food Services	43.73	53.65	62.16	70.01	77.18	83.68	89.29	95.03	100.16	122.53	140.14	154.79	165.65	174.59
Other Services, except Public Administration	48.25	51.73	54.20	56.11	57.65	58.88	60.41	62.18	63.89	73.59	85.56	99.03	112.79	129.76
<i>Yearly Total</i>	<i>1046.2</i>	<i>1147.6</i>	<i>1215.3</i>	<i>1261.5</i>	<i>1294.9</i>	<i>1318.8</i>	<i>1340.2</i>	<i>1361.3</i>	<i>1381.7</i>	<i>1493.4</i>	<i>1633.2</i>	<i>1796.1</i>	<i>1958.5</i>	<i>2141.4</i>

Source: Authors' Calculations

Table 10: Kayenta Mine’s Cumulative Adjusted State Tax Revenues by County, 2011-2044

Region	Cumulative Impact 2011-2044 (2011\$)	Percentage
Apache County	\$6,450,981	2.2%
Cochise County	\$281,243	0.1%
Coconino County	\$13,687,786	4.6%
Gila County	\$2,237,916	0.8%
Graham County	\$14,491	0.0%
Greenlee County	-\$198,758	-0.1%
La Paz County	\$2,201	0.0%
Maricopa County	\$35,171,969	11.9%
Mohave County	\$462,479	0.2%
Navajo County	\$228,700,634	77.1%
Pima County	\$2,315,435	0.8%
Pinal County	\$4,779,067	1.6%
Santa Cruz County	\$100,920	0.0%
Yavapai County	\$3,590,112	1.2%
Yuma County	-\$969,834	-0.3%
<i>All Regions</i>	<i>\$296,626,643</i>	<i>100%</i>

Source: Authors’ Calculations

Table 11: Kayenta Mine’s Aggregate Adjusted State Tax Revenues for Arizona, 2011-2044

Region	Year (Millions 2011\$)														Cumulative Impact 2011-2044
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	
Arizona	4.34	4.78	4.95	5.05	5.31	5.57	5.78	6.01	6.22	7.34	8.67	10.31	12.23	14.64	296.63

Source: Authors’ Calculations

Table 12: Kayenta Mine’s Adjusted State Tax Revenues by Tax Type, 2011-2044¹¹

Category	Year (Millions 2011\$)														Cumulative Impact 2011-2044
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024	2029	2034	2039	2044	
Income Tax	1.16	1.30	1.40	1.49	1.56	1.62	1.67	1.73	1.78	2.05	2.40	2.87	3.41	4.12	83.17
General Sales Tax	2.13	2.36	2.36	2.32	2.46	2.60	2.71	2.84	2.95	3.55	4.23	5.05	6.01	7.19	144.16
Selective Sales Tax	0.53	0.58	0.63	0.68	0.72	0.76	0.79	0.83	0.86	1.04	1.24	1.47	1.76	2.10	41.85
Corporate Income Tax	0.52	0.54	0.55	0.57	0.58	0.59	0.60	0.61	0.62	0.70	0.80	0.92	1.06	1.23	27.44
<i>Total</i>	4.34	4.78	4.95	5.05	5.31	5.57	5.78	6.01	6.22	7.34	8.67	10.31	12.23	14.64	296.62

Source: Authors’ Calculations

¹¹ General State Sales Tax includes authors’ estimates of revenue from Prop 100 temporary tax.

3.3 Cumulative Economic Impact of Navajo Generating Station and Kayenta Mine

To arrive at a total economic impact assessment of both operations at a county and state-wide level, the respective results for Navajo Generating Station and Kayenta Mine are aggregated.

Tables 13-15 illustrate the total economic impact, private non-farm employment across sectors, and adjusted state tax revenues for both operations.

Table 13: NGS and Kayenta Mine’s Total Economic Impact, 2011-2044

Total Private Non-Farm Employment (Full-Time or Equivalent Job Years)	Cumulative Impact 2011-2044
Arizona	112,720
Gross State Product (Billions 2011\$)	
Arizona	20.46
Real Disposable Personal Income (Billions 2011\$)	
Arizona	11.16

Source: Authors’ Calculations

Table 13 suggests that NGS and Kayenta Mine cumulatively support 112,720 full-time or equivalent job years in Arizona, 2011-2044. Real GSP during this period is higher relative to the baseline by \$20.46 billion (2011\$) throughout the state. Real disposable income during 2011-2044 is higher relative to the baseline by \$11.16 billion (2011\$) throughout Arizona.

Table 14 unsurprisingly suggests that the utilities (16.5%) and mining (12.1%) sectors enjoy the greatest employment benefits, measured in job years, with the retail trade (11.9%), health care (11.5%) and construction (10.4%) sectors also enjoying significant indirect job creation.

Table 14: NGS and Kayenta Mine’s Total Private Non-Farm Employment across Sectors, 2011-2044

Sector	Cumulative Impact 2011-2044 (Full-Time Job Years)
Forestry, Fishing, Related Activities & Other	79
Mining	13,675
Utilities	18,631
Construction	11,756
Manufacturing	206
Wholesale Trade	1,303
Retail Trade	13,410
Transportation and Warehousing	914
Information	500
Finance and Insurance	2,302
Real Estate and Rental and Leasing	7,887
Professional and Technical Services	5,652
Management of Companies and Enterprises	410
Administrative and Waste Services	5,814
Educational Services	1,525
Health Care and Social Assistance	12,979
Arts, Entertainment, and Recreation	3,095
Accommodation and Food Services	6,692
Other Services, except Public Administration	5,887
<i>Yearly Total</i>	<i>112,718¹²</i>

Source: Authors’ Calculations

¹² This differs slightly to Table 13 due to rounding-up.

Table 15: NGS and Kayenta Mine’s Total Adjusted State Tax Revenues by Tax Type, 2011-2044¹³

Category	Cumulative Impact 2011-2044 (Millions 2011\$) ¹⁴
Income Tax	203.72
General Sales Tax	276.25
Selective Sales Tax	80.13
Corporate Income Tax	119.47
Total	679.58

Source: Authors’ Calculations

Table 15 suggests that the cumulative total adjusted state tax revenues for NGS and Kayenta Mine, 2011-2044 are approximately \$680 million (2011\$), of which 40.7% is general sales tax, 30% is income tax, 17.6% is corporate income tax and 11.8% selective sales tax. Coconino County benefits from 39.7% of the 2011-2044 adjusted state tax revenues, equating to \$269.5 million (2011\$). Navajo County benefits from 34.6% of the 2011-2044 adjusted state tax revenues, equating to \$228.7 million (2011\$). Maricopa County benefits from 14.5% of the 2011-2044 adjusted state tax revenue, and Yavapai County 6.8%.

The continued operation of NGS and Kayenta Mine is therefore forecast to result in a significant increase in economic activity within Coconino County and Arizona as a whole.

¹³ Numbers do not add up exactly due to rounding-up.

¹⁴ General State Sales Tax includes authors’ estimates of revenue from Prop 100 temporary tax.

4. Direct Payments to the Navajo Nation

The analysis presented in the previous sections summarizes the significant economic impact of NGS and Kayenta Mine at both a state and county level. Given the large percentage of Native American or Navajo workers employed by these facilities, one might also tentatively conclude that the closure of one or both facilities will have a *significant* negative impact upon the Navajo Nation's economy. The REMI model used by this report is unable to estimate any impact exclusively for the Navajo Nation.

As a result, a second study is under way focusing exclusively on the economic impacts for the Navajo Nation. This second study will include all direct payments made by NGS and Kayenta Mine to the Navajo Nation throughout the period 2011 to 2044.

5. Conclusions and Recommendations

The goal of this report is to provide an assessment of the economic impact of NGS and Kayenta Mine at both an operation-specific and aggregate level during the period 2011-2044, with a focus on employment, real GSP, real disposable personal income and state tax revenues.

A summary of the economic impact of NGS and Kayenta Mine, individually and cumulatively, in the state of Arizona is displayed in Table 16, emphasizing the importance of both operations for the Arizona economy.

Table 16 shows that both operations cumulatively account for 112,720 job years during 2011-2044. This equates to almost \$20.5 billion (2011\$) in real GSP, approximately \$11.2 billion (2011\$) in real disposable income, and just under \$680 million (2011\$) in adjusted state tax revenues.

Table 16: Summary of the Statewide Economic Impact of NGS and Kayenta Mine, 2011-2044

	Total Employment (Full-Time Job Years)	Real Gross State Product (Millions 2011\$)	Real Disposable Income (Millions 2011\$)	Adjusted State Taxes (Millions 2011\$)
Navajo Generating Station	57,793	12,161	5,352	382.96
Kayenta Mine	54,927	8,296	5,811	296.62
<i>Cumulative Total</i>	<i>112,720</i>	<i>20,457</i>	<i>11,163</i>	<i>679.58</i>

Source: Authors' Calculations

From an employment perspective, the mining and utilities sectors benefit the greatest throughout Arizona, accounting for 28.6% of the cumulative private, non-farm employment job years generated by NGS and Kayenta Mine during 2011-2044. However, retail trade (11.9%), health care and social assistance (11.5%), and construction (10.4%) also enjoy significant, positive employment impacts throughout the state.

A significant percentage of each impact per macro-economic variable occurs in the host county of each facility, as summarized in Table 17.

Table 17: Percentage Impact of Key Macro-Economic Variables by Facility and Host County, 2011-2044

	Total Employment	Real Gross State Product	Real Disposable Income	Adjusted State Taxes
Navajo Generating Station – Coconino County	71.1%	81.8%	67.9%	66.8%
Kayenta Mine – Navajo County	72.5%	74.2%	72.8%	77.1%

Source: Authors’ Calculations

Table 18 summarizes the total adjusted state tax revenues of NGS and Kayenta Mine impacting at a county level, and the total percentage of tax revenue impacts.

Table 18: NGS and Kayenta Mine’s Cumulative Adjusted State Revenue Impact by County, 2011-2044

Region	Cumulative Impact 2011-2044 (2011\$)			Percentage of Cumulative State Total
	NGS	Kayenta Mine	Total	
Apache County	\$1,180,119	\$6,450,981	\$7,631,100	1.12%
Cochise County	\$309,909	\$281,243	\$591,152	0.09%
Coconino County	\$255,778,467	\$13,687,786	\$269,466,253	39.65%
Gila County	\$768,968	\$2,237,916	\$3,006,884	0.44%
Graham County	\$177,477	\$14,491	\$191,968	0.03%
Greenlee County	\$76,372	(\$198,758)	(\$122,386)	(0.02%)
La Paz County	\$55,395	\$2,201	\$57,596	0.01%
Maricopa County	\$64,074,325	\$35,171,969	\$99,246,294	14.60%
Mohave County	\$2,044,777	\$462,479	\$2,507,256	0.37%
Navajo County	\$6,113,656	\$228,700,634	\$234,814,290	34.55%
Pima County	\$3,846,390	\$2,315,435	\$6,161,825	0.91%
Pinal County	\$5,561,877	\$4,779,067	\$10,340,944	1.52%
Santa Cruz County	\$155,214	\$100,920	\$256,134	0.04%
Yavapai County	\$42,424,381	\$3,590,112	\$46,014,493	6.77%
Yuma County	\$387,295	(\$969,834)	(\$582,539)	(0.09%)
All Regions	\$382,954,622	\$296,626,643	\$679,581,265	

Source: Authors’ Calculations

Every county enjoys positive economic impacts throughout 2011-2044, with the exception of Greenlee and Yuma, who receive no benefits. Coconino County benefits to the greatest extent, receiving 39.65%

of the adjusted state tax revenues during 2011-2044. Navajo County also benefits significantly, receiving 34.55% of the adjusted state tax revenues during 2011-2044.

40.7% of the adjusted state tax revenues throughout Arizona are for general sales tax, 30% for income tax, 17.6% for corporate income tax and 11.8% for selective sales tax.

Given the significant economic impact of NGS and Kayenta Mine, coupled with the large percentage of Native American or Navajo workers employed by these facilities, one might tentatively conclude that the closure of one or both facilities will have a *significant* negative impact upon the Navajo Nation's economy. However, it is impossible to quantify the exact economic impact without first knowing:

- (a) The distribution of Navajo employees, in terms of both salaries earned from, and company positions held at, NGS and Kayenta Mine;
- (b) The current percentage of the Navajo working population employed by both facilities; and
- (c) Of greatest importance, the extent to which Navajo employees spend and invest any monies earned within the confines of their Nation, rather than elsewhere within or outside Arizona.

Additional research is therefore needed, consisting of a survey of Navajo expenditure patterns and the development of a bespoke Navajo-specific IMPLAN impact analysis for 2011, to robustly estimate the economic impact of NGS and Kayenta Mine exclusively for the Navajo Nation.

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Glossary

Gross State Product (GSP): The dollar value of all goods and services produced in Arizona for final demand/consumption.

Job Year: A job year is equivalent to one person having a job for exactly one year.

Real Disposable Personal Income: The household income that is available to be spent after taxes have been paid. Technically speaking, real disposable personal income is the sum of wage and salary disbursements, supplements to wages and salaries, proprietors' income, rental income of persons, personal dividend income, personal interest income, and personal current transfer receipts, less personal taxes and contributions for government social insurance.



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