End of an Era: Navajo Generating Station Is No Longer Economic

Keeping the Plant Open Through 2022 Would Require a $740-Million-to-$1-Billion Subsidy; Keeping it Open Through 2030 Would Require a $1.4 to $2.4 Billion Subsidy

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Executive Summary

The outlook for the Navajo Generating Station, a 2,250-megawatt coal-fired electricity-generation plant in northern Arizona, is bleak.

Declining energy market prices and rising production costs have made the power produced by the plant more expensive than power sold in the larger energy market. NGS, in a word, is no longer competitive.

These factors are not likely to change, leaving the plant's financial viability in doubt—regardless of who owns it. A substantial subsidy will be needed to keep the plant operational

The plant, which is situated on land owned by the Navajo Nation, is owned jointly by the Salt River Project (SRP), the U.S. Department of Reclamation, the Arizona Public Service Company, Nevada Power, and Tucson Electric Power. Barring a viable agreement that could delay retirement until 2019, the utility members of this group—Arizona Public Service Company, SRP, Nevada Power and Tucson Electric—have voted to close the plant this year.

Three of those utilities—SRP, Arizona Public Service Company, and Tucson Electric—told the Arizona Corporation Commission in late April that they no longer require electricity from the generating station because they have access to cheaper gas-fired generation. The Central Arizona Project (CAP), the largest customer for NGS power, wants out as well; CAP managers say the agency could had acquired power in 2016 for $38.5 million less than it paid for power from the plant had it bought that power somewhere else. Both CAP and Salt River Project, which operates the plant, expect power from NGS will become even more expensive than market power in coming years.

Details around any potential bailout for Navajo Generating Station remain murky. Although it looks increasingly likely that an agreement will be reached to keep the plant operating until at least 2019, no bailout start or duration dates have been proposed, nor have any dollar figures been publically discussed. No source of bailout funding has been identified. IEEFA has analyzed three potential bailout scenarios, however, each based on different starting dates and durations and on ranges for future NGS operating costs and generation.

Our analysis here aims to determine the size of a bailout required to make the cost of power from NGS competitive with the market price of power at the regional Mead Hub.

We put the price of keeping NGS open from mid-2017 through the end of 2019 at $414 million. Extending that bailout to keep NGS operating from 2020 until 2030 would cost an additional $1 billion to $2 billion, meaning a total bailout of $1.4 billion to $2.4 billion would be required to keep NGS operating from mid-2017 through the end of 2030.

A five-year bailout plan from mid-2017 through mid-2022, as has been suggested by a member of the Arizona Corporation Commission, would cost $740 million to $1 billion.

In short, keeping the Navajo Generating Station online would require at least hundreds of millions of dollars in subsidies over the short term and billions over the longer term.

Background: Plant Location and Ownership

The Navajo Generating Station near Page, Ariz., is on leased land that is owned by the Navajo Nation. NGS Units 1-3 are each rated at a nominal 803 megawatts (MW) of nameplate capacity, with 750 MW of net capacity[1]. All of the units are over 40 years old (Unit 1, 43 years old; Unit 2, 42 years old; Unit 3, 41 years old).

Unless the plant is retired by 2019, it may be required either to close one unit or add expensive pollution control technology to meet the requirements of "regional haze" air pollution rules.

The plant is the sole purchaser of coal from Peabody Energy's Kayenta Mine, which is about 90 miles away.

The ownership of the plant is divided as follows: Salt River Project (42.9%), the U.S. Department of Reclamation (24.3%), Arizona Public Service Company (14%), Nevada Power (11.3%), and Tucson Electric Power (7.5%),

The Central Arizona Project (CAP) uses the federal government's share of the power to pump water from the Colorado River to Phoenix and Tucson.

Our analyses here are based on publicly available information filed by the plant's owners with the U.S. Department of Energy's Energy Information Administration and with the Federal Energy Regulatory Commission (FERC) and from industry information published by S&P Global Intelligence. The references to Navigant Consulting and Peabody Energy presentations refer to information provided at an Arizona Corporation Commission workshop on April 6, 2017.

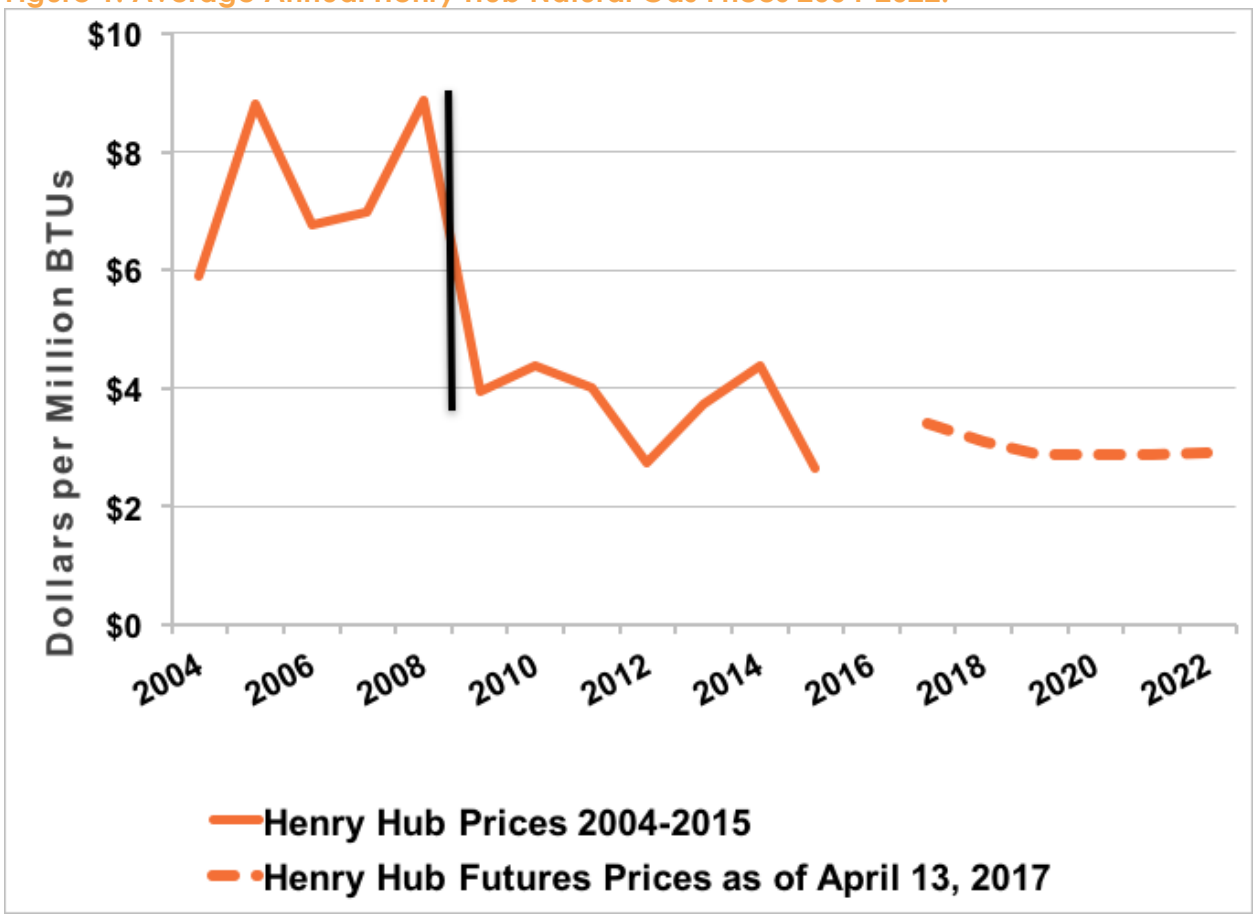
Market Forces Have Rendered NGS Uncompetitive

Nationally, the decline in the financial viability of coal plants and the retirement over the past few years of more than 250 coal-fired units have been driven by changes in the energy markets: very low natural gas prices, leading to low energy market prices; rising plant production costs; and declining generation due to increasing competition from renewable resources and higher generation at natural gas-fired units. These changing circumstances have made NGS less competitive with market power, a trend that will very likely continue in the coming years.

As shown in Figure 1, below, natural gas prices have fallen dramatically since 2008, and are expected to remain low for years to come. The map below shows Henry Hub prices, the national benchmark for natural gas prices.

[1] The difference between each unit's gross and net capacity represents its "parasitic" loads, that is, the power that is used to operate on-site equipment

Figure 1: Average Annual Henry Hub Natural Gas Prices 2004-2022.[2]

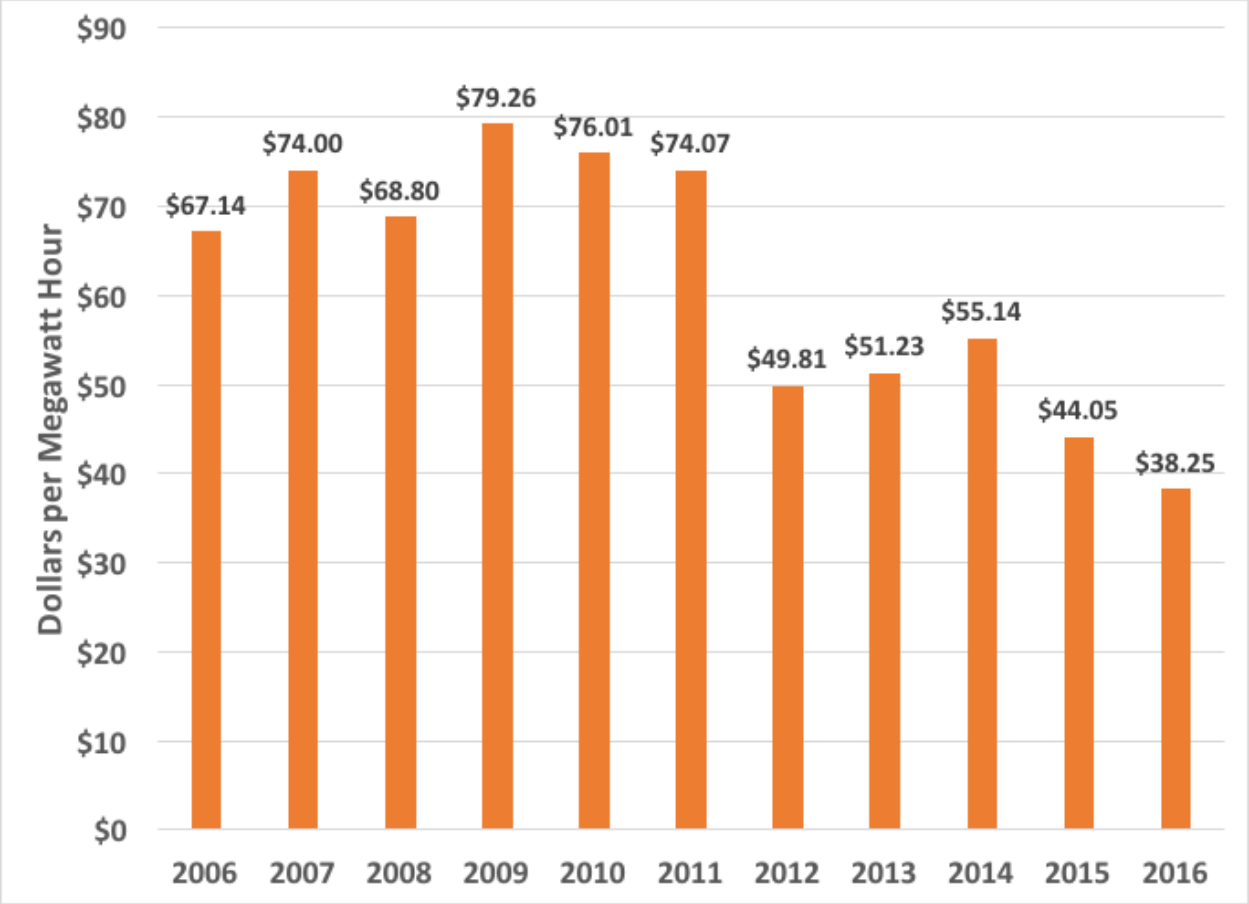


The natural gas futures prices in Figure 1 represent the prices at which gas can be contracted today for delivery that occurs months or years in the future. As such, they represent the market's outlook for natural gas prices. Although utilities and independent power producers in the Southwest do not purchase their natural gas at Henry Hub, the prices there are indicative of prices across the rest of the country.

Low natural gas prices have led to dramatically lower operating costs at gas-fired units, which have made them more competitive with coal-fired generators like NGS. Figure 2, below, shows the decline, over time, of the cost of generating power at Arizona Public Service Company's Redhawk gas-fired combined cycle plant.

[2] Historical natural gas prices from U.S. Energy Information Administration. Futures prices from OTC Global Holdings, as reported by SNL Financial.

Figure 2: Annual Dollar Per Kilowatt Hour Production Costs at APS's Redhawk Combined Cycle Plant.[3]

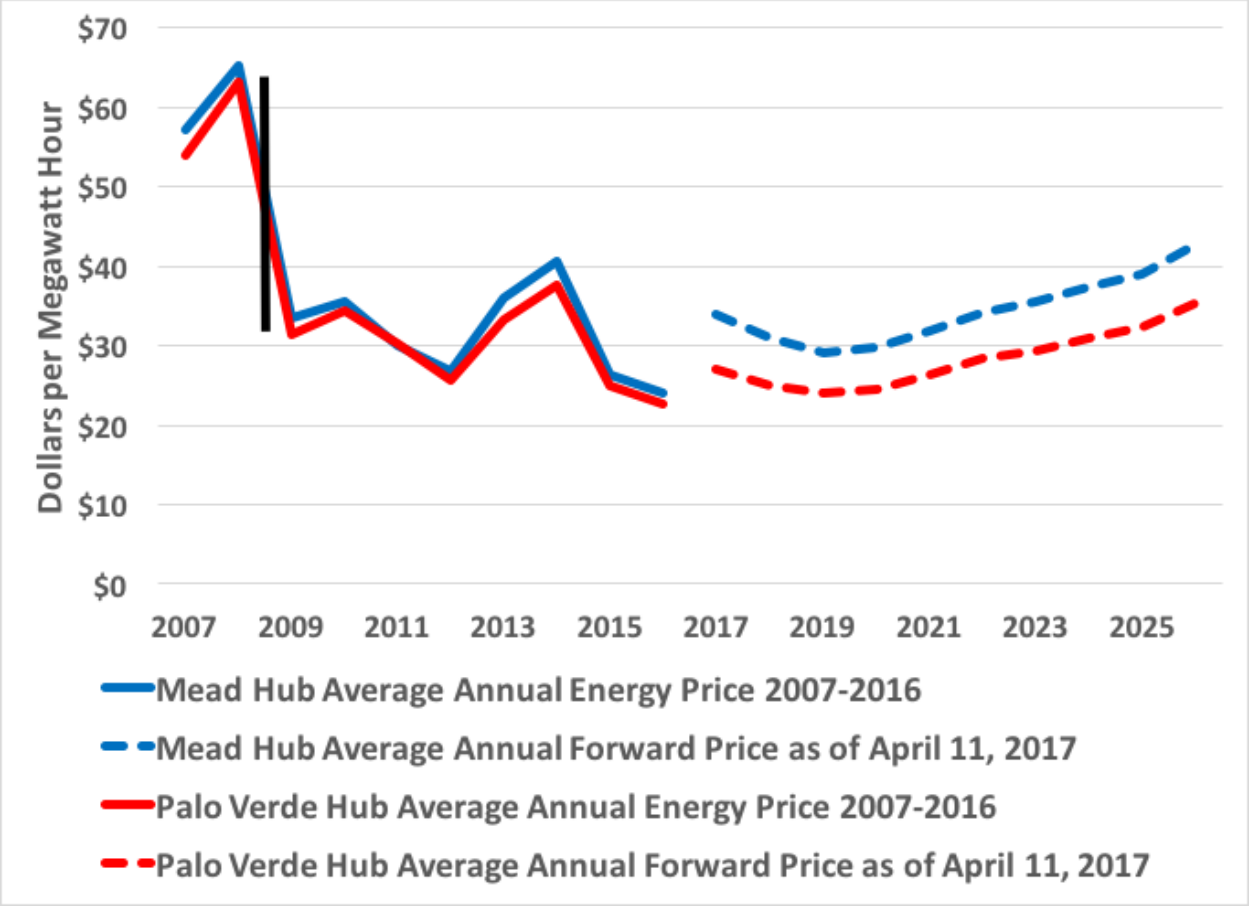


NGS connects to the grid at the Mead Hub, and it also competes with power plants that connect at the Palo Verde Hub. Because natural gas-fired plants set the market price of power during much of the year (including those at the Mead and Palo Verde Hubs), the steep decline in natural gas prices beginning in late 2008 shown in Figure 1 has been followed by precipitous drops in the wholesale power prices (see Figure 3).

Lower energy market prices mean utilities have less expensive options than NGS. Central Arizona Project has compared what it paid in 2016 for power from NGS to the price of market power at Palo Verde and found that it would have saved a total of $38.5 million by buying energy from the broader market instead of from NGS.[4]

[3] Source: Annual Arizona Public Service Company FERC Form 1 Filings for the years 2006-2016.
[4] Source: Central Arizona Project Power Task Force Report, "Impact of NGS Closure on CAP." Dated February 16, 2017.

Figure 3: Average Annual Wholesale Electricity Market Prices at the Mead and Palo Verde Hubs.

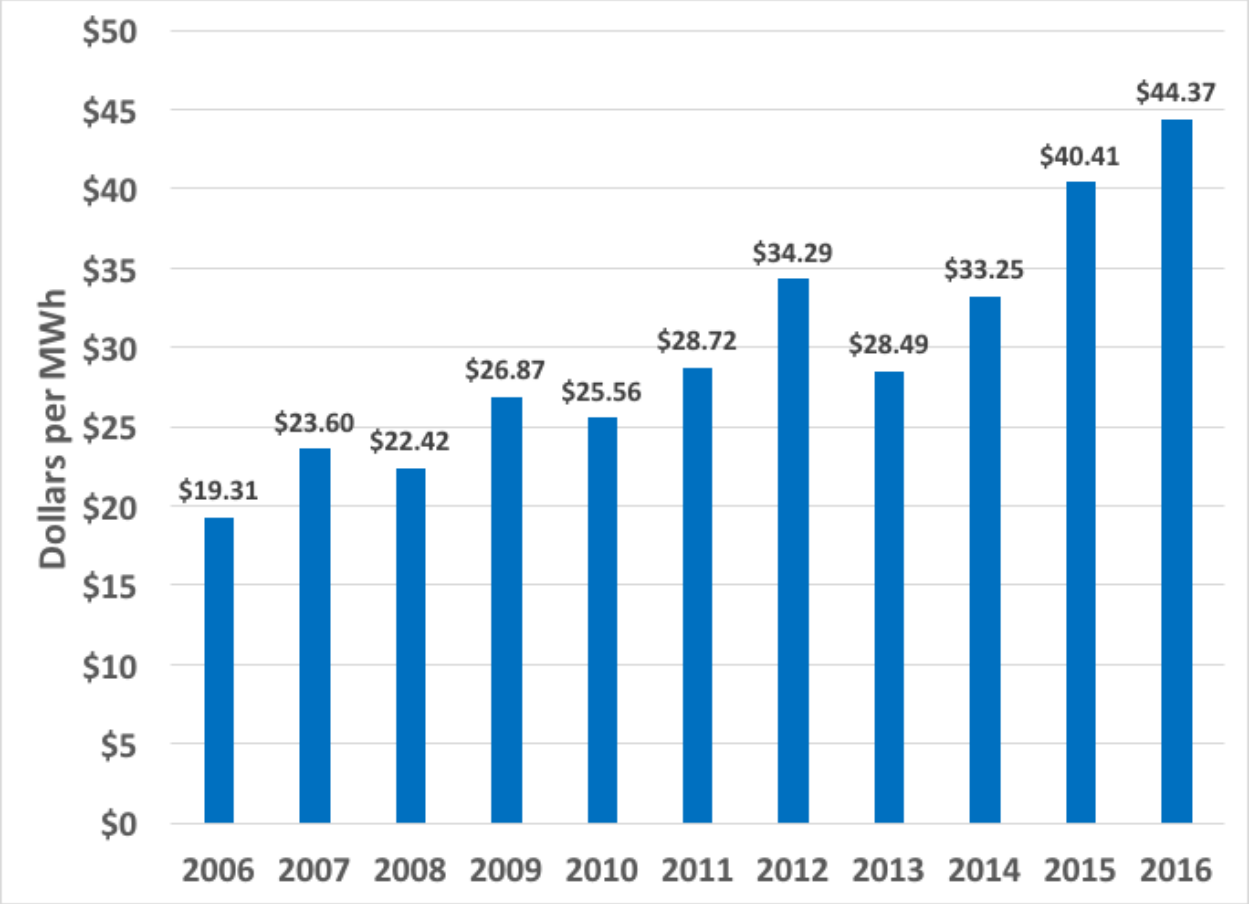


The forward prices in Figure 3 represent the prices at which power can be purchased today for delivery months or years in the future. As such, they represent the market's outlook for future energy market prices at the Mead and Palo Verde Hubs. The vertical line in Figure 3 represents the time in late 2008/early 2009 when natural gas prices collapsed, leading wholesale energy market prices lower.

As market prices for power have plummeted, the cost of generating power at many coal plants around the nation has increased. These rising production costs have made coal-fired units less competitive with natural gas-fired plants and renewable solar and wind resources.

Figure 4, below, shows the steep growth in the cost of generating power at NGS, as reported by Arizona Public Service Company in its annual FERC Form 1 filings.

Figure 4: Annual Navajo Generating Station Production Costs in Dollars per MWh.[5]



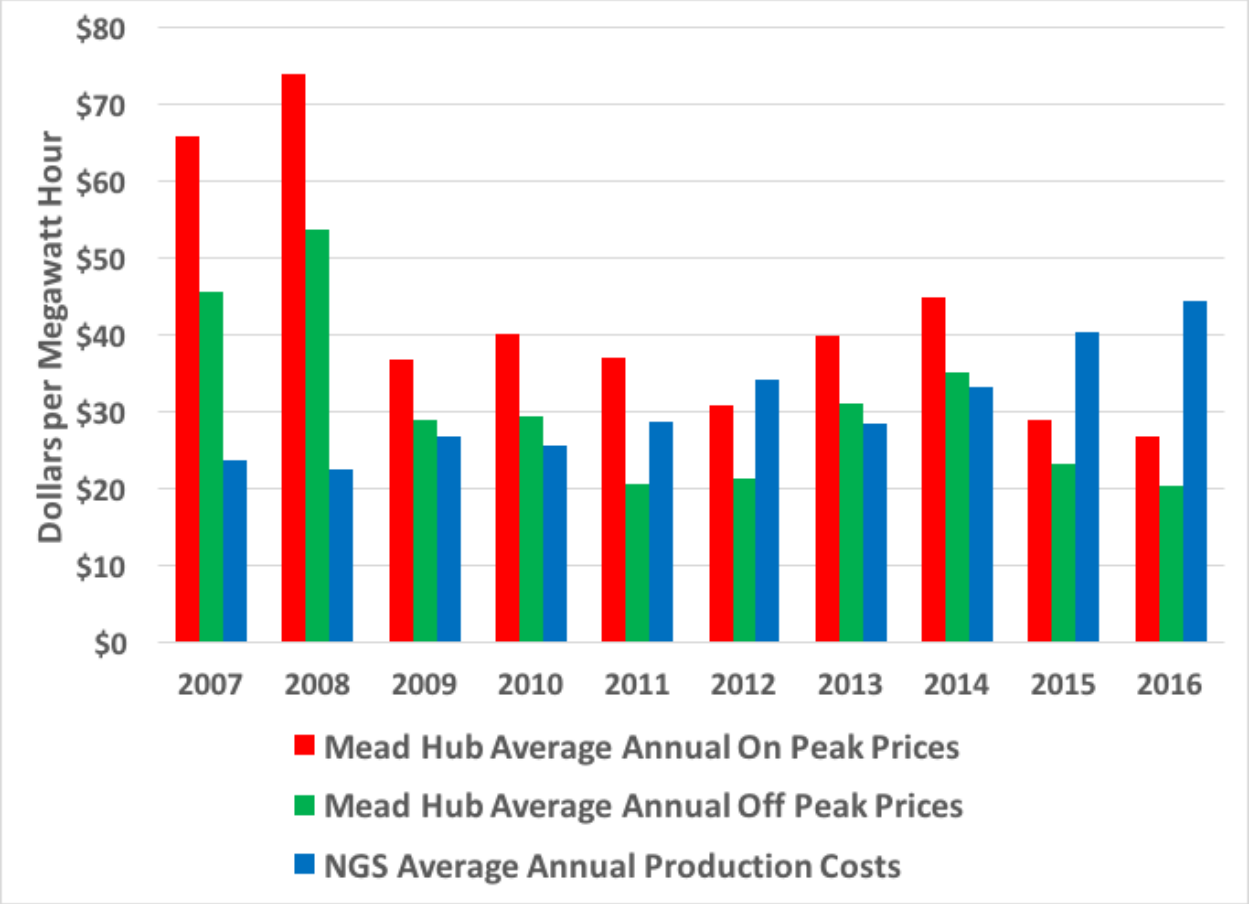
These increases represent a compound annual growth rate in the cost of producing power at NGS of almost nine percent per annum from 2006 through 2016.

Figure 4 reflects only NGS's annual operating & maintenance costs. In addition to these expenses, the plant's owners also have paid an average of $19 million each year for capital expenditures (capex) during the years 2006 through 2016.

The rising cost of generating power at NGS and the declining prices for power at the Mead Hub mean that power from the plant has become significantly more expensive than buying power from the market, as shown in Figure 5, below.

[5] Source Arizona Public Service Company annual FERC Form 1 filings for the years 2006 to 2016.

Figure 5: Historical Cost of Producing Power at NGS vs. Energy Prices at the Mead Hub.[6]



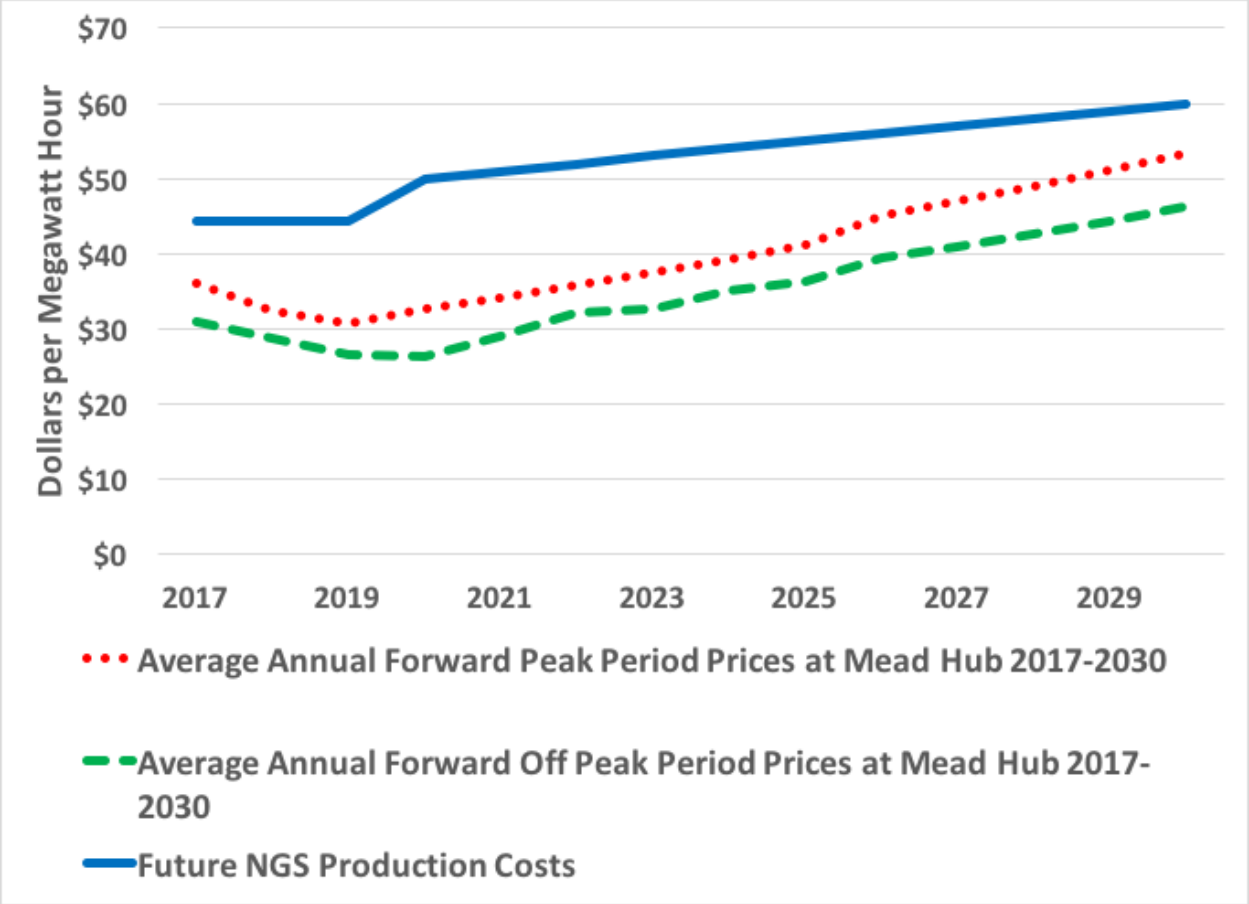
The average cost of producing power at NGS has been higher than average off-peak prices at the Mead Hub since 2012, except for a short period in 2013 and 2014 when the prices were relatively close.[7] The average cost of power at NGS was higher than average peak period prices in 2015 and 2016.

As shown in Figure 6, below, barring substantial and long-term subsidies, the cost of producing power at NGS is almost certain to remain substantially higher than the price of power at the Mead Hub.

[6] Source for NGS Production Costs is Arizona Public Service Company annual FERC Form 1 filings for the years 2006 to 2016. SNL Financial for annual energy prices at the Mead Hub.

[7] The fact that the prices were close in 2013 and 2014 means that the cost of producing power at NGS was higher than energy market prices at the Mead Hub for at least some, if not many, of the hours in those years.

Figure 6: Projected NGS Production Costs vs. Forward Energy Prices at the Mead Hub.[8]



The fact that the cost of generating power at NGS has risen above energy market prices has had two impacts on NGS and its owners, both of which threaten its viability.

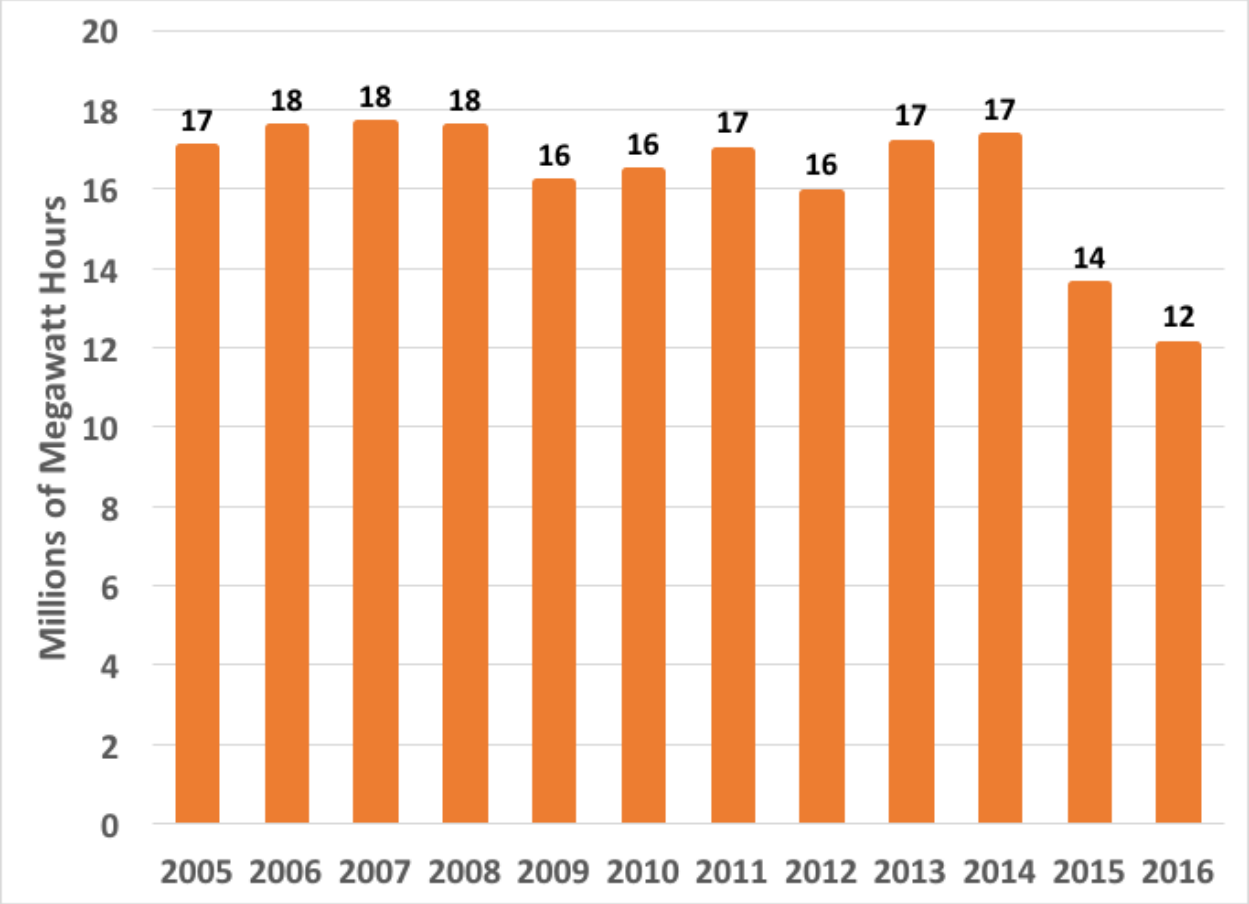
First, the price of the power being sold at the plant has not covered the full cost of producing that power—in other words, it is operating, on average, at a net loss for each of the megawatt hours of power it sells.

Second, as the cost of producing power at the plant has risen, and NGS has become less competitive with the cost of producing power at other generators in the market, the plant has begun to produce significantly less power in recent years than it had previously generated, as shown in Figure 7, below.

In these two ways, the interaction between NGS's rising production costs and declining energy market prices have undermined the financial viability of continuing to operate the plant.

[8] This Figure assumes that the average cost of producing power at NGS (not including Capex) will be $43.75 per MWh in 2017-2019. This was NGS's average production cost in 2016, as reported by Arizona Public Service Company in its annual FERC Form 1 Filing. The production costs for the years 2020 until 2030 reflect SRP's projection that NGS production prices would be between $50 and $60 per MWh.

Figure 7: Annual NGS Generation, 2005 to 2016.[9]

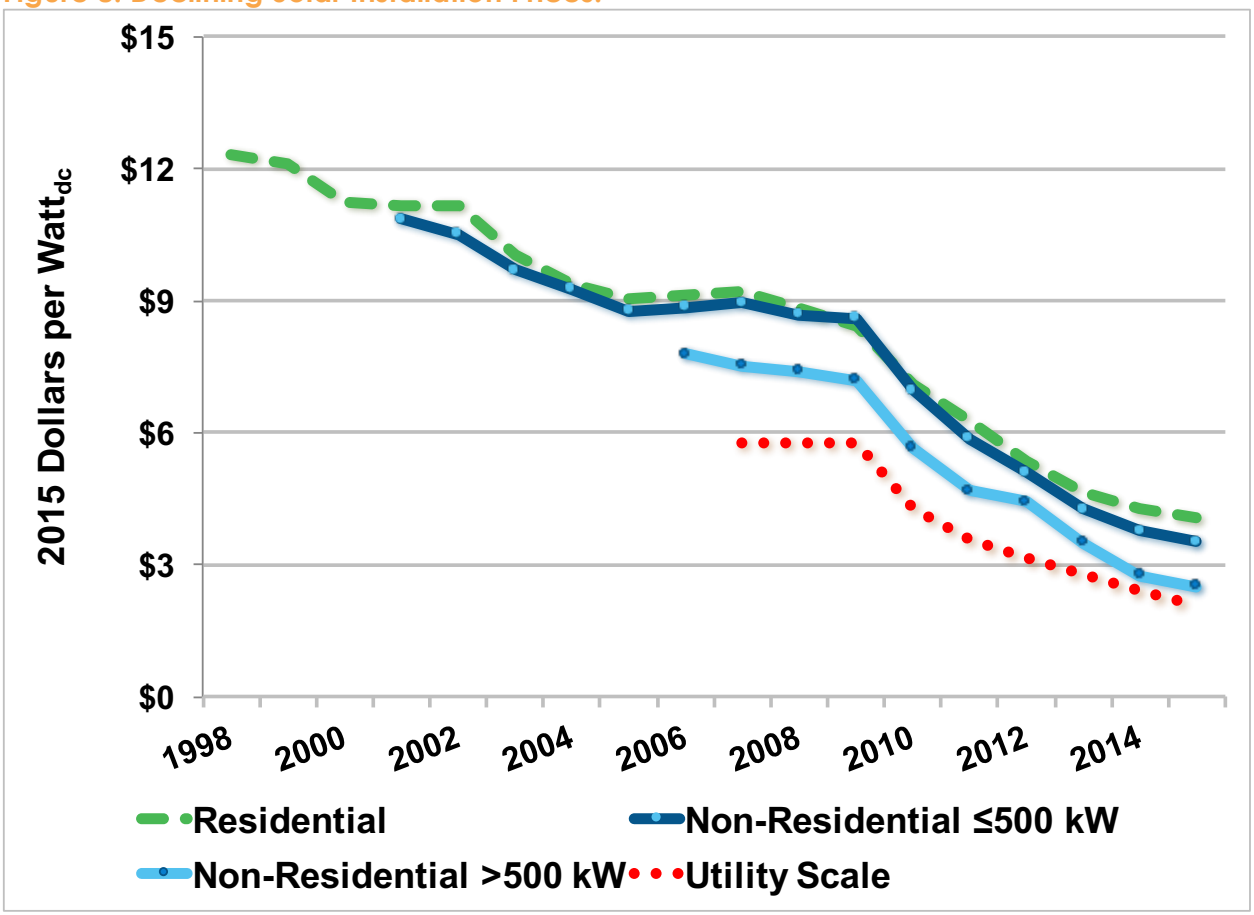


So far, the bulk of NGS's competition has come from low-cost natural gas-fired units. However, it is increasingly likely that higher generation from renewable resources in coming years will put even more pressure on NGS both by displacing generation that would otherwise have been generated at the plant and by keeping energy market prices low.

New solar installations costs have declined substantially in recent years, and further declines are expected in coming years. And solar, like wind-powered electricity generation, has negligible operating costs.

[9] Source EIA Form 923 Filings for the Years 2005-2016.

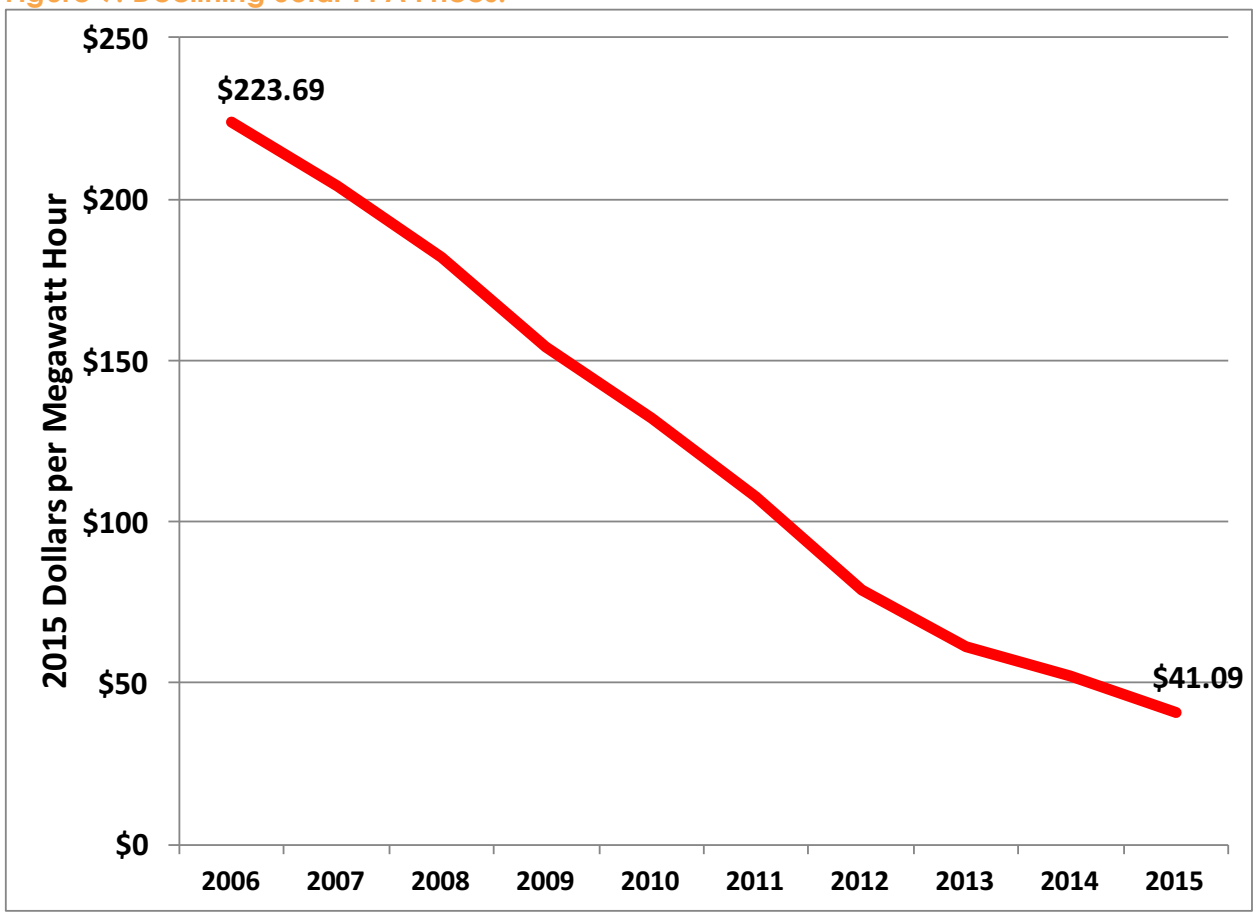
Figure 8: Declining Solar Installation Prices.[10]



As a result of these declining installation costs, solar power purchase agreement (PPA) coasts have declined precipitously, making solar an increasingly economic alternative to aging coal plants like NGS.

[10] *Utility-Scale Solar 2015: An Empirical Analysis of Project Cost, Performance and Pricing Trends in the United States*, Lawrence Berkeley National Laboratory. Available at https://emp.lbl.gov/sites/all/files/lbnl-1006037_report.pdf.

Figure 9: Declining Solar PPA Prices.[11]



Current expectations are that future solar PPA prices will decline further, with some analysts estimating PPA prices of $30 to $40 per MWh in the early 2020s, even without a solar investment tax credit.[12] Due to similar steep declines in installation costs and improvements in operating performance, wind PPA prices also have dropped and are now expected to go perhaps as low as $20 to $30 per MWh by the early 2020s and to do so with no production tax credit.[13]

Wind and utility-scale solar have no operating costs and, therefore, are dispatched ahead of fossil-fired plants. Thus, they displace the generation from and reduce the revenues earned by coal-fired units like NGS. At the same time, distributed rooftop solar photovoltaic resources and energy efficiency investments are putting downward pressure on coal plant revenues by reducing the demand for power. The addition of more solar and wind renewable resources will put ever greater pressure on coal plants in future years by (1) keeping energy market prices low and (2) by displacing generation that would otherwise be produced at NGS.

The bottom line, then, is that continued operation of the Navajo Generating Station is not financially viable given the competitive environment in which the plants would be operating.

[11] Id.
[12] UBS Global Research, *The Renewable Cost Deflation Trends Continue*, February 16, 2017. Available at https://neo.ubs.com/shared/d1X1OBuc7TKNdeG/
[13] Id.

A wave of market and economic forces including low natural gas, low energy market prices (at both the Mead and the Palo Verde Hubs), higher NGS production costs, annual capex at the plant, and increasing competition from low cost renewable resources will prevent NGS from being a profitable and long-term viable investment—by any owner.

There is no reason to expect that, without substantial subsidies, either the cost of producing power at NGS will be competitive with market prices or that the plant will generate substantially more power in the future than it has in recent years.

As three of NGS's current owners (Arizona Public Service, Tucson Electric and Salt River Project) recently have told the Arizona Corporation Commission to continue hold ownership in the plant because the Arizona has cheap gas-fired generation and because electricity from the coal plant is too expensive. They also report that it would cost their companies and ratepayers more to keep NGS open than to replace the capacity with gas-fired resources, of which Arizona has an abundant supply.

Another force at work against the financial viability of NGS is the fact that Arizona does not have a capacity market that can provide subsidies to an otherwise uneconomic generator. This is in comparison, for example, to the Midwest, where coal plants in the regional PJM and MISO markets receive capacity market payments whether their power is even needed. It hard to imagine any utility or other customer entering into any such agreement to pay for capacity from NGS—whether they use the power— and certainly not the three main Arizona utilities that have already said that they don't need or want to maintain their shares in ownership of the plant.

Enormous Subsidies Will Be Required to Keep the Plant Online

The amount and length of the subsidies that would be required to bailout NGS and make the cost of its power competitive with market prices depend on several factors: future plant production costs and capex; expected energy market prices at the Mead Hub and perhaps the Palo Verde Hub; how much power NGS can reasonably be expected to generate; and whether all three units would be run in coming years or if one unit would be retired to meet the Regional Haze agreement.

IEEFA's assessment then looks at four possible futures for the plant and determines a reasonable range for the bailouts that would be required to make and keep NGS competitive with natural gas and renewable sources of power.

NGS Plant Costs:

For the years 2017 through 2019, our analyses use an average NGS production cost of $44.37 per MWh. This is the average cost that Arizona Public Service Company reported for NGS in its 2016 FERC Form 1 Filing. These figures are conservative because they do not include any capital expenditures or escalation from 2016 through 2019. According to APS's annual

FERC Form 1 Filings, NPS-related capex averaged about $19 million per year from 2005 through 2016.

For the base case NGS production costs, starting in 2020 we use the recent projections from the Salt River Project, the plant's operator. These costs are between $50/MWh and $60/MWh during the years 2020-2030.

For a low production cost sensitivity, we have assumed that starting in 2020 NGS's fuel costs would be reduced by $2/MWh due to a $4 per ton (approximate 10 percent) reduction in coal costs. Peabody has been very unclear about how much of a reduction in the price of coal it is willing to offer to keep NGS running, and for how long. However, it appears from Peabody's April 6, 2017, submission to the Arizona Corporation Commission that it is willing to reduce the price of the coal it supplies to NGS by about 5-10 percent for at least a couple of years starting in 2020. For this reason, we believe that our assumption of a $4 per ton coal price reduction for the 10-year period 2020-2030 is conservative in favor of continued operation.[14] In this lower production cost model, we have also assumed that the plant's fixed costs could be reduced by $4 million per unit per year, as claimed by Navigant, a consultant working on Peabody's behalf. We have taken this tack to ensure we are being adequately conservative, even though neither Navigant nor Peabody have provided any evidence as to how realistic it is to assume that such a reduction in non-fuel operating costs actually could be achieved.

Energy Market Prices:

We use the current forwards prices for the Mead Hub in our assessment, even though, as was noted above, NGS also competes with resources that sell power at the Palo Verde Hub, which has lower energy market prices.

Generation:

We examine high- and low-generation scenarios. In our high-generation scenario (our "base case") we have assumed that in future years NGS will generate 12 million MWhs per annum — the same amount of power that it produced in 2016. In lower-generation scenarios we have assumed that starting in 2020 the plant would generate an average of only 8 million MWh each year. This reflects an assumption that one of the three NGS units could be retired by the end of 2019.

[14] Peabody's presentation before the Arizona Corporation Commission contains a slide that shows a "proposed extension pricing – fixed pricing" price of coal to the plant ranging from $40-$47 per ton during the period 2020-2025, an average of $42.75. There is no indication whether these prices purport to be a discount from current market prices (the presentation lacks prices for 2017-2019); whether the "fixed price" period exists for only five years; whether the "fixed price" would be the average $42.75 per ton or require a 17% increase over the five years from $40 to $47 per ton.

It may be that the assumption that NGS will generate even 8 million MWh per year is overly optimistic. The level of the plant's variable O&M costs may well make it uncompetitive to operate during many hours in coming years and, thereby, preclude its dispatching power. Reduced dispatch would mean lower revenues and would further undermine NGS's financial viability.

Period of Analysis:

There is great uncertainty as to when a bailout would start—assuming one does—and for how long it would be used to subsidize NGS's continued operation. For this reason, we have examined four possible bailouts. The first bailout we have looked at is what it would cost to keep NGS operating from mid-2017 through the end of 2019. The second bailout reflects what it would cost to keep the plant operating from 2020 until 2030. The third bailout is simply the total cost to keep NGS operating from mid-2017 through the end of 2030—in other words, the sum of bailouts 1 and 2. Finally, we have examined a potential bailout for five years, starting in mid-2017. This scenario is based on our understanding of the proposal being floated by ACC Commissioner Tobin.

We have ended the timeframe for any NGS bailout at 2030 because we believe it is extremely unlikely that the plant would, in any event, continue to operate beyond that date given the magnitude of the bailouts that would be required and the reasonable possibility that the plant's operating and maintenance costs will increase significantly as it ages and/or that its operating performance will degrade. There is no sense in speculating that NGS might possibly produce benefits in the far distant future after delivering $1.4 to $2.4 billion in operating losses through 2030.

Future Carbon Costs:

To be conservative too we have not assumed the imposition of future carbon costs in our analyses. However, we do believe that it would not be prima facie unreasonable to do so. In fact, although there is great uncertainty about the timing and stringency of any carbon-pricing regime, many utilities in their resource planning analyses assume that carbon dioxide (CO_2) will ultimately be priced under future regulation.

The losses that would be attributable to NGS, and the magnitude of any bailout that would be required to make the plant financially viable would increase significantly if carbon costs were to be included.

Summary of Assumptions

IEEFA prepared four different scenarios for each of the three time periods examined:

(1) The Base Case

Production costs of $44.37 per MWh in 2017-2019 and $50 to $60 per MWh between 2020 and 2030.

Annual generation of 12 million MWh.

Current Mead Hub forward peak and off-peak energy market prices.

(2) Base-Case NGS Production Costs With Lower Annual Generation Starting in 2020

Production costs of $44.37 per MWh in 2017-2019 and $50 to $60 per MWh between 2020 and 2030.

Annual generation of 12 million MWh in 2017-2019, reduced to 8 million MWh per year starting in 2020.

Current Mead Hub forward peak and off-peak energy market prices.

(3) Lower NGS Production Costs with Base Case Generation

Production costs of $44.37 per MWh in 2017-2019. Starting in 2020, production costs are reduced by $2 per MWh to reflect lower fuel costs and $4 million per unit per year to reflect non-fuel cost savings claimed by Navigant in its April 7, 2017, presentation to the Arizona Corporation Commission.

Annual generation of 12 million MWh in all years.

Current Mead Hub forward peak and off-peak energy market prices.

(4) Lower NGS Production Costs and Lower Annual Generation Starting in 2020

Production costs of $44.37 per MWh in 2017-2019. Starting in 2020, production costs reduced by $2 per MWh to reflect lower fuel costs and $4 million per unit per year to reflect non-fuel cost savings claimed by Navigant on Peabody's behalf.

Annual generation of 12 million MWh in the years 2017-2019, reduced to 8 million MWh per year starting in 2020.

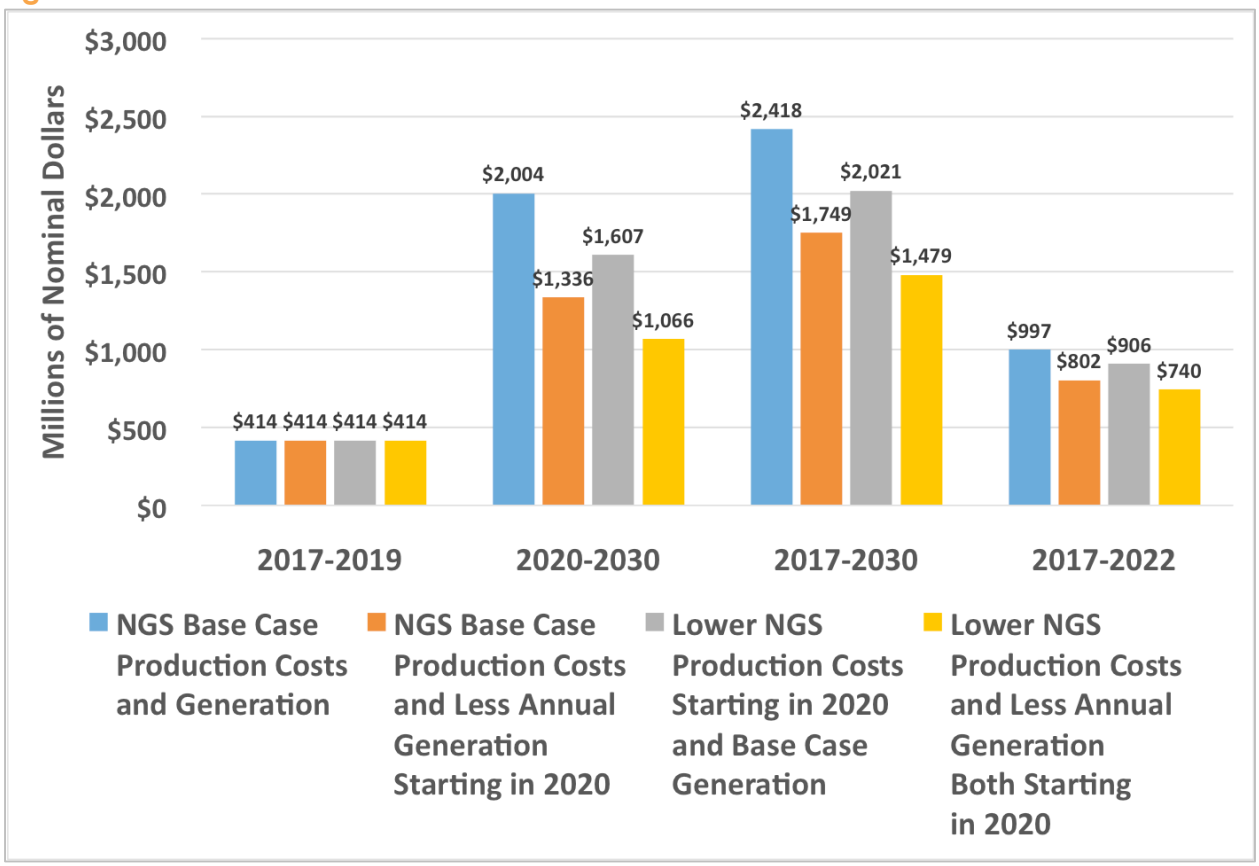
Current Mead Hub forward peak and off-peak energy market prices.

Table 1 and Figure 10 below illustrate our analysis.

Table 1 and Figure 10: Bailouts Required to Make the Cost of Power from Navajo Generating Station Competitive with the Cost of Market Power

	Millions of Nominal Dollars			
Scenario:	**2017-2019**	**2020-2030**	**2017-2030**	**2017-2022**
NGS Base Case Production Costs and Generation	**$414**	**$2,004**	**$2,418**	**$997**
NGS Base Case Production Costs and Less Annual Generation Starting in 2020	**$414**	**$1,336**	**$1,749**	**$802**
Lower NGS Production Costs Starting in 2020 and Base Case Generation	**$414**	**$1,607**	**$2,021**	**$906**
Lower NGS Production Costs and Less Annual Generation Both Starting in 2020	**$414**	**$1,066**	**$1,479**	**$740**

Figure 10:



Conclusion

Enormous subsidies would be required for Navajo Generating Station to continue operating under any owner.

Rather than spend such sums of money on a failing and aging coal-fired power plant, we recommend the plant's owners begin planning immediately for retirement of the plant and toward an orderly transition to a profitable and sustainable energy economy.

Institute for Energy Economics and Financial Analysis

The Institute for Energy Economics and Financial Analysis (IEEFA) conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy and to reduce dependence on coal and other non-renewable energy resources. More can be found at www.ieefa.org.

About the Author

David Schlissel

David Schlissel has been a regulatory attorney and a consultant on electric utility rate and resource planning issues since 1974. He has testified as an expert witness before regulatory commissions in more than 35 states and before the U.S. Federal Energy Regulatory Commission and Nuclear Regulatory Commission. He also has testified as an expert witness in state and federal court proceedings concerning electric utilities. His clients have included state regulatory commissions in Arkansas, Kansas, Arizona, New Mexico and California, publicly owned utilities, state governments and attorneys general, state consumer advocates, city governments, and national and local environmental organizations.

Schlissel has undergraduate and graduate engineering degrees from the Massachusetts Institute of Technology and Stanford University. He also has a Juris Doctor degree from Stanford University School of Law.