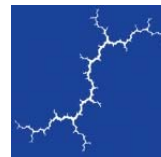

Chasing the Elusive Benefits of Navajo Generating Station

A Review of Peabody & Navigant's Navajo Economic Assessment

Prepared for Sierra Club

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1. INTRODUCTION

On February 13, 2017, utilities representing three-quarters of the ownership of Navajo Generating Station (NGS) voted to cease operations. NGS, a 2,225 MW coal-fired power plant just outside Grand Canyon National Park in northern Arizona was built in 1974. The plant acquires all of its fuel from the nearby Kayenta mine, owned by the Navajo Nation and operated by Peabody Energy.

On April 7, 2017 Peabody arranged a presentation before the Arizona Corporation Commission (ACC) to show an analysis the coal company had commissioned from Navigant. That analysis concluded that, over the period from 2020-2040, “NGS cost is projected to be \$392 million net present value below the cost of market replacement energy and capacity,” and that while NGS’s profitability margins had “declined with gas prices in 2015 and 2016... [they] are expected to rebound with increasing gas prices going forward.” The Navigant study provides extremely little detail on the basis of its analysis assumptions and underlying data, instead making generally blanket statements with respect to the validity of its assessment and critiquing independent analyses conducted by Salt River Project, the majority owner, and the National Renewable Energy Laboratory (NREL) on behalf of the US Department of Energy.

The study presented here is designed to examine the implicit and explicit assumptions of Navigant’s analysis, and assess the validity of Navigant’s conclusions with respect to the economic value of NGS. Our findings are as follows:

1. Navigant’s derived benefit of NGS is overblown, relying on an assumption of a dramatic spread between coal and market energy prices in 2030. Navigant’s own analysis shows little benefit for NGS unless the market recovers.
2. Navigant’s study relies on either substantially reduced coal prices or an assumption that NGS can persist with substantially reduced maintenance expenses – or both – and does not reflect the reality of NGS operations over the last five years.
3. Navigant assumes that market energy prices will rise substantially starting in 2030, exceeding current utility assumptions by over 30% by 2037.
4. Navigant assumes that the market value of capacity will rise substantially starting in 2030, to the equivalent of market capacity prices only seen in the far more capacity-constrained PJM marketplace.

Overall, Navigant’s assessment of the economic viability of Navajo is opaque, and relied on overstated market energy prices and substantially understated fuel prices for Navajo. Reviewing the elements of Navigant’s assessment we find substantial problems, mounting up to **nearly \$2 billion in errors**, faulty assumptions, and exclusions.

The following sections highlight each of the problems embedded in the Navigant / Peabody Energy presentation.

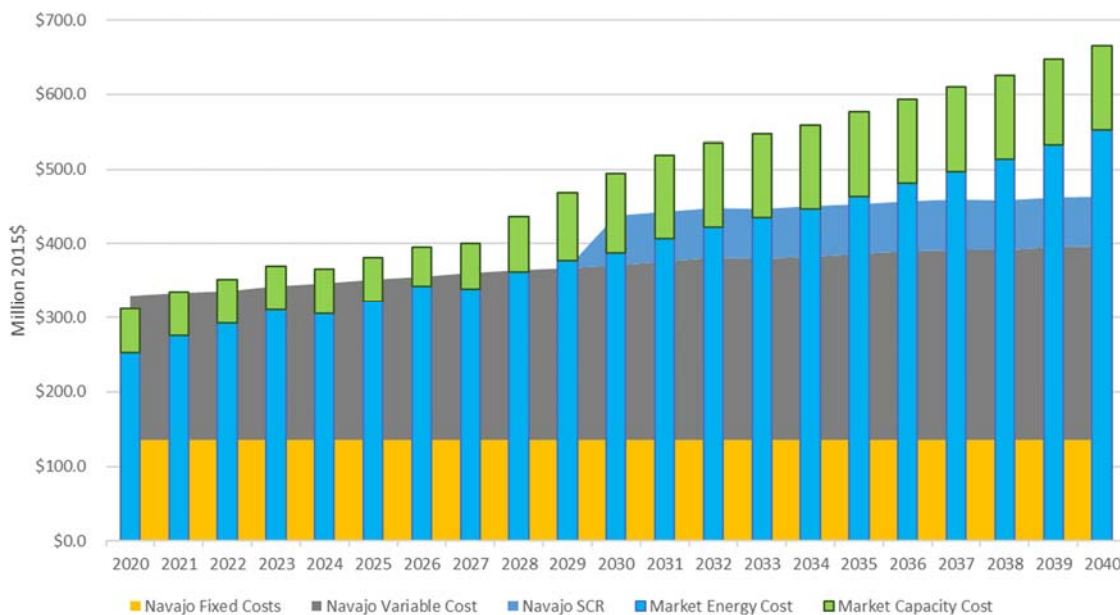


2. THE NAVIGANT/PEABODY ECONOMIC ANALYSIS

Navigant presented an economic analysis of Navajo power station from 2020-2040, with an estimated savings of \$392 million relative to market energy and capacity.¹ Navigant’s presentation is long on assertions, and short on disclosure. Fuel prices, operations and maintenance costs, energy prices, capacity price assumptions, the cost of capital projects incurred in 2030, and the assumed book life of those projects are all missing. Key financial assumptions – such as the assumed discount rate – are also missing. Even a basic question of if the values shown in Navigant’s study represent two units at Navajo, or three, are not mentioned. From the perspective of reasonable resource planning, relied upon by utilities across the country and all of Navajo’s non-federal owners, Peabody’s presentation and Navigant’s study fall short. As we show below, reverse engineering Navigant’s study reveals unsupported and often erroneous assumptions.

The only quantitative information provided by Navigant is in a graphic, re-created in Figure 1, below, showing the equivalent market price of energy and capacity in excess of Navajo’s costs by 2022.

Figure 1. Navigant/Peabody Energy Economic Analysis of Navajo Power Station



There are several immediately notable features of this analysis. First, even under Navigant’s assumed pricing, Navajo barely breaks even on an annual basis until market energy and capacity prices begin

¹ Navigant NGS Study, page 17.



rising in the late 2020s. Second, Navigant shows market energy costs (the blue bars) well in excess of Navajo’s variable cost of production (“variable costs”) even in 2020.

The first feature, the long span until a break-even, is important in evaluating the risk of maintaining the plant. Even under Navigant’s generous assumptions, Navajo doesn’t start paying back substantially until the late 2020s, meaning that any owner would have to be willing to absorb the risk of stagnant energy prices or rising coal prices for another decade. Few new owners would be willing to take on such a risk profile, effectively betting ratepayer dollars on a market recovery.

The second feature, the high market energy costs in early years relative to the variable cost of production at Navajo, implies that Navajo should be making large energy margins today and through 2020, a fact that is belied by the falling capacity factor of the plant, and the losses being incurred by Navajo’s owners today. In a recent presentation, Central Arizona Project (CAP) estimated that it “would have saved \$38.5 million in 2016 by buying energy on the market instead of from NGS.”²

So how did Peabody and Navigant find such a substantial benefit in Navajo when all of the private owners have decided the plant is not in the best interests of their customers? The answer requires reverse engineering the Navigant presentation.

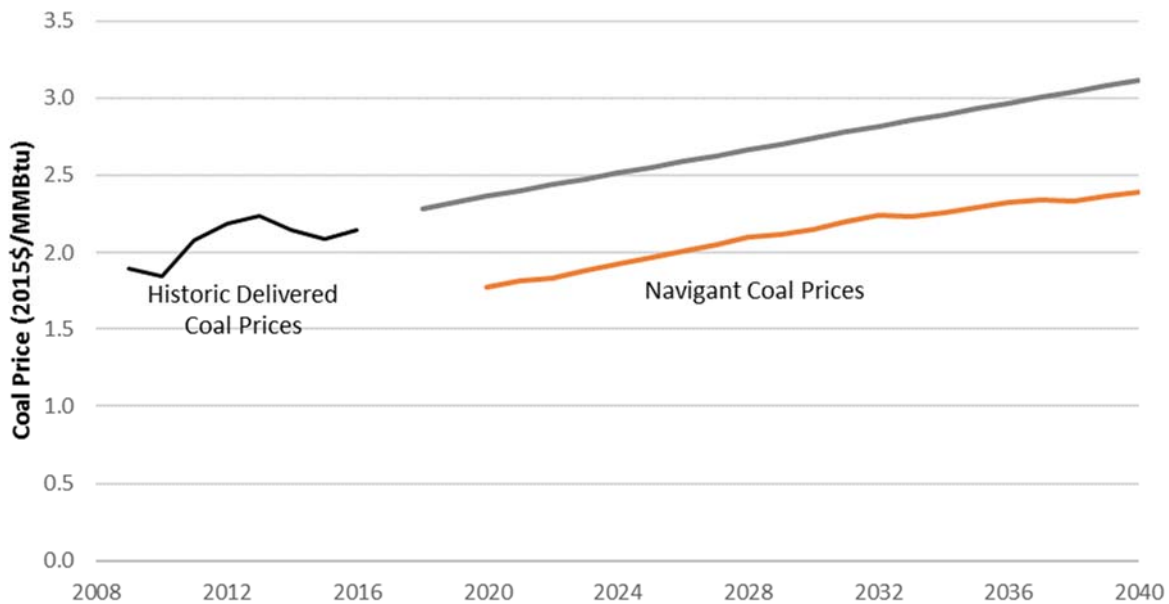
3. NAVIGANT STUDY RELIES ON UNREALISTICALLY LOW FUEL COSTS

Navigant’s presentation has a footnote that reads “Assumes Peabody proposed coal prices, with annual \$2/ton carry on coal prices 2026 and later.” A breakdown of Navigant’s analysis shows that the consultancy ended up using coal prices substantially lower than historic delivered prices, only reaching Kayenta’s actual delivered prices from 2016 in the year 2029.

² Central Arizona Project, February 16, 2017. Presentation to Power Task Force.



Figure 2. Coal fuel prices as delivered to Navajo Power Station 2008-2016,³ as assumed by Navigant,⁴ and extrapolated. 2015\$/MMBtu.



A reasonable extrapolation of coal prices paid by Navajo to the Kayenta Mine (2008-2016) reveals a constant underpricing by Navigant of about \$0.75/MMBtu. While this pricing difference may appear relatively small, the impact on the overall economics of Navajo is substantial. Replacing Navigant’s coal prices with the extrapolated fuel price increases the relative cost of Navajo by \$65-\$80 million per year, or about **\$620 million** (NPV 2020-2040),⁵ completely erasing Navigant’s assumed benefit for Navajo over the full analysis period.

In addition, Navigant appears to exclude any variable operating and maintenance (“O&M”) costs, including the costs of reagents used in Navajo’s scrubber, water consumed or day-to-day maintenance costs. Variable O&M may run about 25-30% of the total O&M expenses incurred at a steam boiler power plant. How do we know that Navigant excluded variable O&M? The extraordinarily low fuel cost shown in Figure 2 makes up the *entirety* of Navigant’s variable cost of production. If Navigant had also included

³ EIA Form 923, adjusted to 2015\$ using BLS Consumer Price Index 2008-2016.

⁴ Navigant presents aggregate annual “Navajo Variable Operating Costs,” which are usually comprised of (at least) fuel costs, variable operation and maintenance costs, and any emissions allowance costs. Through a series of steps, we determined that Navigant had assumed, for the presentation on slide 17, all three units operating (2,250 MW) with a 50% capacity factor through all years. With this assumption, Navigant’s near-term “replacement energy” prices match near-term market expectations (~\$25.5/MWh in 2020), and the variable cost of energy at Navajo is about \$20/MWh in 2020. Using an 11.1 MMBtu/MWh heat rate (EIA Form 923 and EPA AMPD data, 2016), we can assess this variable cost amounts to about \$1.78/MMBtu, or about 15% lower than the actual costs paid to Peabody in 2016.

⁵ Assumes a 6% real discount rate, reverse engineered from Navigant assessment. Uses Navigant assumed 3-units at 50% capacity factor assumption set.

a variable O&M cost, the implied coal cost would have been even lower, falling well outside the bounds of reason or about half the cost of the coal as reported to the Energy Information Administration (EIA).

Multiple sources show that the variable O&M costs associated with running a coal plant can be substantial. The US Department of Energy's National Energy Technology Laboratory (NETL) estimates that, in general, coal-fired power plants cost about \$5/MWh in addition to fuel costs.⁶ These variable expenses include the costs for sorbents and chemicals, waste disposal, and water expenses, as well as maintenance costs incurred as a function of generation.

A review of federal filings from Navajo co-owners Arizona Public Service Company,⁷ Tucson Electric Power,⁸ Nevada Energy Company,⁹ and Salt River Project,¹⁰ suggests that Navajo pays about \$3.80/MWh in variable O&M costs, apparently also not captured by Navigant. Figure 3, below, shows historic costs of fuel and variable O&M as reported to the Federal Energy Regulatory Commission (FERC) from Navajo participants against Navigant's total production costs. It shows that Navigant's assumed production costs in 2020 are lower than any entity reported in any year 2008-2016, and stay well below the average cost of Navajo in every year of the analysis.

⁶ National Energy and Technology Laboratory. 2013. Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity. Exhibit ES-7. https://www.netl.doe.gov/File%20Library/Research/Energy%20Analysis/OE/BitBase_FinRep_Rev2a-3_20130919_1.pdf

⁷ FERC Form 1, 2012-2016

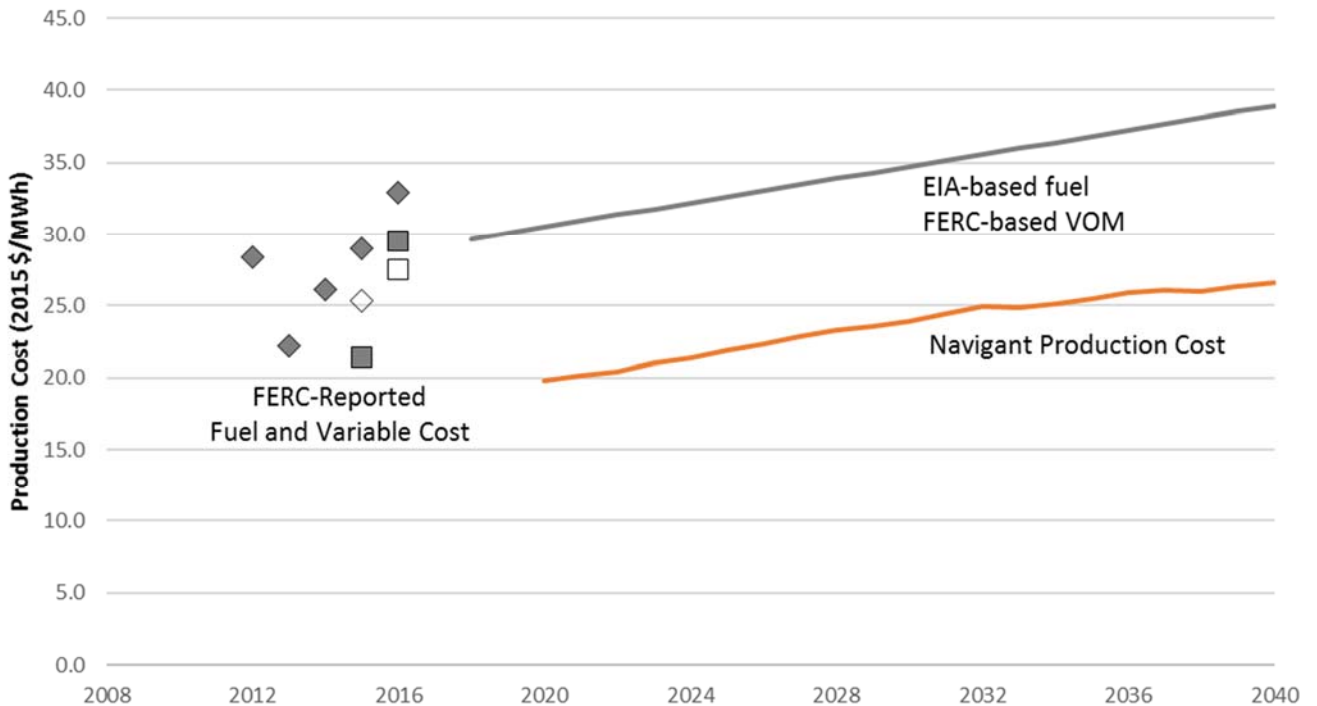
⁸ FERC Form 1, 2015-2016

⁹ FERC Form 1, 2015

¹⁰ Direct correspondence (May 1, 2017), 2016 data.



Figure 3. Estimated production cost at NGS 2008-2016 from FERC Form 1 data,¹¹ as assumed by Navigant, and based on EIA and FERC forward-looking.¹² 2015\$/MWh.



We assess that between fuel and variable O&M, Navigant excluded nearly \$950 million in costs at Navajo (NPV 2020-2040). But these exclusions are only the start of the flaws in this study.

4. NAVIGANT STUDY INFLATES OUT-YEAR MARKET ENERGY PRICES

The Navigant presentation dramatically increased market energy prices towards the end of the analysis period, driving the substantial apparent benefits beyond the late 2020s. So how did Navigant derive their long-term market energy price forecast?

Navigant appears to have taken forward market energy prices for the Mead energy hub (Southern Nevada) and simply extrapolated them forward – apparently on the basis of the last two years of data, a

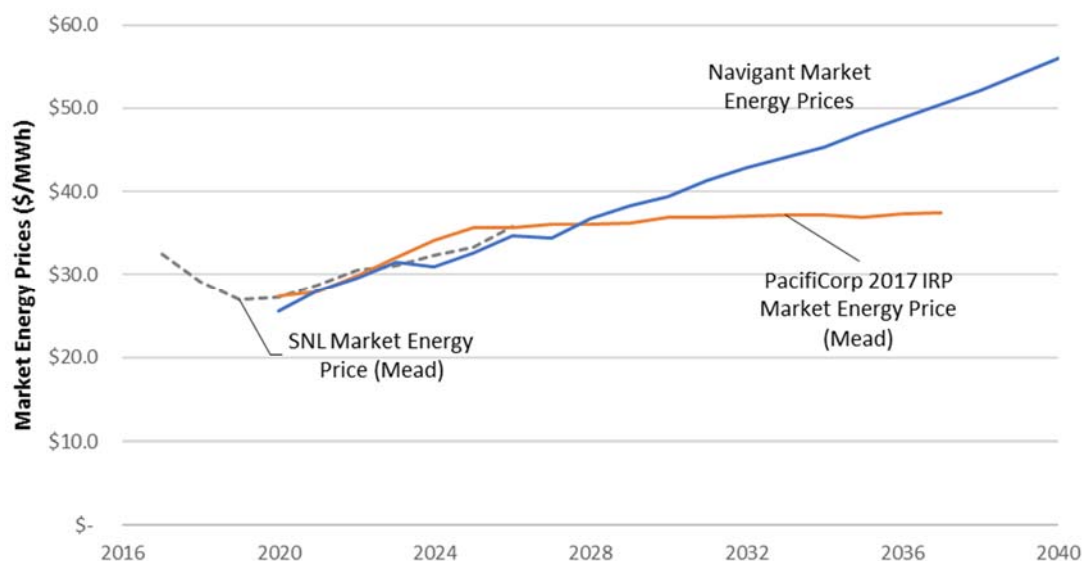
¹¹ EIA Form 923, adjusted to 2015\$ using BLS Consumer Price Index 2008-2016. FERC Form 1 data from APS, TEC, NPC, and Salt River Project (direct correspondence). FERC Variable expenses assumed to include Electric Expenses, Misc Steam (or Nuclear) Power Expenses and Allowances.

¹² Based on extrapolation of EIA fuel prices (see Figure 2) and FERC-based VOM (held constant in 2015\$).

reckless mechanism in a long-term forecast.¹³ The aggressively rising cost of energy inflated energy prices in the out-years of the analysis, notably the period in which Navigant found the best benefits for Navajo Generating Station. Other market participants are not nearly as optimistic as Navigant, which imagined that energy prices will rise – in real terms – at a cumulative average growth rate of 6.1% year on year (nominal) through 2040, or roughly three times faster than inflation.

On April 4, 2017 PacifiCorp, a multi-state utility covering much of the intermountain west (UT, WY, OR, WA, ID, and CA) released its 2017 Integrated Resource Plan, and associated public work papers. PacifiCorp makes public its long-term forecast for market energy prices at multiple western hubs, including the Mead hub. PacifiCorp uses its long-term energy market forecast to make substantial resource decisions and, importantly, is completely divorced from the question of Navajo’s economic viability. Figure 4 compares the market energy price in the Navigant study against near-term market forecasts from SNL, and long-term forecasts in the PacifiCorp 2017 IRP.

Figure 4. Market Energy prices in Navigant Study, forward-market prices from SNL Energy, and PacifiCorp 2017 IRP (April 2017).¹⁴



Comparing the PacifiCorp long-term “all hours” market price forecast¹⁵ against Navigant’s assumption indicates that Navigant’s extrapolated forecast is extremely aggressive in out years, explaining the substantial increase in market energy costs in the Navigant analysis. Comparing the market price

¹³ Navigant energy prices for the Mead Hub in \$/MWh derived by taking total “Market Energy Cost” values and dividing by 2,250 MW at 50% capacity factor (9,855 GWh).

¹⁴ PacifiCorp workpapers, Official Forward Price Curve (OFPC), adjusted with 2.2% inflation rate; ratable combination of High Load Hours and Low Load Hours for “all hours” price. SNL Energy Market forecast, Mead Hub; ratable all hours price from peak and non-peak forecasts, adjusted at 1.5% assumed inflation rate.

¹⁵ Adjusted to 2015\$ using a 2.2% inflation rate assumed in PacifiCorp’s 2017 IRP.

differential between these two forecasts suggests that market energy price inflation results in a **\$244 million** (NPV 2020-2040) excessive benefit in the Navigant study.

5. CAPACITY VALUES EQUIVALENT TO EAST-COAST MARKET PRICES

The Navigant study assigns a market price to the capacity provided by NGS. Utilities in Western states are generally required to provide the capacity required by their customers – either directly or through a bilateral market purchase. There is no liquid market for capacity in the west, and thus very little market intelligence on the going price (or likely forward costs) for capacity. A capacity price – real or notional – only comes into play when capacity is limited or required; no market participant would pay a substantial fee for capacity when the market is flush.

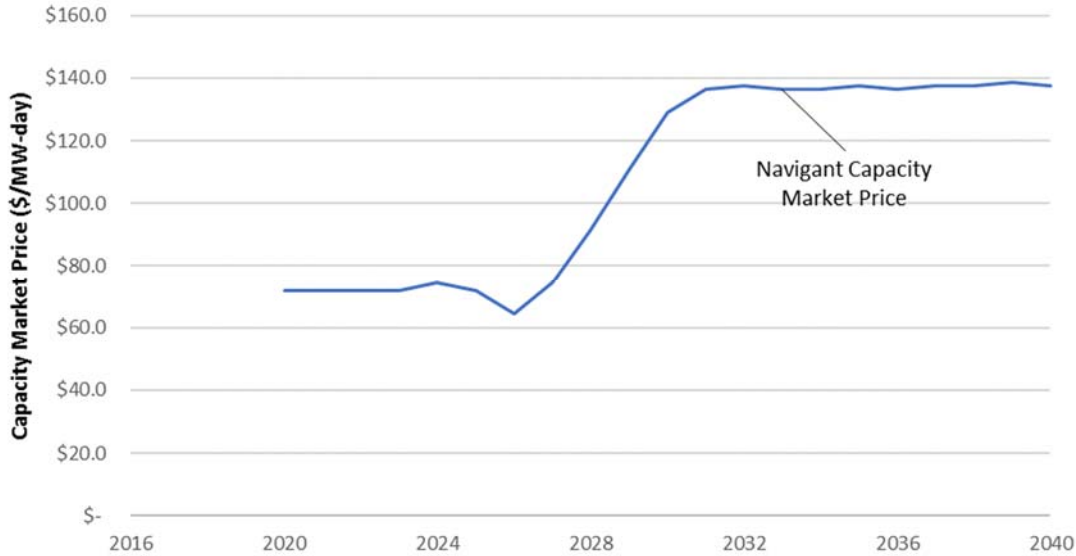
According to the North American Reliability Council (NERC), the Arizona/New Mexico region is expected to remain flush on capacity through at least the mid-2020s,¹⁶ remaining above peak season reserve margins despite a number of anticipated retirements in the region.

Navigant, however, assumed that there is a substantial regional need for capacity today, and market participants are willing to pay \$70/MW-day in 2020, or 46 times this year’s actual market prices in the Midwest (MISO) region, which just cleared at \$1.5/MW-day.¹⁷ In fact, Navigant assumed that there is such an appetite for capacity that other utilities would be willing to pay nearly the full net cost of new entry (CONE) starting in 2030 (see Figure 5, below).

¹⁶ <http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2016%20Long-Term%20Reliability%20Assessment.pdf>

¹⁷ <https://www.misoenergy.org/Library/Repository/Report/Resource%20Adequacy/AuctionResults/2017-2018%20PRA%20Summary.pdf>

Figure 5. Navigant capacity market prices in Navajo study, 2015\$/MW-day.



Navigant’s assumption about the appetite for capacity in the Southwest, and its inflated value to customers is an assumed benefit of **\$755 million** (NPV 2020-2040), a benefit unlikely to be realized by any party.

6. CONCLUSION

Overall, we identify nearly \$2 billion in faulty assumptions from the Peabody / Navigant presentation. Together, four major utilities and service providers – the Salt River Project, Arizona Public Service, Tucson Electric Power, and Nevada Power Company, and one of the largest customers, Central Arizona Project, determined operating Navajo today was a substantial loss of revenue, and operating Navajo into the future would burden customers with unnecessary cost and risk. Navigant’s quickly executed and undocumented study notwithstanding, the owners of this plant made a rational choice for their ratepayers. The choice to exit a large plant like Navajo is a substantial step for vertically integrated utilities, and is not conducted lightly. Our re-assessment of the Navigant study affirms the decision of these utilities to exit Navajo, and demonstrates that Peabody’s assessment is simply wishful thinking.