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Arizona Corporation Commission
1200 W. Washington Street
Phoenix, AZ 85007-2996

Re: Docket Nos. RU-00000V-19-0034 and RU-00000A-18-0284, Independent Assessment of the Ascend Analytics Report

Dear Chair Márquez Peterson and Members of the Arizona Corporation Commission,

On behalf of the Arizona Technology Council[1] and Ceres,[2] we are pleased to provide the attached independent assessment of the Ascend Analytics report on the 2020 Integrated Resource Plans of Arizona Public Service Company (APS), Tucson Electric Power (TEP), and UniSource Electric (UNSE) and the cost of utility compliance with the Arizona Corporation Commission's Clean Energy Rules relative to a "hypothetical 'Least Cost' pathway" for each of these utilities.

This assessment was prepared by Energy Futures Group, a nationally renowned consultancy with deep expertise in energy planning and analysis.[3]

The assessment concludes that the Ascend report and the underlying utility modeling had significant shortcomings, inconsistencies, and a lack of transparency. As a result, the Ascend engagement failed to achieve its objective of bringing an independent and consistent approach to the utility IRP plans and providing the Commission with an objective assessment of the costs of meeting the Clean Energy Rules.

It further concludes that there are reasons to be concerned with the Ascend report's conclusions, particularly as it relates to the utility cost of compliance with the Clean Energy Rules. It finds that those costs are likely to be incorrect and generally overstated, especially for APS. The factors that contributed to this outcome are documented in detail in the assessment.

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[1] The Arizona Technology Council is one of the largest technology-driven trade associations in North America, with more than 850 members.

[2] Ceres is a national sustainability nonprofit working with the country's most influential investors and companies to build a more sustainable economy. As part of this work, Ceres runs the BICEP Network, a coalition of nearly 70 major employers, large electricity customers, leading consumer brands, and Fortune 500s, including many with operations, facilities, and business interests in Arizona.

[3] Visit www.energyfuturesgroup.com for more information.

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The assessment also explains that despite several requests, we were denied access to the precise information the utilities shared with the Commission Staff and Ascend to prepare the report including Ascend's workpapers; and obtained limited access to: (1) some of the modeling files used by APS to conduct its IRP modeling (though none from TEP); and (2) the precise information used to calculate company-derived revenue requirements.

For all of these reasons, Energy Futures Group cautions the Commission against reliance on the Ascend report as the rationale for not adopting or implementing the Clean Energy Rules. **We agree wholeheartedly.**

We hope this information is useful to you as you evaluate next steps with the Clean Energy Rules. We look forward to the opportunity to brief you on the findings of this important report.

Sincerely,

Steve Zylstra	***Jennifer Helfrich***
President & CEO, Arizona Technology Council	Senior Policy Manager, Ceres

October 6, 2021

1 Introduction and Overarching Concerns[1]

1.1 Scope of Energy Futures Group's (EFG) Review

This memo contains the results of a review to independently assess Ascend Analytics's ("Ascend") report on the 2020 Integrated Resource Plans ("IRPs") of Arizona Public Service Company ("APS"), Tucson Electric Power ("TEP"), and UNS Electric ("UNSE"); and the manner in which Ascend determined the cost of utility compliance with the Arizona Corporation Commission's ("ACC") Clean Energy Rules relative to a "hypothetical 'Least Cost' pathway" for each of these utilities.

1.2 Limited Access to Information

The information we were able to examine for our review was extremely limited due to a lack of access to key information underlying the Ascend report, including limited access to the utilities' modeling files upon which the Ascend report relied.

In fact, despite several requests, we were denied access to the precise information the utilities shared with the Commission Staff and Ascend to prepare the report including Ascend's workpapers; and obtained limited access to: (1) some of the modeling files used by APS to conduct its IRP modeling (though none from TEP); and (2) the precise information used to calculate company-derived revenue requirements.

This is highly unusual and concerning. In nearly all of the jurisdictions in which we work, EFG is given access to all of the modeling files used to produce an IRP and related analyses; all of the workpapers used to post-process those modeling results, including those used to create revenue requirements; and is able to ask discovery questions about those files.

Given that the Commission Staff would not share any workpapers supporting Ascend's report, we attempted to gather additional relevant information through our own discovery questions, through review of discovery previously provided to other parties, and one-on-one discussions with APS and TEP.

1.3 Overview EFG's Main Findings

As we understand it, the purpose of Ascend's oversight of the utilities' modeling was to bring an independent and consistent approach to the utility IRP plans and provide the Commission with an objective assessment of the costs of meeting the Clean Energy Rules. The Ascend report and

[1] This memo was prepared by Anna Sommer and Chelsea Hotaling of Energy Futures Group.

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the underlying utility modeling, however, had significant shortcomings, inconsistencies, and a lack of transparency that failed to achieve this objective.

We further conclude that there are reasons to be concerned with the Ascend report's conclusions, particularly as it relates to the utility cost of compliance with the Clean Energy Rules. Those costs are likely to be incorrect and generally overstated, especially for APS.

Consequently, we caution the Commission against reliance on the Ascend report as the rationale for not adopting or implementing the Clean Energy Rules.

1.3.1 EFG's Main Findings with the APS Results Presented in the Ascend Report

There are five main factors in the Ascend report that contribute to an incorrect and overstated estimate of APS's costs to comply with the Clean Energy Rules.

First, there are serious flaws with APS's modeling that cause its costs of clean energy to be incorrect and generally overstated. Specifically, we identified the following issues with APS's modeling of clean energy resources:

1. APS's solar costs are much higher than the National Renewable Energy Laboratory's (NREL)'s Annual Technology Baseline (ATB) estimates, and may be higher than Ascend's assumptions,
2. APS's wind costs were incorrectly modeled, are much higher than NREL's ATB estimates, and may be higher than Ascend's assumptions,
3. APS's battery storage costs were incorrectly modeled, and
4. The exclusion of the Investment Tax Credit for solar and paired battery storage in APS's cost estimates causes the costs of those resources to be significantly overstated.

Second, APS's "Least Cost" portfolio is unlikely to represent the utility's true least cost portfolio because of cost and constraint limitations in the underlying modeling. As a result, the comparison of the cost of utility compliance with the Clean Energy Rules relative to a "hypothetical 'Least Cost' pathway" is fundamentally flawed.

Third, gas prices were modeled to be too low in the near term. Because the Ascend report assumed the "Least Cost" portfolio to be one in which natural gas generation remained the primary resource for incremental capacity, this approach underestimates the cost of the "Least Cost" portfolio and overstates the relative cost of the Clean Energy Rules in comparison.[2]

[2] In its response to Commissioner questions, Ascend also said that the "Least Cost" portfolios would have "less energy efficiency savings in the future (as cost-effective energy efficiency gets harder to find and implement)." This is a concerning statement. After all, a Lawrence Berkeley National Lab study concluded that Arizona energy efficiency savings had an average levelized cost of $13 per MWh, dramatically lower than the cost of any supply-side resources. While Ascend contends that energy efficiency will get "harder to find and implement," it does not offer any evidence that this would be the case. Indeed, energy efficiency costs have held steady across many jurisdictions even as savings have increased. Lighting-related savings, some of the most cost-effective savings in

Fourth, due to the limitations of the Strategist modeling platform, APS's resource mix to comply with the Clean Energy Rules was effectively handpicked and does not represent a true resource optimization. This approach, coupled with the inflated costs of clean energy and the depressed costs of natural gas, likely inflate the relative cost of compliance with the Clean Energy Rules.

Finally, the modeling did not evaluate the economic retirement or dispatch of the Four Corners coal plant. The impact of potential early retirement of Four Corners on the Clean Energy Rules portfolios is unclear, but performing resource optimization modeling would facilitate a clearer picture about whether its early retirement reduces the cost of compliance.

1.3.2 EFG's Main Findings with the TEP and UNSE Results Presented in the Ascend Report

TEP's and UNSE's own modeling demonstrates that the cost differential between their "Least Cost" portfolios and compliance with the Clean Energy Rules is negligible – particularly over the next 15 years. Ascend's extrapolation of TEP's portfolio resources out to 2050, and the application of its assumptions in place of TEP's, however, shows a meaningful difference. Under Ascend's assumptions, for example, the differential for both utilities is found to be 4% in 2030 and continues to grow.

It appears that this difference is largely attributable to differences in opinion between TEP and Ascend about the effective load carrying capability ("ELCC") of renewables and storage. However, Ascend does not provide any of the specific ELCC values it believes TEP ought to have used.[3] Thus, due to a lack of transparency, it is not possible to fully understand the significance of this difference or determine if Ascend's recommended ELCC's values were appropriate.

In the case of UNSE, it appears that the difference, at least in the near-term cost impacts, is due to an error Ascend made in its directed treatment of energy efficiency.

1.3.3 Conclusions and Recommendations

In the final analysis, the Ascend report and the underlying utility modeling had significant shortcomings, inconsistencies, and a lack of transparency that failed to bring an independent and consistent approach to the utility IRP plans and provide the Commission with an objective assessment of the costs of meeting the Clean Energy Rules. Consequently, we caution the

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most energy efficiency portfolios, are increasingly being absorbed by federal standards that require more efficient lighting. However, even if those measures were replaced with savings from more expensive measures, there is a wide gulf to bridge before Arizona's cost of energy efficiency would exceed the cost of supply-side resources.

[3] Ascend did provide limited information for stakeholders to be able to approximate the ELCC of four-hour storage for several years across the plans, but this information was not presented for each technology type. In addition, Ascend only provided this information for the APS portfolios and not the TEP portfolios.

Commission against reliance on the Ascend report as the rationale for not adopting or implementing the Clean Energy Rules.

Additionally, the Commission should take steps to ensure the transparency and rigor of similar future analyses. EFG works in many jurisdictions across the country including Indiana, Kansas, Michigan, Minnesota, Missouri, New Mexico, Puerto Rico, South Carolina, and South Dakota. Typically, we can see all of the modeling files used to produce an IRP or similar analysis, all of the workpapers used to post-process those modeling results including those used to create revenue requirements, and are able to ask discovery questions about those files. During the course of our review of this work, we sought copies of Ascend's workpapers, but were not given them and tried to ask some discovery questions about Ascend's work.[4] Much of our understanding of this analysis arises from the limited discovery we were able to ask of APS and TEP, which also did not provide the entirety of their modeling files or the full set of spreadsheets used to calculate revenue requirements.[5] We strongly feel that transparency is a key element of fair decision making in the public interest and should underpin important policy decisions like consideration of the Clean Energy Rules.

Several jurisdictions (Michigan, New Mexico, and South Carolina) in which we work go so far as to provide intervenors with a free license for the IRP model that the utility uses so that intervenors can provide alternative scenario and portfolio modeling. Taking a step like this would put parties on a more level playing field and produce a more robust record upon which to base Commission decision-making.

2 EFG Review of the APS Analysis Presented in the Ascend Report

Below we discuss key factors that contribute to a cost of Clean Energy Rules compliance by APS that is likely incorrect and overstated in the Ascend report.

2.1 Flaws with APS's Clean Energy Costs as Presented in the Ascend Report

2.1.1 Flaws with APS's Solar Costs

We discovered serious flaws with APS's modeling inputs that cause it to overstate the costs of clean energy, including solar, wind, and solar+storage.

[4] We would have liked to review Ascend's workpapers to understand the substantive issues discussed in this report but also to understand some inconsistencies such as those between the APS load and capability tables in Section 5.1 and Table 2 of Ascend's report.

[5] APS did provide us with some revenue requirements spreadsheets, but some were password protected. TEP provided high-level spreadsheets that did not demonstrate how its full revenue requirements were derived.

Unfortunately, Ascend failed to identify these issues in its report and found APS's clean energy costs to be reasonable – citing a comparison with the National Renewable Energy Laboratory's (NREL) Annual Technology Baseline (ATB):[6]

> *Technology cost assumptions for renewables and batteries used in this IRP are in line with other reputable resources. Projections used in the APS IRP are shown in the following graphs with comparable cost curves from Ascend for storage and the National Renewable Energy Laboratory (NREL) for solar and wind. The cost projection used by APS for energy storage, utility scale solar, and wind are lower in all graphs.*

Based on discovery responses provided to us by APS, it appears that Ascend's comparison to the ATB was based on overnight capital costs only, and not "all-in" or CAPEX costs, which include construction financing costs. See Figure 1 on page 6.

When comparing overnight capital costs only, APS's solar costs do indeed appear lower than the ATB. However, this comparison is highly misleading. After all, the total cost of any generator includes not just overnight capital, but also the financial treatment of the asset including the depreciation schedule and the construction financing costs.

In APS's case those assumptions matter a great deal. When APS's all-in solar costs[7] are compared with the ATB, they are higher by 12%[8] — a significant amount. See Figure 2 on page 6.

Unfortunately, since the Commission Staff never provided Ascend's workpapers, we cannot verify if APS made any adjustments to its solar costs between the modeling it conducted for its 2020 IRP and the information it provided for the Ascend report. We also cannot verify if Ascend's analysis suffered from the same flaws, i.e., incorrect financial treatment. However, since the relative revenue requirements of the portfolios are largely unchanged, even with Ascend's assumptions, it is possible that Ascend did not correct for these issues.

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[6] Ascend report at page 30.

[7] APS used a module of Strategist called the Capital Expenditure and Recovery ("CER") module that creates an all-in capital expenditure figure for each new resource.

[8] The CER module's methodology for converting overnight solar costs into CAPEX costs is largely a black box, but we think at least part of the explanation for the fact that APS's assumption is much higher than the ATB's is that APS is assuming tax depreciation and a tax life for solar that is not consistent with the fact that the resource is eligible for accelerated depreciation (which reduces cost).

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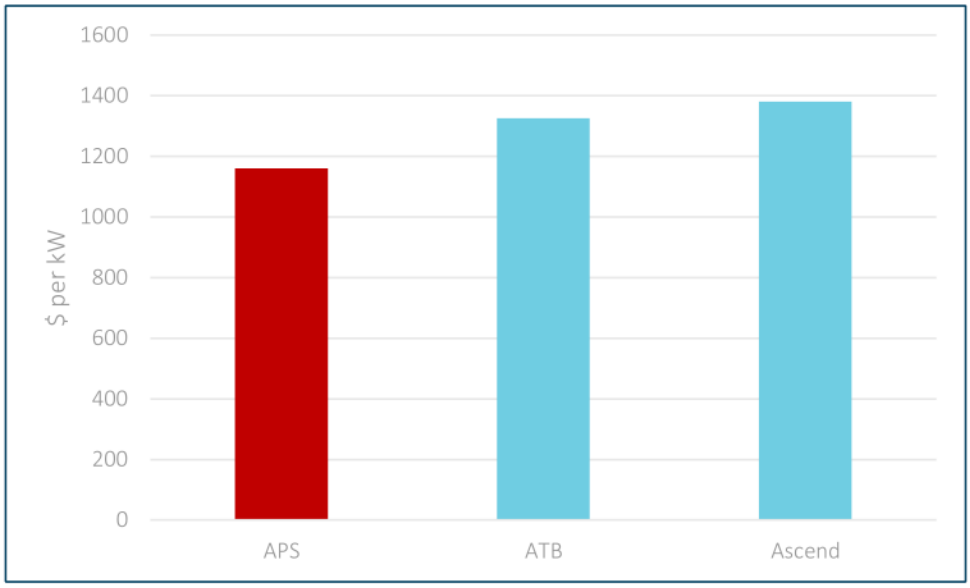

Figure 1. Overnight Solar Capital Costs in 2022[9]

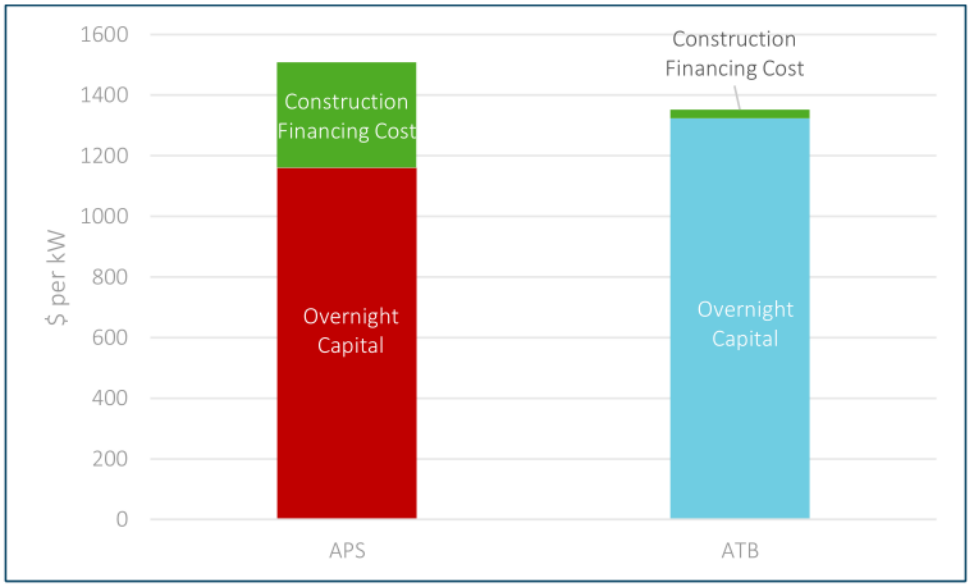

Figure 2. CAPEX Solar Costs in 2022[10]

[9] Discovery response Ceres 2.2_ExcelAPS16476_Ascend Capital Assumptions; Table D.3 of APS's 2020 IRP; 2021 ATB

[10] Discovery Response Ceres 2.11_APS16480_PRV_InputSummary.REP; Table D.3 of APS 2020 IRP; 2021 ATB. The numbers in the figure also do not include the 26% Investment Tax Credit ("ITC") for which solar facilities who have safe harbored at least 5% of costs by the end of 2022 would be eligible.

2.1.2 Failure to Account for the Solar and Solar+Storage Investment Tax Credit

Based on our review of APS's Strategist modeling files, we do not see any evidence that it included the Investment Tax Credit ("ITC") when modeling solar or solar+storage.[11] Typically this tax credit is treated as a 26% reduction in upfront capital cost, so eliminating it from the analysis would result in a significant overstatement of solar costs, particularly in the near-term.[12]

When battery storage is paired with solar it also becomes eligible for the ITC. Ascend states that, "Half of [APS's] battery additions are part of solar hybrid installations." However, it does not indicate anywhere in its report that APS applied the ITC to those batteries. (This is somewhat mollified by the fact that APS appears to have modeled a wrong and too low battery cost as well.[13])

Unfortunately, since the Commission Staff never provided Ascend's workpapers, we cannot verify if APS made any adjustments to its solar costs between the modeling it conducted for its 2020 IRP and the information provided for the Ascend report to account for the ITC.

2.1.3 Flaws with APS's Wind Costs

In its report, Ascend claims that APS's wind costs are reasonable because they are lower than the ATB. Ascend again relied on overnight wind capital costs to conduct this comparison, which, for the reasons described above, is a misleading comparison. Regardless, as shown in Figure 3 on page 8, Ascend's conclusion is demonstrably false.

This, however, does not tell the whole story. APS also relies on wind assumptions that further inflate wind's costs. Specifically, a review of APS's Strategist modeling files reveals that its wind costs have been mischaracterized, i.e., the modeled costs are much higher than the costs reported in Table D.3 of its IRP, which appear to be Ascend's basis for comparison. In addition to that error, APS uses a tax depreciation methodology and tax life that is inconsistent with the accelerated depreciation available to renewable resources. Because APS's Clean Energy Rules portfolios include about 2,000 to 4,000 MW of additional wind on a more accelerated schedule than the "Least Cost" portfolio, these errors compound the utility cost of compliance with the Clean Energy Rules vis-à-vis the utility's "Least Cost" path. See Figure 4 on page 8.

[11] The ITC will eventually decline to 10% but is not expected to sunset for utility-scale projects.

[12] In contrast, it appears to us that TEP applied the ITC to solar and paired batteries in its analysis.

[13] We do not discuss the battery cost differences in this memo because it is difficult to do so without disclosing confidential information.

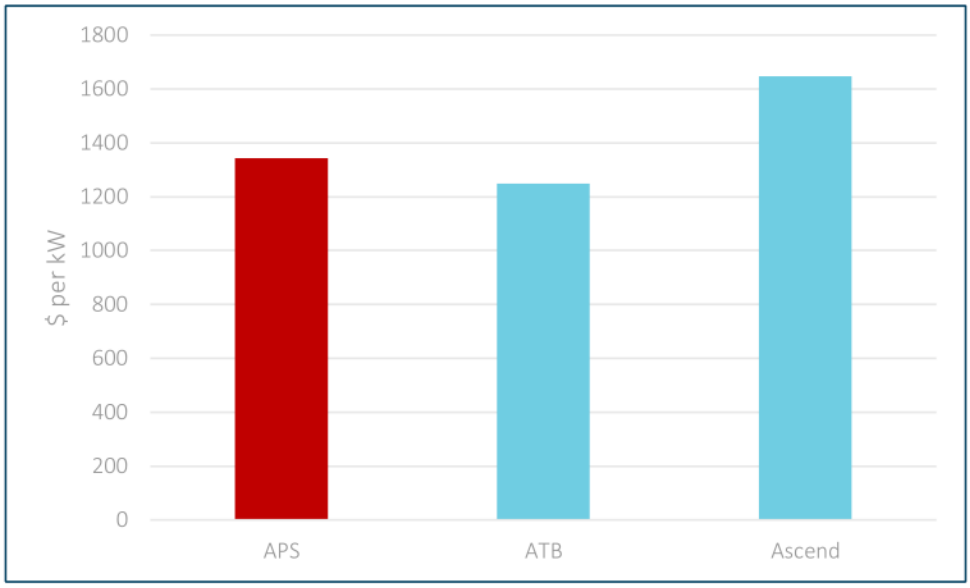

Figure 3. Overnight Wind Capital Costs in 2022[14]

Figure 4. Capex Wind Costs in 2022[15]

[14] Discovery response Ceres 2.2_ExcelAPS16476_Ascend Capital Assumptions; Table D.3 of APS's 2020 IRP; 2021 ATB

[15] Discovery Response Ceres 2.11_APS16480_PRV_InputSummary.REP; Table D.3 of APS 2020 IRP; 2021 ATB

2.1.4 Potential Failure to Account for the Wind Production Tax Credit

The treatment of the wind production tax credit ("PTC") by APS is also unclear. It does not appear to be in any of the modeling files we received, though APS would not provide all of its Strategist modeling files. Consequently, it is possible that APS's modeling failed to account for the federal tax credit available to near-term wind projects, thus overstating the cost of wind in the near-term.

Unfortunately, since the Commission Staff never provided Ascend's workpapers, we cannot verify if APS made any adjustments to its treatment of wind costs between the modeling it conducted for its 2020 IRP and the information it provided for the Ascend report.

2.2 Flaws with APS's Modeling and the "Least Cost" Portfolio Presented in the Ascend Report

We identified several issues with APS's modeling approach as well as its "Least Cost" portfolio.

We conclude the Least Cost portfolio is unlikely to represent the utility's true least cost path. As a result, the comparison of the utility's cost of compliance with the Clean Energy Rules relative to a "hypothetical 'Least Cost' pathway" is fundamentally flawed.

Additionally, due to the limitations of the Strategist modeling platform (described below in Section 2.2.1), APS's resource mix to comply with the Clean Energy Rules was effectively handpicked and does not represent a true resource optimization. This approach, coupled with the inflated costs of clean energy described above (see Section 2.1) and the depressed costs of natural gas (discussed below in Section 2.3), likely inflate the utility's cost of compliance with the Clean Energy Rules.

Finally, the modeling did not evaluate the economic retirement or dispatch of the Four Corners coal plant. The impact of potential early retirement of Four Corners on the Energy Rules portfolios is unclear, but performing resource optimization modeling would facilitate a clearer picture about whether its early retirement reduces the cost of compliance.

2.2.1 Key Issues with APS's Modeling Software

APS relies upon the Strategist resource planning software tool to conduct its capacity expansion modeling. There are a number of known issues with Strategist tool that raise concerns about any conclusions drawn from its use:

1. It is very difficult to represent battery storage in Strategist. It has to be modeled as a pumped storage resource and cannot be dispatched based on price.

2. Strategist is unable to connect battery storage to another resource like solar. Paired solar and battery projects are often economical in the procurement dockets we participate in because, when charged by solar, battery projects are eligible for the federal Investment Tax Credit (ITC).
3. Strategist uses a programming logic that devotes a significant portion of its capability to developing hundreds, if not thousands of discrete portfolios. This severely limits Strategist's ability to consider a wide range of resources in any one portfolio.

The Ascend report acknowledges these problems with Strategist. Indeed, regarding the resource optimization modeling that APS conducted in its IRP, Ascend stated:[16]

> *"The capacity expansion model would not correctly model the more diverse [renewable] resources. This is a critical flaw in the APS modeling software. High levels of renewable resources in a model add complexity but should not be a barrier to implementing a capacity expansion model. APS would have been better off running capacity expansion models with varying limits set for carbon emissions."*

When we spoke with APS representatives, they concurred with Ascend's assessment.

Due to these limitations, APS effectively used its own judgment to come up with its own resource mix for the Clean Energy Rules portfolios it examined. In other words, it did not rely upon resource optimization to identify the "Least Cost" path of compliance with the Commission's Clean Energy Rules. While there is nothing wrong with using modeler judgment to create different portfolios for evaluation, it would be extraordinarily difficult, if not impossible, to determine a "Least Cost" portfolio for Clean Energy Rules compliance without using optimization logic.

2.2.2 Key Issues with APS's "Least Cost" Portfolio

Through discovery, we received a handful of APS's Strategist modeling files for its "Least Cost" ("Technology Agnostic") portfolio.[17] The constraints imposed on the "Least Cost" portfolio are shown in Table 1 on page 12. These constraints reveal that APS's "Least Cost" portfolio:

- Was forced to add one 607 MW "M500" – a long-term contract with an existing gas combined cycle unit.
- Can add only one 231 MW wind unit before 2027 and only one 300 MW solar unit between 2023 and 2027, for a total of 1,731 MW of renewables.[18]

[16] Ascend report at page 33.

[17] Response to Ceres 2.11.

[18] In comparison, Strategist is allowed to add 3,975 MW of gas capacity during this time (5,189 MW if the "M500" resource is included). The numbers are on a nameplate basis, with the adjustment for APS's assumed Effective Load Carrying Capability (ELCC) value for each, which further advantages gas resources over renewables.

- Used a reserve margin that is lower than the stated 15 percent that APS claims it modeled, which has the practical effect of limiting renewable energy additions.[19] See Figure 5 below. And,
- Did not model paired solar and battery resources.

In other words, due to these modeling constraints, the "Least Cost" portfolio was effectively handpicked by the utility and largely constrained to add gas.[20]

As we discuss further below, gas prices were modeled to be too low in the near term. Because APS's "Least Cost" portfolio is one in which natural gas generation remained the primary resource for incremental capacity, this approach underestimates the cost of the "Least Cost" portfolio and overstates the relative cost of the Clean Energy Rules in comparison.

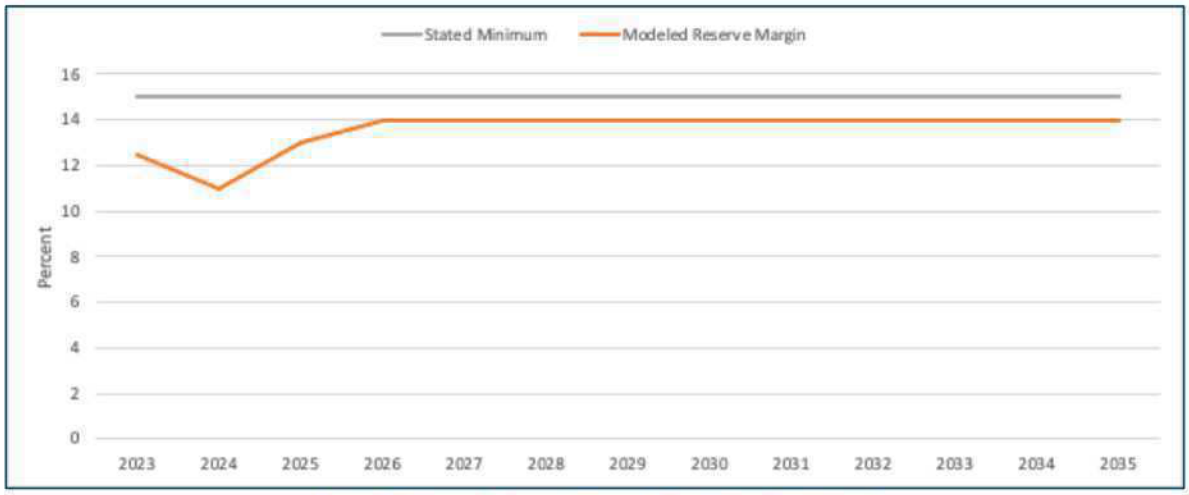

Figure 5. Modeled Reserve Margin is Less than APS Claims

[19] The practical effect of this reserve margin requirement is that the model is less likely to add renewables, which can only be added in increments of one unit per year and only if there is a capacity need (this outcome is constrained through a Strategist setting called "superfluous" units). Therefore, when the reserve margin is lower, the likelihood that Strategist will add a renewable unit is also lower. Even when the reserve margin jumps in 2026, the model would have been unlikely to add renewables because APS forced in the M500 unit and since Strategist would only add additional capacity if there were a capacity need (it cannot do so even if the unit lowers system cost).

[20] During a conversation with APS's modelers, they said that they had tested relaxing the superfluous unit settings and increasing the reserve margin requirement in prior runs but it did not change the optimal plan. Clearly, we are unable to verify that because those files are not available to us, but taking them at their word it is not surprising that Strategist would still not add wind and solar since the capital costs of those resources are overstated as discussed in Section 2.1. APS also said that Strategist routinely selected the M500 unit and that's the reason it was fixed in, but that unit has no cost in Strategist so it is not clear if that was the reason it was always picked or if APS modeled the unit with a cost in prior runs.

Table 1. Constraints Modeled[21]

Constraint	CT	CC	M500	WIND	WND2	PV 1	PV 2	ESS	WDAZ
Resource Size (MW)	389	547	607	231	231	300	300	400	250
First Year Strategist Can Add Resource	2024	2024	2026	2023	2027	2023	2028	2025	2023
Last Year Available	2099	2099	2027	2026	2099	2027	2099	2099	2099
No. of Units that Can be Added Per Year (Max in any Year)	2	1	2	1	1	1	1	1	1
Cumulative Max Units	30	10	2	1	10	5	10	4	2

A "unit" refers to a single addition of each resource type.

[21] Most resource names are self-explanatory, but "WDAZ" means Arizona wind and "ESS" refers to a four-hour storage resource.

2.2.3 Four Corners Retirement Date and Must-Run Designation

Neither the "Least Cost" portfolio or APS's carbon constrained portfolios evaluated the impact of the economic retirement or dispatch of the Four Corners coal plant. A 2031 retirement date for the plant was simply assumed.

As a result, APS's "Least Cost" portfolio is unlikely to represent its true least cost, underscoring again that any results drawn from its conclusions are fundamentally flawed.

Ascend appears to agree and states the following in its report: "In our opinion, it is likely true that the must-run constraint on Four Corners does not result in the least-cost portfolio."[22]

2.3 Flaws with APS's Natural Gas Prices as Presented in the Ascend Report

In its 2020 IRP, APS projects that natural gas prices will rise from about $2.25 per MMBtu to about $2.80 MMBtu between 2021 and 2035. Both Ascend and APS are characterized as using similar methodologies to derive a natural price forecast that was based on an analysis of forward prices. Figure 6 compares APS's gas assumptions in its 2020 IRP to Ascend's assumptions.

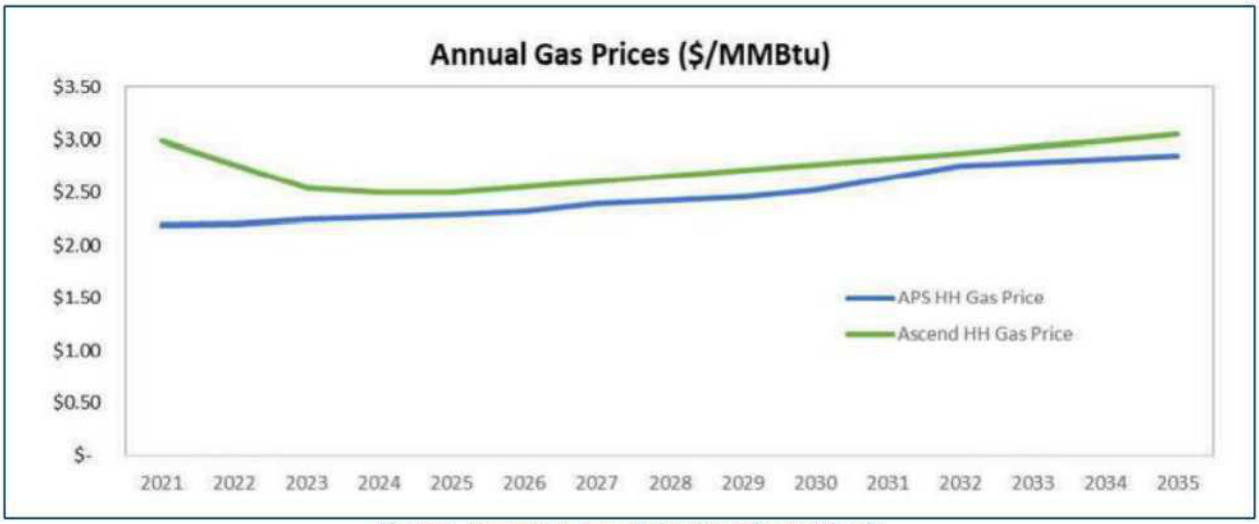

Figure 6. Henry Hub Annual Gas Price Comparison[23]

[22] Ascend Report, p. 37.

[23] Ascend Report, Figure 6, p.31.

Notably, current Henry Hub forward prices tend to be higher than both of these forecasts in the near term, though the fact that Ascend report documents annual rather than monthly prices obscures this comparison. See Figure 7.[24]

Updating the gas prices to more recent data would make the APS "Least Cost" portfolio in particular look more expensive relative to the utility's carbon constrained portfolios because of its relatively higher gas consumption.

While Ascend states that "the model outputs were not sensitive to the natural gas price forecast in the model," importantly, this conclusion appears to hinge on an assessment of the gas contribution to the resource mix in 2035 and not the near-term.

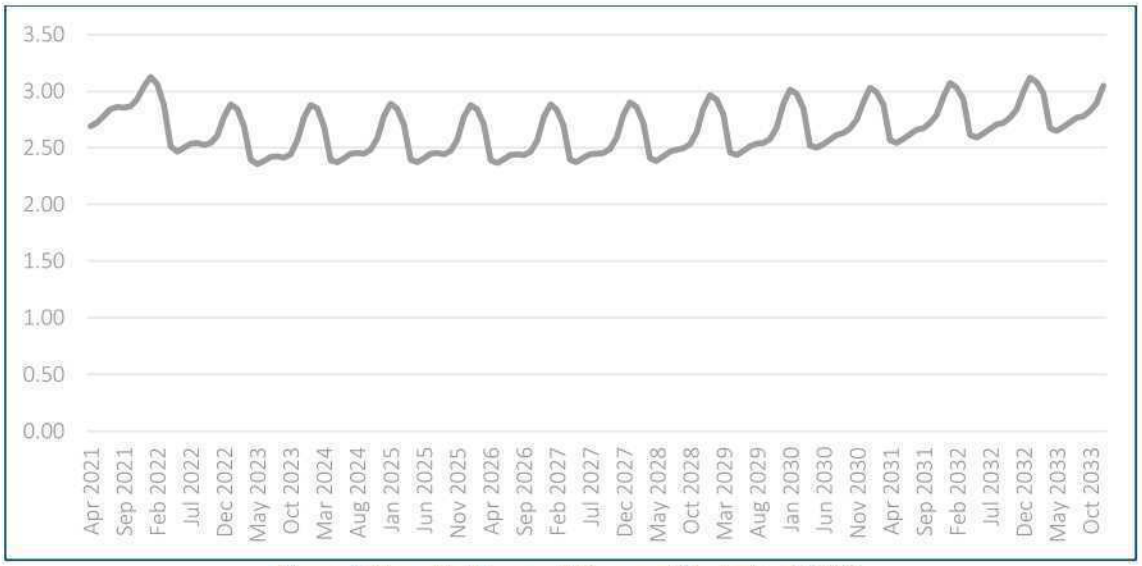

Figure 7. Henry Hub Forward Prices as of September 6, 2021

2.4 Observations on the APS Revenue Requirements and Bill Impacts

A key product of the Ascend report is the revenue requirements and bill impacts associated with various APS resource portfolios, including compliance with the Clean Energy Rules.

Table 2 on page 15 shows the difference in rate impacts across portfolios over time and compares the difference between APS's modeled "Least Cost" portfolio" versus its "100% Clean" and "80% Clean" portfolios. This difference is smallest in the near term: 4% in 2025. Notably, this is precisely the time period in which the highest level of ITC is available to APS, and we would expect including it to materially change that difference in rate impacts. This is also the time period when near-term adjustments to gas prices to update APS's Henry Hub pricing would also materially change that difference in rate impacts.

[24] Indeed, if they are not doing so currently, both APS and TEP should model gas prices with seasonal variations in price.

The rate impacts in the later years are certainly higher, but the inclusion of inflated construction financing charges for wind and solar (described above in Section 2.1) would also significantly affect those years. And it is important to note that the accuracy of these rate impacts decreases significantly the farther out one goes. That is because the level of certainty about costs increases dramatically and also because the composition of the portfolios needed to meet the carbon reduction constraints becomes more uncertain as time goes on. We would note, for example, that none of APS's portfolios considered multi-day storage which is currently in early commercialization stages.

Table 2. Average Rate Impacts ($/kWh) for Various APS Portfolios Presented in the Ascend Report

	2025	2030	2035	2040	2050
100% Clean	0.083	0.088	0.091	0.094	0.136
80% Clean	0.083	0.088	0.091	0.086	0.105
Least Cost	0.079	0.077	0.073	0.067	0.076
Difference (100% Clean – Least Cost)	0.0036	0.0109	0.0179	0.0274	0.0597
Difference (80% Clean – Least Cost)	0.0036	0.0109	0.0179	0.0191	0.0285
% Difference (100% Clean – Least Cost)	4%	14%	24%	41%	78%
% Difference (80% Clean – Least Cost)	4%	14%	24%	29%	37%

3 EFG Review of the TEP Analysis Presented in the Ascend Report

TEP's own modeling shows a minimal difference in the rate impacts between the utility's "Least Cost" portfolio and a portfolio that complies with the Clean Energy Rules. That difference is found to be 0% between now and 2035; and 1% between 2035 and 2050. In other words, TEP's own modeling suggests that compliance with the Commission's Clean Energy Rules approximates least cost. See Table 3.

Table 3. Rate Impacts Under TEP's Assumptions

	2025	2030	2035	2040	2050
100% Clean	0.136	0.141	0.145	0.152	0.167
80% Clean	0.135	0.141	0.145	0.150	0.153
Least Cost	0.135	0.141	0.145	0.148	0.152
Difference (100% Clean – Least Cost)	0.0002	0.0001	0.0001	0.0039	0.0156
Difference (80% Clean – Least Cost)	0.0000	0.0000	0.0000	0.0016	0.0016
% Difference (100% Clean – Least Cost)	0%	0%	0%	3%	10%
% Difference (80% Clean – Least Cost)	0%	0%	0%	1%	1%

However, when Ascend directed TEP to make changes to its modeling, that differential increased significantly, particularly in the post-2030 timeframe. Indeed, that difference starts at 4% in 2030 and grows to 30% by 2050. See Table 4.

Table 4. Rate Impacts Under Ascend's Assumptions

	2025	2030	2035	2040	2050
100% Clean	0.135	0.148	0.155	0.181	0.249
80% Clean	0.135	0.148	0.155	0.176	0.231
Least Cost	0.135	0.142	0.143	0.158	0.191
Difference (100% Clean – Least Cost)	0.0000	0.0060	0.0124	0.0226	0.0582
Difference (80% Clean – Least Cost)	0.0000	0.0060	0.0124	0.0177	0.0403
% Difference (100% Clean – Least Cost)	0%	4%	9%	14%	30%
% Difference (80% Clean – Least Cost)	0%	4%	9%	11%	21%

Ascend attributes this change to the way it directed the utility to model the effective load carrying capability ("ELCC") of renewables and storage. Ascend states that TEP assumed a constant ELCC value and that it directed the utility to model a declining ELCC. [25] Despite stating this in the report, Ascend does not provide any of the ELCC values it directed the utility to model.[26] Thus, due to a lack of transparency, it is impossible to verify this claim, understand its significance, or determine if Ascend's recommended ELCC values were appropriate.

3.1 Flaws with TEP's "Least Cost" Portfolio Presented in the Ascend Report

3.1.1 Four Corners Retirement Date and Must-Run Designation

Neither the "Least Cost" portfolio or TEP's carbon constrained portfolios evaluated the impact of the economic retirement or dispatch of the Four Corners coal plant. A 2031 retirement date for the plant was assumed.

The impact of this constraint is less of a factor for TEP versus APS, since TEP has only a 7% ownership share of the plant.

4 EFG Review of the UNSE Analysis Presented in the Ascend Report

Like TEP, UNSE's own modeling concludes there is no difference between "Least Cost" and compliance with the Clean Energy Rules. And, as in the case with TEP, when Ascend directed

[25] Ascend Report, p.8.

[26] Ascend did provide limited information for stakeholders to be able to approximate the ELCC of four-hour storage for several years across the plans, but this information was not presented for each technology type. In addition, Ascend only provided this information for the APS portfolios and not the TEP portfolios.

changes to UNSE's modeling for inclusion in its report, a near-term differential in the rate impact of 4% between the "Least Cost" and the Clean Energy Rules portfolios emerges.

One potential explanation for this differential is a possible error in Ascend's directed treatment of energy efficiency. Indeed, Ascend changes the level of energy efficiency in the Energy Rules portfolios to numbers that do not make sense. They are too high in the near term and do not accumulate at a rate that makes sense as show in Table 5. The cumulative impacts of energy efficiency go down from 2020 to 2025, increase from 2025 to 2030, and then go down again from 2030 to 2035. In contrast, UNSE assumes the same rate of accumulation of savings across all its portfolios and assumes those savings continue to grow over the planning period.

Table 5. Energy Efficiency Impacts by Portfolio Type (MW)

	2020	2025	2030	2035	2040	2050
UNSE - All Portfolios	9.9	33.6	65	102	145	250
Ascend Least Cost	9.9	33.6	65	102	145	250
Ascend 80%	44	42	55	53	69	84
Ascend 100%	44	42	55	53	69	84

Without knowing how the cost of energy efficiency was characterized, these differences in impact are potentially large enough to explain at least part of the difference in cost in Ascend's analysis.

Unfortunately, Ascend's report on the UNSE pathways does not give information about the capital cost assumptions it directed UNSE to model or sufficient detail about the treatment of energy efficiency. And, given the late filed nature of the report, we did not have time to ask discovery questions about these issues.

Thus, again, due to a lack of transparency, it is impossible to verify and evaluate Ascend's conclusions and determine if they can withstand scrutiny.

5 Conclusions

For all of the reasons discussed herein, the Ascend report and the underlying utility modeling had significant shortcomings, inconsistencies, and a lack of transparency that failed to bring an independent and consistent approach to the utility IRP plans and provide the Commission with an objective assessment of the costs of meeting the Clean Energy Rules. Consequently, we caution the Commission against reliance on the Ascend report as the rationale for not adopting or implementing the Clean Energy Rules.

Additionally, the Commission should take steps to ensure the transparency and rigor of similar future engagements. EFG works in many jurisdictions across the country including Indiana, Kansas, Michigan, Minnesota, Missouri, New Mexico, Puerto Rico, South Carolina, and South Dakota. Typically, we can see all of the modeling files used to produce an IRP and related analyses, all the workpapers used to post-process those modeling results including those used to

create revenue requirements, and are able to ask discovery about those files. During the course of our review of this work, we sought copies of Ascend's workpapers, but were not given them and tried to ask some discovery questions about Ascend's work.[27] Much of our understanding of this analysis arises from the limited discovery we were able to ask of APS and TEP, which also did not provide the entirety of their modeling files or the spreadsheets used to calculate revenue requirements. We strongly feel that transparency is a key element of fair decision making in the public interest and should underpin important policy decisions like consideration of the Clean Energy Rules.

Several jurisdictions (Michigan, New Mexico, and South Carolina) in which we work go so far as to provide intervenors with a free license for the IRP model the utility uses so that intervenors can provide alternative scenario and portfolio modeling. Taking a step like this would put parties on a more level playing field and produce a more robust record upon which to base Commission decision-making.

[27] We would have liked to review Ascend's workpapers to understand the substantive issues discussed in this report but also to understand some inconsistencies such as those between the APS load and capability tables in Section 5.1 and Table 2 of Ascend's report.

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