COMMENTS ON EPA'S MODELING OF THE IMPACTS OF THE PROPOSED CLEAN POWER PLAN IN ARIZONA

PREPARED FOR

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Executive Summary

In this paper, we examine how the EPA Building Block analysis of the Best System of Emission Reduction (BSER) affects the target emission rate for Arizona, and the degree to which the Integrated Planning Model (IPM) analysis accurately depicts likely changes in response to the Plan. We find that:

- The majority of the emission rate reduction impact in Arizona arises from applying Building Block 2 (redispatch from coal to gas) which replaces generation from all coal and oil/gas steam units with generation from existing natural gas combined cycle units (NGCC). This implies that all affected coal and oil/gas steam generation will retire and thus be unavailable to maintain reliability during peak load hours. Effectively, EPA's assumptions imply that Arizona can meet peak demand without 3,928 MW of coal and oil/gas steam capacity, which is unrealistic given that NGCC units are already operating at high output levels during the peak periods.

- EPA's energy efficiency assumptions have several shortcomings:
  - The assumed level of energy efficiency in Building Block 4 is too high to be consistent with the assumed cost-effectiveness of energy efficiency programs. EPA ignored the fact that the baseline load forecast already assumed a substantial impact from energy efficiency programs. Also, EPA used a national estimate of energy efficiency cost without examining how costs might vary at the state level.
  - EPA's IPM analysis did not analyze the cost-effectiveness of energy efficiency programs in either the base case or the policy case projections. Instead, EPA assumed in the IPM analysis that a certain percentage of base case load in the future would be reduced in the policy case without comparing its performance and cost to other resource options.
  - EPA's IPM analysis assumes that the additional EE programs would reduce the Arizona peak load by the same percentage as reductions in annual energy consumption. This assumption likely overstates the EE-related peak load reductions since some of the EE programs available to Arizona utilities involve providing incentives to customers to reduce consumption that may have less impact during on-peak periods than off-peak periods. Therefore, EPA likely understates the future capacity requirements in Arizona under the policy case.

- The IPM analysis implies a radical shift for Arizona, which transitions from a significant net energy and capacity exporter to other western states to a significant importer of energy and capacity from other western states. This analysis has several deficiencies:
    - EPA did not account for out-of-state ownership of capacity in its IPM modeling. The model appears to assume that all power that is generated by a plant located within Arizona is available to meet Arizona's peak demand, even if a portion of that plant is owned by an out-of-state entity and exported out of state to serve that entity's load obligations. On balance, IPM simulations overstated the generation capacity available to serve Arizona load by about 1,624 MW.
    - EPA projects that Arizona will import 5.8 GW of its summer capacity reserves (or about 20% of its total reserve margin capacity requirements), mainly from Pacific Northwest (PNW) and LADWP. Implementing this large reliance on imported capacity to meet Arizona's summer reserve requirements would force the Arizona utilities to sign capacity purchase contracts with generation owners in Pacific Northwest and LADWP <u>and</u> reserve firm transmission capacity with the owners of the transmission paths from those regions to Arizona. EPA's IPM model ignores the cost of such contractual arrangements, their feasibility subject to existing transmission reservations and transmission constraints, and their cost-effectiveness relative to building more generation capacity within Arizona.

The proposed Clean Power Plan has numerous structural flaws and relies on questionable analytic support. In Arizona, the shortcomings of the Plan are most prominent in the assumed feasibility and cost-effectiveness of high and sustained success in reducing electricity demand through efficiency measures and the assumed ability of the western power system to quickly and costlessly reconfigure historic energy and capacity flows among utilities in the region. These issues deserve much more attention from EPA than was evident in the analysis offered in support of the Plan as proposed, and call into question EPA's conclusion that the Plan can be achieved at a reasonable cost and without reliability implications.

I. Introduction

EPA performed two analyses for the proposed Clean Power Plan (the Plan). First, EPA determined the CO_2 emission rates that each state must achieve annually from 2020 onward, applying the calculated impact of the "Building Blocks" to annual (2012) state-level data. The second analysis is the Regulatory Impact Analysis, which uses the Integrated Planning Model (IPM) to model the effect of some of the Building Blocks. The IPM Base Case (Version 5.13) is based on the Energy Information Administration's Annual Energy Outlook 2013 ("AEO 2013"), and is designed to represent current policies and rules. This Base Case is compared against four "Policy" cases. The Policy cases impose two levels of stringency (Option 1 and Option 2) for the Plan with compliance analyzed at two levels (state or regional). We focus on the more stringent state level version of the Plan (Option 1 State) because it is also the focus of EPA's analysis.

For the IPM analysis, the EPA imposes the state-level emission rates calculated in their Building Block analysis as constraints in IPM, and allows IPM to select resource options to meet the emission rates of all states simultaneously, but these actions *assume* two of the Building Block components as given (Energy Efficiency and avoided premature nuclear retirements). Unlike the Building Block analysis, however, IPM makes decisions on power sales and purchases *between* states and regions to balance supply and demand of energy and capacity in each region. As we will discuss later, the interstate purchase and sale flexibility built into the IPM model leads to results that do not reflect real-world constraints and thus are very unrealistic for Arizona. We will also discuss at length the EPA's energy efficiency assumptions, which, although are not a major portion of the emission rate reduction in the Building Block analysis, are major drivers of the measured cost of the Plan in the IPM analysis.

This document is organized as follows. In Section II, we summarize the historical generation resources and historical load in Arizona for the year 2012. In Section III, we compare and contrast the key assumptions and projections in EPA's Building Block and IPM analyses for Arizona. Section IV provides an overview of EPA's IPM modeling results for maintaining reliable power supply for Arizona's electric load while complying with the proposed CO_2 emission standards. Section V includes our concluding remarks.

II. Historical Generation and Exports in Arizona

In 2012, Arizona exported a large portion (30 million MWhs, or 27%) of its in-state generation to the neighboring regions.[1] As shown in Figure 1 using EIA and EPA data, total generation in Arizona was 111 million MWh compared to 81 million MWh of consumption within the state.[2] As we explain below in Section V, Arizona's historical net-exporter status is in stark contrast to EPA's IPM projections for Arizona to become heavily dependent on imported energy and capacity in both the Base Case (without the rule) and under the proposed rule in the future.[3] EPA has not performed the required studies to support this major shift in power flows on the system. In a recent study, NERC has raised concerns about the sufficiency of the time frame to build necessary infrastructure for transmission and gas pipelines (in various regions including Arizona) to accommodate the shift in generation from coal to gas.[4]

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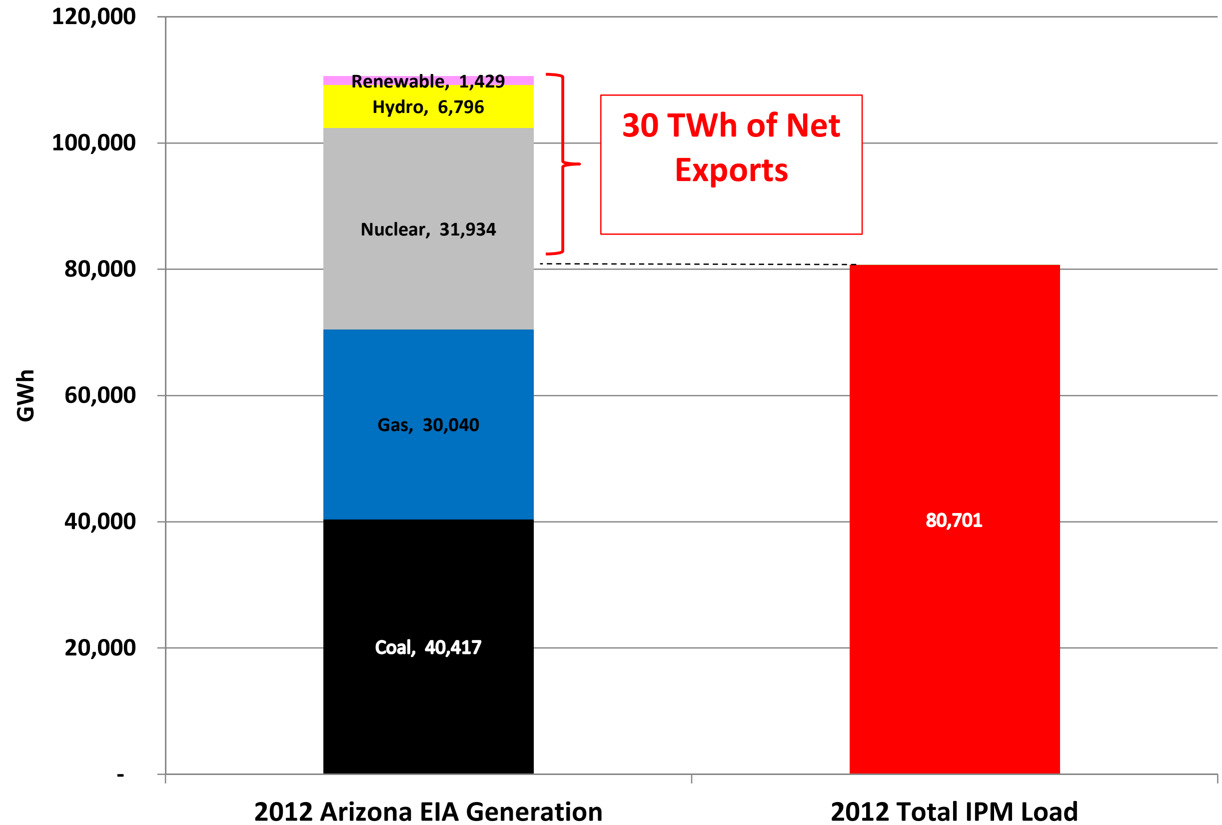
1 The Building Block analysis uses pounds of CO_2 per megawatt hour (MWh) as the basic unit. However, when discussing state generation totals, we also use gigawatt hours (GWh) which are 1,000 MWh and terawatt hours (TWh) which are 1,000 GWh or one million MWh.

2 Load data is from EPA ("20140602tsd-state-goal-data-computation.xlsx"), and generation data is from EIA data compiled by Ventyx.

3 EPA's projections for Arizona to become heavily dependent on imported energy in 2030 is substantially different than EIA's projections in AEO2014. EIA's AEO2014 did not model Arizona as a separate region, but the AZNM region (that contains the IPM regions Arizona, New Mexico, Southern Nevada, and Imperial Irrigation District) was projected to be exporting 36 TWh of energy in 2030 in EIA's Reference Case. IPM's projections under the Base Case (without the CO2 standards) for total exports from the same AZNM region is much smaller at 8.4 TWh.

4 NERC, "Potential Reliability Impacts of EPA's Proposed Clean Power Plan", November 2014, posted at http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/Potential_Reliability_Impacts_of_EPA_Proposed_CPP_Final.pdf.

Figure 1: Arizona Generation and Load in 2012



Source: Ventyx, EPA Building Block Analysis

III. Assumptions in IPM vs. The Building Block Analysis

Under the proposed Clean Power Plan, the EPA sets CO_2 emission rates goals that the states must meet or exceed. The goals are set at the state level, "taking into account the costs of achieving reductions," based on the Best System of Emission Reduction ("BSER") that EPA deems to have been "adequately demonstrated.[5]" The EPA has suggested that the following four "Building

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[5] "Under Clean Air Act (CAA) section 111(d), state plans must establish standards of performance that reflect the degree of emission limitation achievable through the application of the "best system of emission reduction" (BSER) that, taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements, the Administrator determines has been adequately demonstrated. Consistent with CAA section 111(d), this proposed rule contains state-specific goals that reflect the EPA's calculation of the emission reductions that a state can achieve through the application of BSER.," *Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants*, June 2014, EPA -542/R-14-002, pp. ES-1 to ES-2.

Blocks" comprise the BSER for reducing CO_2 emission rates. The EPA's Building Block CO_2 rate reduction calculations are all done relative to 2012 actual load, generation and emissions within each individual state.

- Building Block 1 — All existing coal units improve heat rate by 6% for a one-time investment cost of $100/kW.
- Building Block 2 — Generation switches from existing coal units to existing natural gas combined cycle (NGCC) units to the maximum extent possible. The existing combined cycle fleet in each state is limited to a maximum capacity factor of 70%.
- Building Block 3 — This block consists primarily of new and existing renewable energy ("RE"). However, it also includes energy from nuclear units currently under construction and nuclear units "at risk" of retiring for economic reasons. Rather than identifying the specific nuclear units that are at risk, the EPA assumes that 5.8% of each states generation from existing nuclear units is "at risk" for the purpose of setting the goals.[6]
- Building Block 4 — States achieve savings in energy consumption and peak load reductions through additional Energy Efficiency ("EE") programs. The assumed EE savings for setting the goals are supported by what EPA indicated as "Twelve leading states have either achieved, or have established requirements that will lead them to achieve.…"[7]

EPA calculates the target emission rate constraint for each state as:

$$\frac{\textit{CO}_2\textit{ emissions from existing fossil units (lbs.)}}{\begin{array}{c}\textit{2012 generation from existing fossil units +}\\ \textit{Sum MWh (avoided nuclear shutdown, new nuclear, new and existing RE, future EE)}\end{array}}$$

6 "Reflecting similar concern for these challenges, EIA in its most recent Annual Energy Outlook has projected an additional 5.7 GW of capacity reductions to the nuclear fleet. EIA describes the projected capacity reductions—which are not tied to the retirement of any specific unit—as necessary to recognize the "continued economic challenges" faced by the higher-cost nuclear units. Likewise, without making any judgment about the likelihood that any individual EGU will retire, we view this 5.7 GW, which comprises an approximately six percent share of nuclear capacity, as a reasonable proxy for the amount of nuclear capacity at risk of retirement." *Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units*, June 10, 2014, Docket ID No. EPA-HQ-OAR-2013-0602, page 4-33.

7 *Regulatory Impact Analysis*, page 3-14.

For Arizona, the Building Block analysis for 2030 has the components shown in Table 1.

Table 1: Arizona Building Block Analysis for 2030 (lb/MWh)

	Option 1 (lb/MWh)
2012 Emission Rate	1,551
Building Block 1 - Heat Rate Improvement	0
Building Block 2 - Coal to Gas Switching	651
Building Block 3 - "At-Risk" Nuclear	30
Building Block 3 - Renewable Energy	55
Building Block 4 - Energy Efficiency	112
Final Policy Emission Rate	702

Source: EPA Building Block Analysis

BUILDING BLOCKS 1 & 2 — HEAT RATE IMPROVEMENT & COAL TO GAS SWITCHING

In some sense, EPA's first step in calculating the state goals is actually Building Block 2. For this Building Block, the EPA assumes that generation from existing and under construction combined cycles replaces coal generation (and steam oil and gas generation) to the greatest extent deemed feasible.[8] For the purposes of this calculation, the EPA 1) limits each state's re-dispatched existing combined cycle fleet to a capacity factor of 70%, and 2) limits each state's under construction combined cycle fleet to a capacity factor of 15%.[9] For purposes of setting the state goals, the EPA assumes the increase in combined cycle generation over 2012 levels is equal to the reduction in coal and oil/gas steam generation.

Next, the EPA calculates the impact of Building Block 1 (coal heat rate improvements). When setting the state goals, the EPA uses the reduced heat rates for coal units to calculate the total emissions from the re-dispatched coal and combined cycle units. Since all affected coal units

8 Units that are under construction as of January 8, 2014 are included in the rule. *Regulatory Impact Analysis*, page 1-5.

9 *Technical Support Document* (20140602tsd-state-goal-data-computation_1.xlsx).

cease to operate in Arizona as a result of applying Building Block 2, Building Block 1 leads to no rate reduction.

In the IPM modeling, the Coronado, Cholla, and Apache Generating Stations retire by 2020 (2,359 MW), but Springerville (1,609 MW) remains online and gets the 6% heat rate improvement (selected as economic in the model). Note that Springerville 3 does not operate in the IPM analysis in 2020, but it does in all other modeled years. In addition, Navajo continues to operate since it is not affected by the June proposal, and the modeling was conducted prior to EPA having finalized the Supplemental Proposal for facilities located in Indian Country.[10]

A major problem with the EPA analysis of Building Block 2 is that its focus on annual data does not account for the need to run thermal generators during periods of peak demand. The EPA assumes that Arizona can reduce its annual coal and steam oil/gas generation from 25,370 GWh to zero. This assumes that 2,359 MW of coal capacity and 1,569 MW of oil/gas steam capacity (for a total of 3,928 MW) would not be needed to serve peak load (and hence not needed for reliability). While combined cycle units in Arizona can run in all likelihood more hours than they did in 2012, it is unlikely that they could have provided any additional capacity during peak load hours by running more hours (since they already were running at high output levels during the peak load periods). Therefore, it is an unrealistic assumption that Arizona can achieve the emission rate reductions the EPA assumes for Building Block 2 without potentially compromising reliability.

In the EPA's IPM analysis, outside of the assumed EE, Arizona complies with the emission rate standard entirely through fuel switching. However, unlike EPA's Building Block analysis that keeps fossil generation levels unchanged by assuming combined cycle generation replaces coal and oil and gas steam generation, total generation in Arizona falls dramatically in the IPM analysis of Option 1 policy scenario.[11] Figure 2 shows the comparison. Most of the reduction in output at affected coal and oil/gas steam units is offset by imported power from other states.

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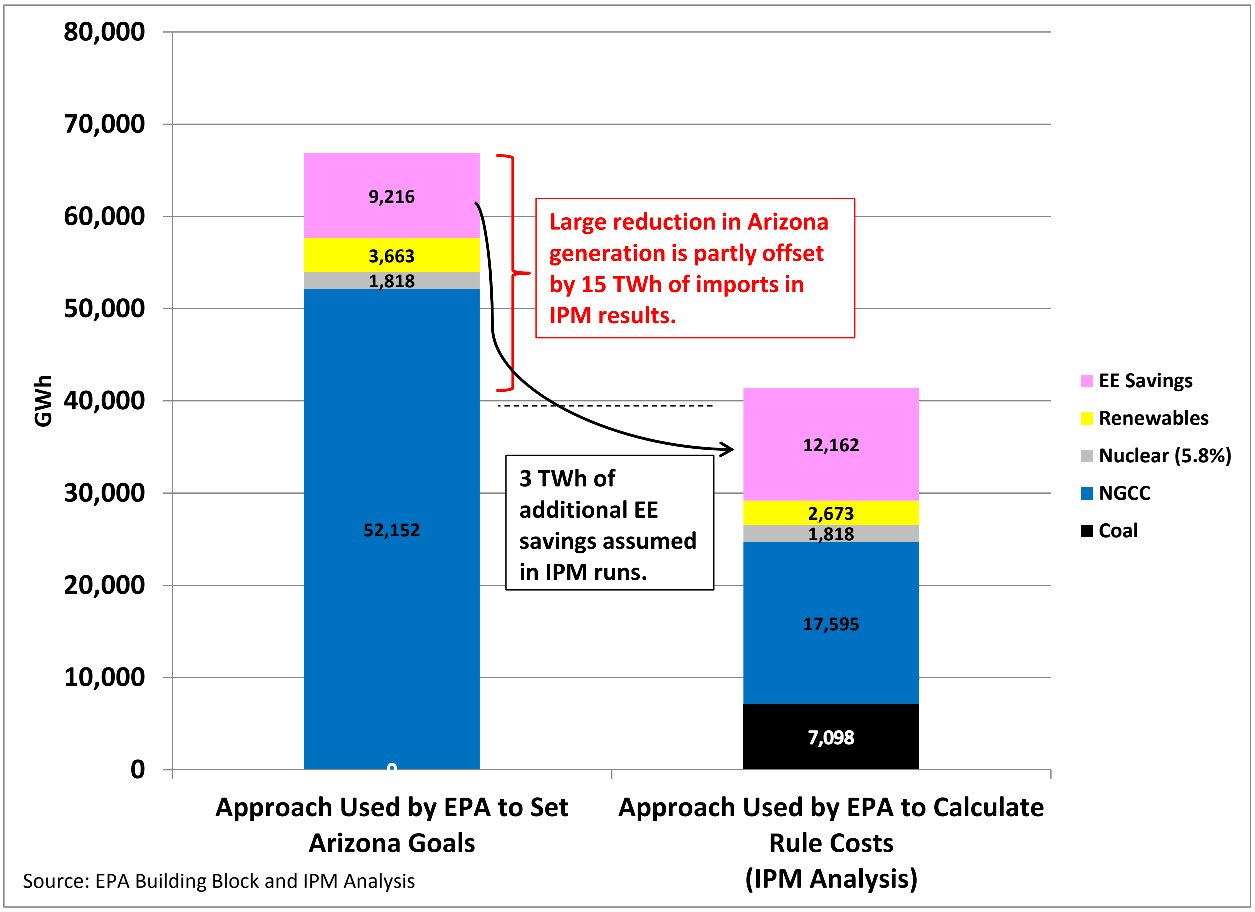
10 Plants on Indian land are excluded from the Plan and are not included in the building block analysis. These plants are Navajo (AZ), Bonanza (UT), Four Corners (NM) and South Point (AZ). On October 28, 2014, EPA issued a supplemental proposal for Tribal owned units.

11 The October 28, 2014 Notice of Data Availability (NODA) discussed the implications of assuming constant fossil generation in the analysis of Building Block 2.

Figure 2: Arizona Generation and EE Assumptions in 2030



BUILDING BLOCK 3 — RENEWABLES AND NUCLEAR GENERATION

The EPA calculates each state's achievable renewable energy (RE) potential in setting the CO_2 standards based on regional RPS standards using a multi-step process:

1. For each region, the EPA calculates a Regional RE Generation Target (%) by taking the simple average of the renewable energy targets for those states with RPS policies.
2. The EPA calculates a Regional RE Target (MWh). The Regional RE Target (MWh) equals the product of the Regional RE Generation Target (%) and 2012 generation in the region (excluding Indian Country generation).
3. The EPA calculates an Annual Regional Growth Factor (%). The Annual Regional Growth Factor (%) equals the annual growth rate necessary for each region to meet its target in 13 years.

4. The EPA calculates a State RE Target Generation (MWh). The State RE Target Generation (MWh) equals the product of each state's Regional RE Generation Target (%) and the state's 2012 RE generation.
5. The RE generation included in the Building Block analysis is the minimum of the State RE Target Generation (MWh) and the state's 2012 renewable generation increased by the Annual Regional Growth Factor (%) in each year after 2016.

For Arizona, the RE target in the Building Block analysis is 3.7 million MWh up from 1.7 million MWh in 2012.

In contrast, EPA's IPM model projects 2.7 million MWh of renewable generation in Arizona under Option 1 in 2030, about 1.0 million MWh less than the assumption in the Building Block analysis. This difference appears to be driven by the differences in implementation of state RPS targets in IPM versus the methodology to set renewable energy targets in the Building Block analysis described above. In particular, the IPM model uses constraints to satisfy state RPS requirements on an aggregate basis across groups of modeled regions. For example, IPM enforces an 11.1% RPS constraint for the aggregated AZNM region that includes the IPM regions Arizona, Imperial Irrigation District, New Mexico and Southern Nevada. In contrast, the Building Block analysis assumes Arizona's renewable generation in 2012 would grow at the Annual Regional Growth Factor for the entire WECC region. It is important to note that IPM can choose more renewable generation than the RPS requirement, but based on the economics of renewable generation, EPA's IPM modeling does not find renewable energy an economic Clean Power Plan compliance option.[12]

Building Block 4 — Energy Efficiency

EPA's assumptions for projected reductions in energy and peak load due to enhanced EE programs have several shortcomings:

1. In setting the building block, EPA does not consider existing and planned EE programs, which have already reduced load in Arizona and will continue to do so. Achieving large additional reduction from those levels is likely to be both challenging and expensive.

[12] EPA's building block analysis assumes that for most states renewable energy is a cost-effective compliance option. However, EPA's IPM analysis shows that for the majority of states, renewable energy is not a cost effective option.

Part of EPA's justification for its assumptions is based on a selective reading of the literature on EE.

2. If additional EE is as cost effective as EPA believes, some or all of that EE should be part of the IPM Base Case analysis and not solely attributable to the Plan. If EPA included the EE in the Base Case, the cost of the Plan would have been much higher.
3. EPA's IPM analysis assumes that the additional EE programs would reduce the Arizona peak load by the same percentage as reductions in annual energy consumption. This assumption likely overstates the EE-related peak load reductions since some of the EE programs available to Arizona utilities involve providing incentives to customers to reduce consumption that may have less impact during on-peak periods than off-peak periods such as residential lighting and variable speed pool pumps.

The high levels of EE proposed by the EPA go well beyond most states' plans – including Arizona. The EPA's analysis suggests that Arizona and many other states can cost-effectively eliminate all future load growth through 2030 by implementing new EE programs. At the national level, the EPA projects that the Plan will result in total United States load falling by 1.0% between 2016 (when the EE programs begin) and 2030.[13]

Figure 3 shows the extent of energy savings that the EPA assumes Arizona can achieve through new EE programs. Relative to the Base Case, EE results in a 12% decrease in state load by 2030. Between 2016 and 2030, the EPA forecasts that Arizona load will increase by 0.4% annually through compliance with the Plan compared with 1.3% annual growth in the Base Case.

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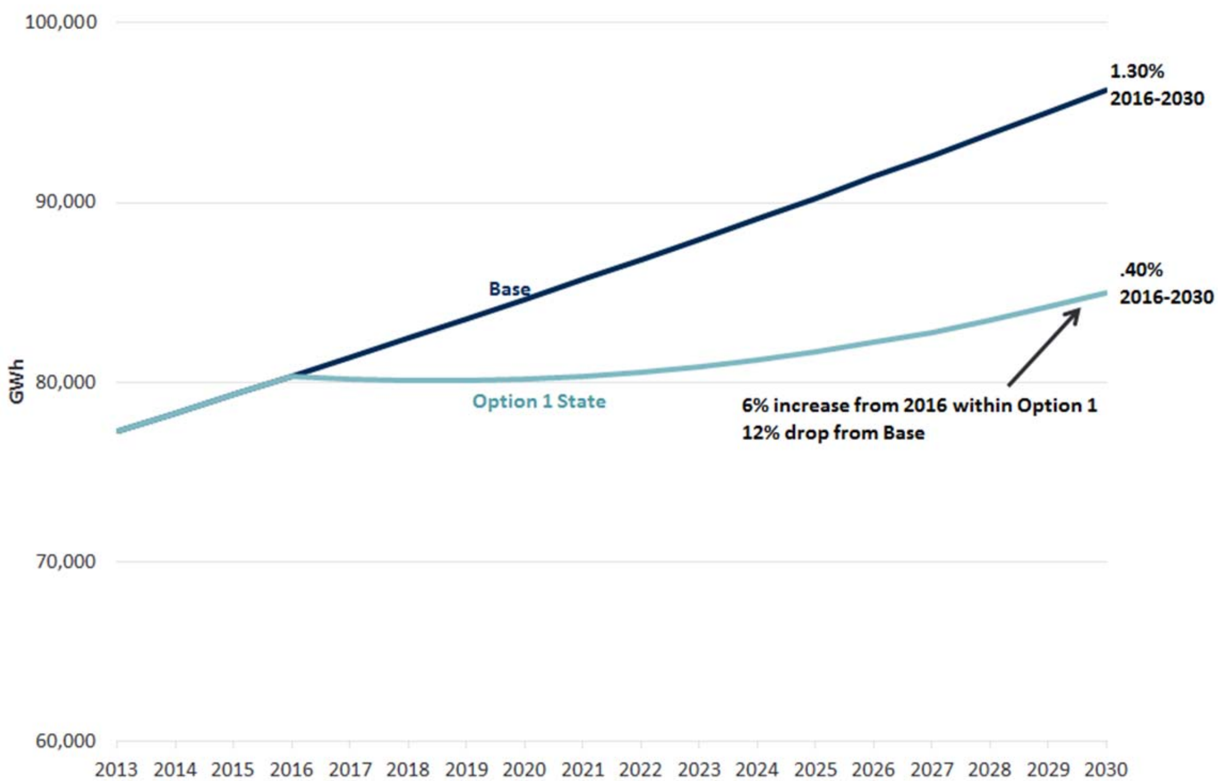
13 *Technical Support Document* supplemental model (20140602tsd-ghg-abatement-measures-scenario4.xlsx) shows that, after assumed energy efficiency, the EPA forecasts total US sales will fall from 3,831,692,334 MWh in 2016 to 3,792,370,830 MWh in 2030.

Figure 3: Retail Electricity Sales in Arizona



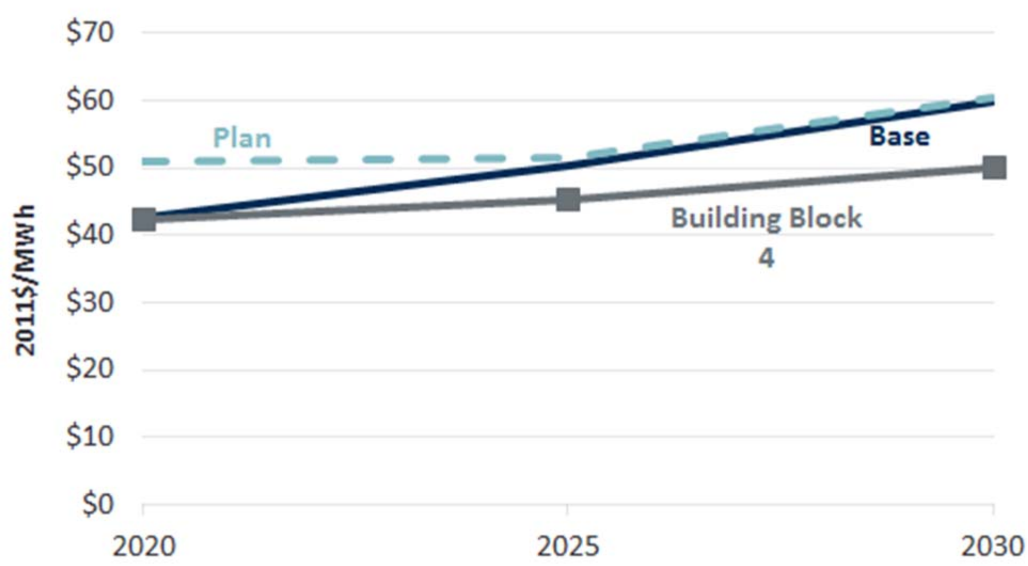
Source: EPA Technical Support Documentation, GHG Abatement Measures Scenario 1

It is likely that there are untapped, cost-effective EE opportunities in Arizona and most other states—many EE potential studies that have been conducted over the past decade have found this to be the case. However, there are problems with EPA's assumption that extremely high levels of EE are cost-effective across multiple states facing very different circumstances. Nevertheless, the EPA uses this assumption to set the state-level target rates. If states cannot achieve the assumed reductions, they will need to comply with the required emission rate reductions through other means. The EE assumption is critical to the EPA's conclusions about what is achievable in terms of state emission rates and the cost of reaching these limits. Moreover, if Arizona were to set aggressive EE targets and then fall short, making up the difference with the fossil system would be very difficult as we will discuss in Section 4.

The EE assumptions are applied inconsistently in the EPA's IPM analysis. The percent reduction that is calculated during the Building Block analysis is applied to the demand (both energy and peak demand) for the IPM cases that have the Plan modeled, but no EE is assumed in the Base Case. Thus, when the EPA calculates costs (one of the main purposes of the RIA), they have lower electricity demand under the Plan, which makes the Plan appear to be less expensive than it would otherwise be. As we will discuss later in this section, at least some (if not all) of the EE assumed by the EPA to occur only in the cases with the Plan should have been included in the Base Case. This would have lowered the cost of the Base Case and made the measured cost of compliance larger.[14]

One of the EPA's side cases ("Building Block 4") has the same input assumptions as the Base Case, except that it uses the post-EE load forecast as the Plan cases. This case is illuminating because we can directly compare this case with the Plan Case to estimate the likely cost impact of treating EE consistently across the cases. While we believe the EPA's analysis of EE potential is overstated (both in terms of feasibility and cost-effectiveness), using the Building Block 4 Case as the baseline against which cost changes are calculated provides a better estimate of the actual cost of the Policy. Figure 4 compares the 2020 - 2030 Arizona wholesale prices under the Base Case, the Plan Case, and the Building Block 4 Case.

Figure 4: Wholesale Prices across Three Cases (2011 $/MWh)



Source: EPA IPM Results

The projected wholesale prices under Base and the Building Block 4 Cases diverge quite sharply as the load in the two cases diverges. The EE assumptions in the Building Block 4 Case reduce the load from Base case load by 5%, 9% and 11% in 2020, 2025 and 2030, respectively. This load

14 Compliance costs are measured as the difference between a Plan Case and Base Case costs.

reduction is responsible for lowering the price in the Plan Case from what it would have been without the EE assumptions, and likely dominates the measured cost of the Plan.

The EPA Does Not Accurately Account for Existing and Planned EE

The EPA uses a sales growth forecast from the Energy Information Administration's Annual Energy Outlook ("AEO") as the sales forecast for the Base Case. The AEO sales forecast includes improvements in end-use efficiency, some of which would be driven by utility EE programs. While EPA's energy savings estimates in the Clean Power Plan case are described as being inclusive of these efficiency improvements, they are modeled as being entirely incremental to the base case outcomes. Thus, EPA's modeled energy savings double-count these planned EE improvements as a result. The EPA acknowledges this issue, but does not address it quantitatively in its modeling.[15]

Properly accounting for this issue would likely have a significant impact on the results. According to the Electric Power Research Institute ("EPRI"), in 2035 roughly 136 terawatt hours (TWh) of energy savings are embedded in the AEO forecast, representing roughly 3% of baseline sales.[16]

Arizona's strong EE programs were projected to reduce demand by as much as the EPA assumes Building Block 4 will in 2020. The Arizona Corporation Commission (ACC) ordered that all investor-owned utilities must achieve 1.25% annual electricity savings starting in 2011, ramping up to 2% beginning in 2012, and 2.5% from 2016 to 2020.[17] EPA assumes that from 2020 to 2030 Arizona can continue high levels of annual reductions of 1.5% after its 2012 to 2020 program has harvested much of the low cost energy efficiency by its EERS program. If 1.5% each year from 2020 to 2030 were achievable, which is unlikely as explained further below, its cost would in all likelihood be well above what EPA assumes in its analysis.

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15 *Technical Support Document*, page 5-62.

16 EPRI, "U.S. Energy Efficiency Potential Through 2035," April 2014, Table 2-6, page 2-10.

17 ACEEE, State Energy Efficiency Resource Standards (EERS) , April 2014, http://www.aceee.org/files/pdf/policy-brief/eers-04-2014.pdf; ACEEE, Arizona Utility Policies, http://www.aceee.org/energy-efficiency-sector/state-policy/arizona/177/all/191#Customer Energy Efficiency Programs

The EPA's Support for its "Best Practices" Energy Savings Estimate is Based on Misleading Comparisons

To show that its overall projection of achievable EE savings is reasonable, the EPA benchmarks its estimates against a fairly comprehensive survey of recent EE potential studies. While the EPA's projection appears to be consistent with some selected utility- and state-level studies, it is much higher than that of a comprehensive national study on the topic - an EPRI study that was originally conducted in 2009 and recently updated in April 2014.[18] Whereas the EPA estimates that all states can eventually reach incremental annual energy savings of 1.5%, the EPRI estimates are only in the range of 0.2% and 0.6%.[19] Even after accounting for the fact that some states will take several years to ramp up to the 1.5% annual rate, the EPA's annual average energy savings estimate across its forecast horizon is still higher at around 0.9% on average. Thus, the selection of an "achievable" energy savings target that is outside the upper-bound of achievable energy savings in an authoritative national assessment suggest that the estimate is too aggressive to be reasonable. For Arizona, EPA assumes a 1.5% growth rate for all years.[20]

Additionally, to justify the achievability of its energy savings projections, the EPA points to other states that have already reported achieving similar levels of savings (*e.g.*, California) according to EIA data. However, their analysis of these other states is based on the reported incremental energy savings for a single year (2012).[21] The EPA then assumes that, in some cases, those incremental annual energy savings increases could be achieved for a consecutive stretch of 13 straight years.[22] This is problematic because (1) there is likely a fair amount of year-to-year variability in the reported incremental impacts of EE, thus calling into question the use of a single year of data for this exercise, (2) no evidence is provided to support that these single-year "best practices" impacts could be propagated and sustained for over a decade, and (3) the EPA's analysis does not account for differences in retail rates – California, for example, has some of the highest electricity rates in the U.S., so it would naturally invest more in EE than a state with

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18 EPRI, "Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.," January 2009. EPRI, "U.S. Energy Efficiency Potential Through 2035," April 2014.

19 Technical Support Document, page 5-24.

20 Only two other states – Vermont and Maine – are assumed to achieve the same level of EE effect throughout the period.

21 *Technical Support Document*, pages 5-62 to 5-63.

22 *Technical Support Document*, page 5-37.

lower rates. The California experience, therefore, does not provide a reasonable basis for estimating the amount of cost-effective EE in other regions.

Table 2: Arizona versus California Retail Rates

	2020	2025	2030
Arizona Retail Rate	10.5	10.8	11.5
California Retail Rate	14.3	13.9	14.1

Source: RIA Tables 3-21 to 3-23

The EPA Does not Differentiate EE Costs by State

The cost of EE in each state is derived from a single national average estimate of levelized EE costs based on recent historical data. However, each state will have a different starting efficiency level. For states with relatively high efficiency levels due to a strong history of EE initiatives, this likely understates the cost of achieving large incremental increases in energy savings. In these states, aggressive programs will have already captured the "low hanging fruit" and such states will need to pursue costlier initiatives in order to achieve the EPA's targets. This contradicts the EPA's assumption that states that are currently achieving high levels of energy reductions should have higher energy savings targets than those states that have only rudimentary EE programs. In reality, the situation is likely the opposite – states that have already reached deep into their available EE resources may have fewer cost-effective EE opportunities going forward. In Arizona, the ACC has required that the utilities meet strong energy savings targets for several years. While there is likely still untapped cost-effective EE potential in the state, the EPA's target likely overstates the achievable potential for the above reasons.

The EPA May Have Underestimated the Escalation in Costs That Would Be Associated with Achieving Their Energy Savings Targets

The EPA assumes that annual incremental energy savings that are less than 0.5% of baseline consumption can be achieved at their estimate of the recent national average levelized cost of EE programs. Between 0.5% and 1% incremental annual energy savings, they escalate the cost estimate by 20%. Above 1% annual incremental energy savings, they escalate the average cost estimate by 40%. These estimates are loosely based on studies by Lawrence Berkeley National Lab and the American Council for an Energy Efficient Economy ("ACEEE").[23] However, neither of those studies considered an unprecedented national increase in energy savings of the magnitude and duration that the EPA has proposed and the total cost of compliance may be understated as a result. More detailed analysis is needed to determine the likely cost of the large-scale nationwide EE program that is proposed by the EPA.

The EPA Analysis Indicates That at Least a Portion Is Cost Effective in the Base Case without the Plan and Therefore Should Have Been Included in the Base Case

The EPA reports that EE has a cost of 8.5-11 cents/kWh in the Base Case,[24] while retail rates in most states—including Arizona—are above those levels.[25] Under the EPA's cost assumptions, at least some of the EE would be cost effective in the Base Case. This leads to the conclusion that not only does the EPA double count some of the EE savings in the Policy Case (and overstate the true EE potential), but the EPA also understates EE penetration in the Base Case. Therefore, the electricity demand in the Base and Policy Cases EE should be much closer together.

Table 3: Levelized Cost of Saved Energy vs. Retail Rates

	2020	2025	2030
Levelized cost of saved energy (3% discount rate)	8.49	8.91	9.03
Levelized cost of saved energy (7% discount rate)	10.30	10.81	10.95
Base Case Arizona Retail Rate	10.50	10.80	11.50

Source: GHG Abatement Measures Appendix 5-4

23 *Technical Support Document*, Table 5-32, page 5-61.

24 *Technical Support Document*, (20140602tsd-ghg-abatement-measures-appendix5-4.xls).

25 *Regulatory Impact Analysis*, Tables 3-21 to 3-23, pages 3-40 to 3-42.

Risks from Overestimating the EE Potential

Arizona utilities face considerable risk under the Plan. First, as we will see in Section IV, reliability considerations likely would prevent Arizona from curtailing in-state generation and purchasing large quantities of power from out of state as the IPM analysis selects as the least-cost compliance option. Second, if natural gas prices were to rise above the levels assumed by the EPA, compliance costs would also rise. Third, there is financial risk associated with a Plan that relies on large quantities of EE for Arizona. It is impossible to know in advance if EE targets will actually be met in each year. If not, Arizona would have to take potentially costly action to rebalance its generation mix to comply with the Plan. Finally, the amount of generation and capacity outside of Arizona available for import into Arizona depends substantially on the success of other states' EE programs. Should those states fall short of their EE targets, they may not have surplus generation or capacity to export to assist other states' compliance. Thus, Arizona's reliance on other states' EE program success would expose itself to risks that cannot be controlled.[26]

A shortfall in EE would require a commensurate reduction in covered fossil emissions. For Arizona, EPA's Building Block analysis assumes that there will no longer be any coal generation by 2030. The target emission rates are 778 lbs CO_2/MWh in 2020 declining to 702 lbs CO_2/MWh in 2030. These emission rates are below those of most combined cycle units. Hence, the only ways to lower the emission rate are to add more renewables, add new combined cycle to back out existing combined cycle, or to import more power, which may not be feasible from a reliability point of view or may be very expensive in the market. If Arizona were in a position where it had to back down existing combined cycles to replace unattained EE savings, Arizona would have to back down up to six MWh for every MWh of unattained EE savings.

EPRI has developed a "Fossil Leverage Factor" (FLF), which relates how much (in this case) combined cycle generation would have to be reduced per MWh of EE shortfall. This can be calculated as:[27]

$$FLF = Rate/(r - Rate)$$

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[26] Similar risks would arise if states exporting to Arizona did not achieve in-state fossil generation emission rates implied by the IPM analysis, which would limit the amount of fossil generation available for export.

[27] http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=3002004658

where “Rate” is the state’s target emission rate and “r” is the marginal emission rate for that state’s fossil generation (here the Arizona existing combined cycle emission rate or 900 lbs CO_2/MWh).

For 2020, the FLF is 6.38 and for 2030 it is 3.55. This means that in 2020, if the assumed 4,226 GWh of EE savings that the EPA assumes for Building Block 4 is not achieved, then Arizona would have to reduce existing CC generation by 6.38 times the amount of EE or about 27,000 GWh, which is about one-third of 2012 state energy consumption. To replace that reduced generation, the state would have to rely on a combination of additional imports, new combined cycle or new renewables. For context, 27,000 GWh from new combined cycle is about 4.4 GW of combined cycle at a 70% capacity factor (about seven new plants). Adding new combined cycle units would have little carbon benefit, but great cost since each MWh from the new units would be generated with only slightly higher efficiency than the units existing units they back down.

IV. Assessment of EPA’s IPM Modeling Assumptions

Most utilities in the WECC region conduct their system operations and resource planning in a semi-independent way, by taking into account the joint-ownership of generation assets, long-term power contracts and transmission reservations, and required reserve margins to meet their projected load obligations. Even though imports of energy and capacity from other utilities and states often are part of the mix of resources to meet load obligations, utilities only rely on the imported capacity that they (and their regulators) deem as assured and deliverable in their resource planning. This means that a utility would only rely on the imported power in its resource plan to the extent that the power is dedicated under a contract with an out-of-state generation owner and the required reservations on the affected transmission paths are made in advance. To the extent the existing transmission infrastructure is not sufficient to accommodate the additional required reservations, upgrades or additions to the transmission infrastructure would be necessary to import substantially more capacity into a region. EPA’s IPM analysis did not include an assessment of the costs and or the associated time necessary to implement such changes to the transmission infrastructure.

EPA's IPM simulations under the Clean Power Plan do not portray a realistic view of system dispatch and resource planning in Arizona and rest of WECC region. Our review of the EPA's IPM simulations for Arizona indicates the following key deficiencies with respect to modeling approach and assumptions:

1. **Ignores joint ownership of generation by out-of-state utilities.** EPA's IPM modeling does not appear to account for power plants that are jointly owned by Arizona utilities and out-of-state entities. The model appears to assume that all power that is generated by a plant located within Arizona is available to meet Arizona's peak demand, even if a portion of that plant is owned by an out-of-state entity and exported out of state to serve that entity's load obligations.

   For example, as shown in the table below, 53% (2,103 MW) of the Palo Verde nuclear power plant, 37% (380 MW) of the Cholla coal plant, and 33% (731 MW) of the Navajo coal plant are owned by out-of-state entities. These are only partially offset by Arizona' utilities' ownership of the some out-of-state power plants (*e.g.*, Four Corners and San Juan coal plants in New Mexico). On balance, IPM simulations overstated the generation capacity available to serve Arizona load by about 1,624 MW (difference between 3,761 MW of Arizona capacity owned by out-of-state entities versus 2,137 MW of out-of-state capacity owned by major utilities in Arizona). In addition, EPA's IPM analysis does not account for the EPA's recent approvals of plans to retire one unit at Navajo[28] in Arizona in 2019 if certain ownership changes occur, and retire San Juan[29] Unit 1 and Unit 2 (850 MW) in New Mexico in 2017. Thus, while IPM output shows a 13.5% reserve margin for Arizona in 2030, the reserve margin is actually below 13.5% as a result of overstating the generation capacity that will be available to serve Arizona load.

[28] Final Regional Haze Federal Implementation Plan (FIP) for Navajo Generating Station, 79 Fed. Reg. at 46,514.

[29] http://www.tricitytribuneusa.com/agreement-reached-local-plant-to-close-units-2-and-3-in-2017/

Table 4: Joint-Ownership of Generation

Plant	State	Summer MW	AZ ownership	non-AZ ownership	AZ ownership MW	non-AZ ownership MW
Cholla	AZ	1,027	63%	37%	647	380
IRC Generator Facility	AZ	3	0%	100%	-	3
Mesquite Solar	AZ	32	0%	100%	-	32
Navajo	AZ	2,250	68%	33%	1,519	731
Palo Verde	AZ	3,937	47%	53%	1,834	2,103
Springerville	AZ	1,609	74%	26%	1,192	417
Yucca	AZ	95	0%	100%	-	95
Out of State Ownership of AZ Capacity						**3,761**
Craig	CO	1,304	19%	81%	248	1,056
Four Corners	NM	1,540	80%	20%	1,232	308
Hayden	CO	446	29%	71%	131	315
Luna Energy Facility	NM	559	33%	67%	186	373
San Juan Generating Station	NM	1,684	20%	80%	340	1,344
Arizona Ownership of out of State Capacity					**2,137**	

Source: Ventyx

2. **Ignores existing transmission reservations to transfer power among utilities and states.** EPA's IPM model uses Total Transfer Capabilities (TTCs) on the transmission links between the modeled regions in order to limit the transfer of capacity (or "reserve transfers") among regions. This implies that the model ignores the existing long-term reservations on the transmission paths, and assumes all of the transfer capability between regions will be available for supporting capacity transfers to meet regional reserve margin requirements. However, in reality, use of transmission system in some regions (such as in the WECC) is based on physical reservations of transmission capacity. Available transmission capacity is reduced by the amount reserved under Existing Transmission Commitments (ETCs). Therefore, the ability of Arizona utilities to rely on imported power to meet their planning reserve margin requirements in the future depends on the availability and cost of obtaining firm transmission reservations on the paths from the out-of-state source to their load. The assumed transmission wheeling charges up to $8/MWh for transfers during the summer peak load hour in the IPM model do not fully capture the cost of reserving transmission service on paths to Arizona for meeting reserve margin requirements, since the reservations would need to be made in advance for the whole period (season or year, not just the peak load hour). EPA's modeling of reliability ignores these constraints and associated costs.

3. **Ignores lack of centralized reserve sharing and dispatch among utilities in the WECC.** EPA's IPM model simulates transfers of energy and capacity among regions in the WECC by implicitly assuming coordinated sharing of capacity and energy subject to the assumed transmission tariffs (or wheeling charges) up to $8/MWh. For example, EPA assumes that each MWh of transfer from the Southern Nevada region to the Arizona region faces zero wheeling charge, and transfers from SCE to Arizona face an $8/MWh charge.[30]

   In reality, however, most of the regions in the WECC do not operate as if they are part of a WECC-wide centralized reserve sharing and dispatch system.[31] Instead, each region typically acts to meet its own load obligations in the operating and planning horizons with some limited coordination within the reserve sharing groups[32] or other bilateral arrangements for real-time coordination of dispatch (such as the recently established Energy Imbalance Market (EIM) among CAISO, PacifiCorp and NV Energy). In order to account for this lack of centralized sharing of reserves and dispatch among WECC regions, simulation models typically use "hurdle rates" greater than the transmission tariffs for energy and capacity transfers and introduce limits for reliance on imported capacity to meet regional capacity reserve margin requirements. EPA did not implement either of these techniques when modeling the reliability implications of the proposed rule in the WECC..

4. **Projects a heavy reliance on imported capacity by utilities in Arizona by ignoring the required contractual arrangements for power and transmission.** IPM simulation results for Arizona under the Base Case (no policy) and Option 1 (policy case without regional cooperation) project a heavy reliance on imported energy and capacity in 2030. As shown in the figure below, reliance on imported energy is higher under Option 1 (7.4 TWh in Base Case vs. 15.2 TWh in Option 1) while reliance on imported capacity to meet summer peak load and 13.5% reserve margin requirement is less under Option 1 (6.2 GW in Base Case vs. 5.6 GW in Option 1). In addition, EPA projects that Arizona's compliance with the proposed

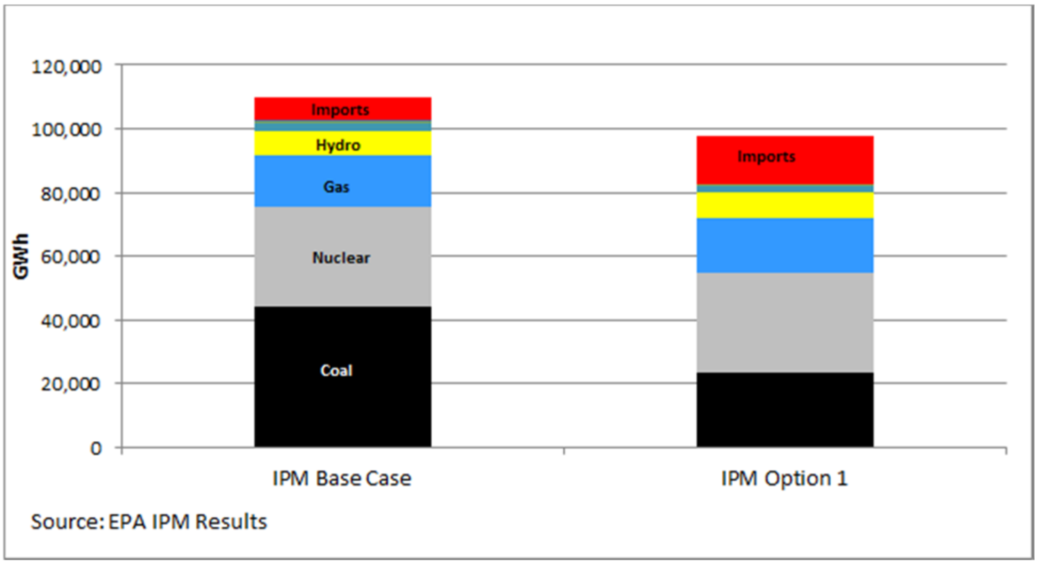
30 EPA, "Documentation for EPA Base Case v.5.13 Using the Integrated Planning Model", Table 3-4.

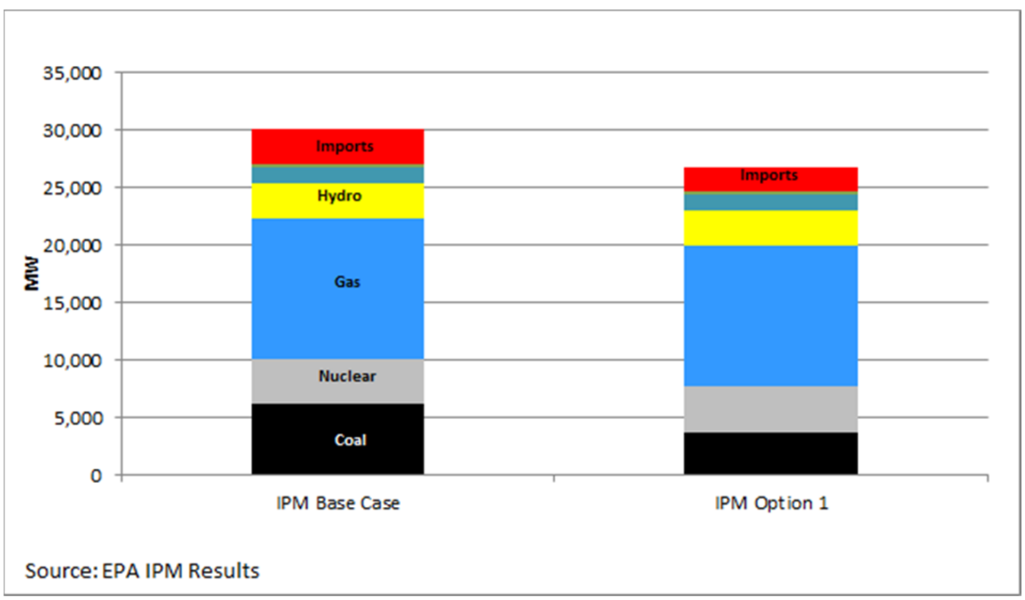
31 There are some limited amount of contractual arrangements between utilities in the WECC region to exchange energy and capacity, but the ones we are aware of are for small amounts of power with expiration dates in the near-term. For example, APS has a power exchange agreement with PacifiCorp such that APS imports power from PacifiCorp during APS' peak load conditions in return for PacifiCorp importing from APS during winter. The contract expires in 2020, hence would not be available to serve APS' summer peak load in 2030 unless it is renewed.

32 For example, the Southwest Reserve Sharing Group includes Arizona, New Mexico, southern Nevada, parts of southern California including the Imperial Valley, and El Paso, Texas. See http://srsg.org/.

rule under Option 1 would result in a reduction in coal generation and capacity, and a small increase in gas generation. Finally, EPA assumes a substantial reduction in both annual energy and summer peak load requirements under Option 1 as a result of the aggressive energy efficiency assumptions.

Figure 5: IPM Projections for Arizona's Generation and Capacity Mix in 2030





According to the IPM results, the sources of imported energy and capacity into Arizona under the Option 1 scenario in 2030 are very different: the New Mexico region is the source for majority of energy imports, while Pacific Northwest and LADWP regions are the main sources of summer capacity. As shown in the figures below, EPA projects that Arizona will be a net importer of 15.4 TWh of energy (or about 15% of the projected annual load of 98 TWh), mostly due to projected imports of 18 TWh from New Mexico. For summer capacity, EPA projects that Arizona will import 5.8 GW of its summer capacity reserves (or about 20% of its total reserve margin capacity requirements), mainly from Pacific Northwest (PNW) and LADWP. Implementing this large reliance on imported capacity to meet Arizona's summer reserve requirements would force the Arizona utilities to sign capacity purchase contracts with generation owners in Pacific Northwest and LADWP <u>and</u> reserve firm transmission capacity with the owners of the transmission paths from those regions to Arizona. EPA's IPM model ignores the cost of such contractual arrangements, their feasibility subject to existing transmission reservations and transmission constraints, and their cost-effectiveness relative to building more generation capacity within Arizona.

Figure 6: IPM Projections for Summer Reserve Flows (MW) in 2030 in Option 1

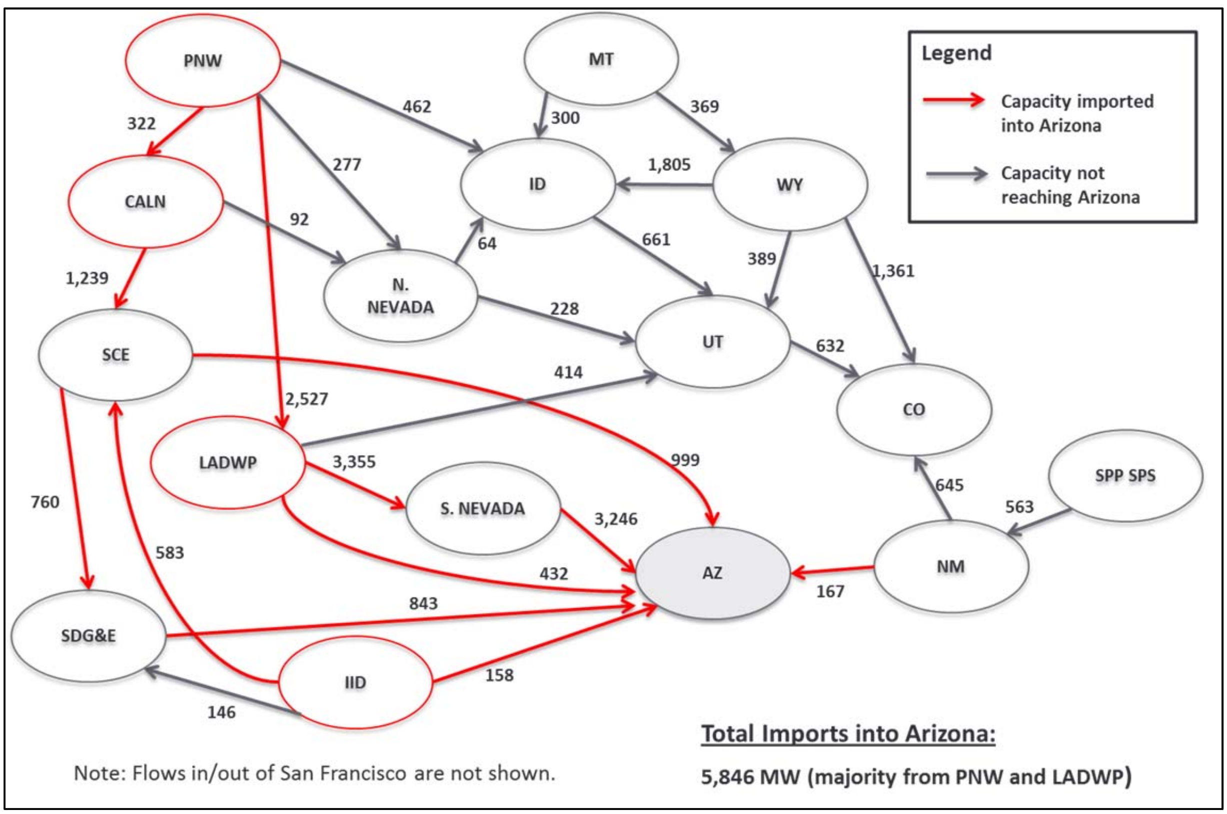
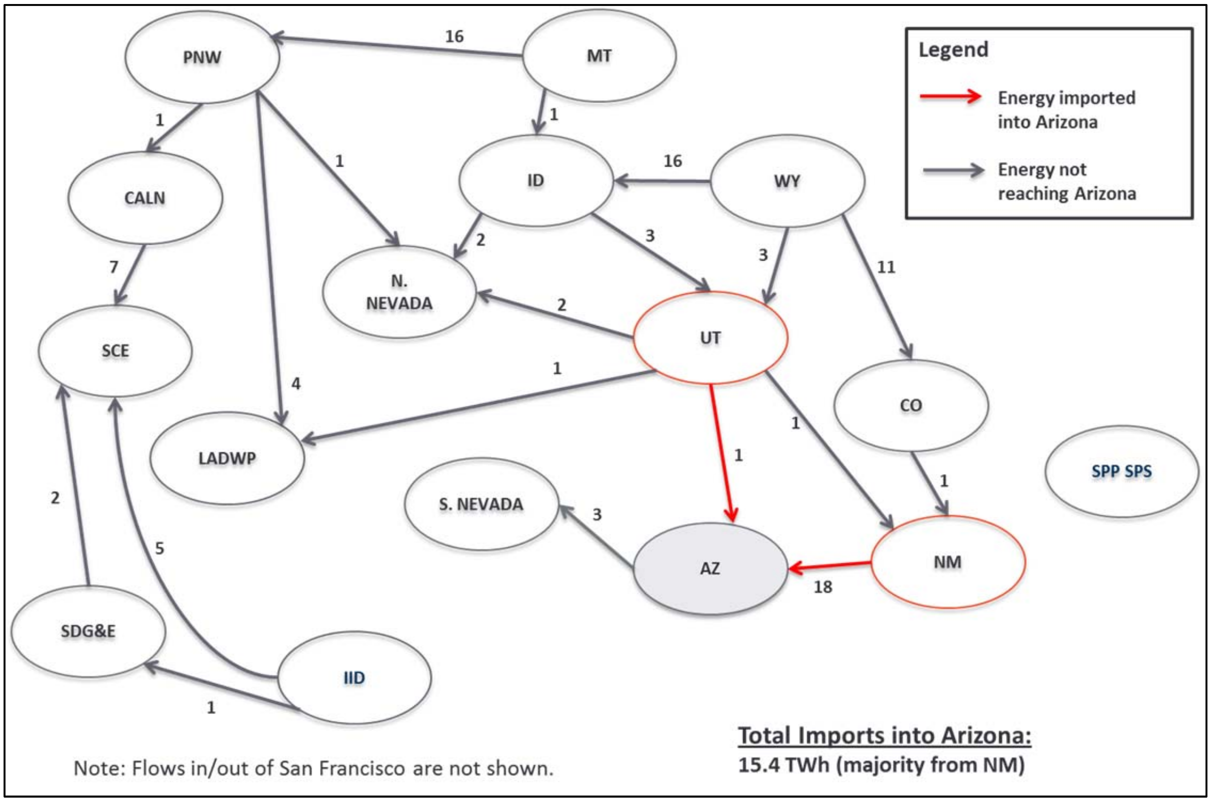


Figure 7: IPM Projections for Annual Net Energy Flows (TWh) in 2030 in Option 1



V. Conclusions

The proposed Clean Power Plan has numerous structural flaws and relies on questionable analytic support. These flaws and errors affect all states' treatment under the Plan, with impacts that vary depending on specific circumstances. In Arizona, the shortcomings of the Plan are most prominent in the assumed feasibility and cost-effectiveness of high and sustained success in reducing electricity demand through efficiency measures and the assumed ability of the western power system to quickly and costlessly reconfigure historic energy and capacity flows among utilities in the region. These issues deserve much more attention from EPA than was evident in the analysis offered in support of the Plan as proposed, and call into question EPA's conclusion that the Plan can be achieved at a reasonable cost and without reliability implications.

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