INDEPENDENT
ENERGY
PRODUCERS
ASSOCIATION

**January 11, 2016**

**Comments of the Independent Energy Producers Association (IEP) on CARB's Workshop Related to The Clean Power Plan and Potential Amendments to the Cap-and-Trade Regulation Convened December 14, 2015**

IEP submits these comments in response to the CARB workshop convened December 14, 2015 regarding California's compliance with the U.S. Environmental Protection Agency's Clean Power Plan (CPP), and the scope for potential amendments to the Cap-and-Trade Regulation related to electricity sector topics. IEP's comments below are grouped by discussion of the Clean Power Plan, SB 350 implementation and the RPS adjustment.

**Clean Power Plan:**

**Cap-and-Trade is the Preferred Option for Compliance with the Clean Power Plan.** IEP supports a mass-based, state measures plan, based primarily on the continued operation of the Cap-and-Trade program, as the most efficient and effective way to comply with the Clean Power Plan. A mass-based approach is used under the existing cap-and-trade program and regulated entities are familiar with this form of measurement. IEP supports the continuation of programs that are market-based, already operational, and that have been effective in terms of reducing carbon emissions. This approach is preferable to creating a completely new greenhouse gas emissions compliance paradigm. A compliance plan that uses existing programs may also prove to be the most cost-effective path for compliance with the Clean Power Plan given that much of the administrative costs to create these programs have already occurred.

**The Backstop to the Preferred Compliance Plan Should Not Create Additional Mandatory Measures for Electric Generators.** The cap-and-trade continues to be the preferred option in terms of demonstrating compliance with the Clean Power Plan. While IEP understands that CARB is required to implement a backstop for plans that rely on state measures,[1] the backstop should only be used in the scenario that the cap-and-trade program (i.e. "the front-stop") fails.

[1] CARB Presentation (December 14, 2015), *Clean Power Plan & Cap-and-Trade,* page 11.

Whatever form the backstop takes, the backstop should not be an additional mandatory measure that will be imposed on electric generators in addition to the cap-and-trade program. This ensures individual electric generators are not paying twice for the same ton of carbon emissions.

**CARB Needs to Establish Clear Standards for When The Backstop Becomes Effective.** Definitive guidelines must be set up ahead of time to delineate circumstances under which the primary compliance measure (i.e. the cap-and-trade program) has failed; how failure will be measured and identified; and how and when the backstop becomes the new compliance mechanism. Without these standards delineated upfront with a clear division between the "front-stop" and the backstop, California runs the risk of running multiple $CO_2$ reduction programs simultaneously, creating a high level of regulatory uncertainty for electric generators.

IEP agrees with other commenters that CARB should spend limited staff time and resources in developing a backstop program, given that the likelihood the backstop will be triggered is small. However, IEP supports CARB spending some efforts on identifying guidelines that will establish under what circumstances the primary measure for demonstrating compliance (i.e. the cap-and-trade program) is deemed a failure; in addition to providing clear indicators as to how, when, and under what circumstances the backstop becomes the new compliance mechanism. Redundant and/or inconsistent plan measures to achieve the Clean Power Plan goals and objectives would foster a measure of regulatory inconsistency and litigation that would not be helpful to industry and commercial interests.

**"Are There Any Policy Reasons to Adjust the Policy for "Accounting" for Imported Power Post 2022?"[2]** YES. IEP continues to be concerned about potential emissions leakage. The Air Resources Board needs to reassess whether the current methodology for imputing the default emissions factor to unspecified out-of-state resources is accurately imputing emissions to unspecified resources. In addition, the Air Resources Board needs to ensure that "double-counting" is not occurring.

As the western electricity market becomes more integrated through the Energy Imbalance Market, the proposed CAISO regionalization, etc., the volume of imports/exports and the number

[2] CARB Presentation (December 14, 2015), *Clean Power Plan & Cap-and-Trade,* page 12.

of importers/exporters may change. Certainly a reliance on other balancing authorities likely will increase. Furthermore, some resources may end up facing a new compliance obligation under the cap-and-trade program; and, new power sources may be serving California in the future that have not historically served California in the past.

Western integration creates great opportunity for more efficient operations across regional areas and provides an opportunity to leverage a greater pool of resources to lower the Western carbon footprint in general. However, along with great benefits, also comes the opportunity for actual emissions to be distorted through larger supply pools and resource shuffling. While regional expansion may provide a better opportunity to identify where a particular resource originated, the opposite may also be true. Therefore, the need to have a system that encourages accurate accounting and discourages resource re-labeling will become increasingly important. Accurate accounting is an important feature of the cap-and-trade and the mandatory reporting program and an accurate accounting of imported power should be a central issue of focus for CARB staff.

IEP previously advocated that the CARB take another look at the default emission factor. We believe the default emission factor ought to be set sufficiently high to discourage the incentive to "re-label" a particular resource. This future round of amendments provides a suitable and needed opportunity to evaluate the current methodology with this goal in mind. The evidence described in the attached report, which IEP previously submitted to CARB in 2014, indicates that the methodology for imputing emissions associated with unspecified imports may be shielding accurate emissions accounting and reporting thereby exacerbating inefficiencies and inequities in the current program design. This may potentially contribute to resource shuffling and GHG emissions "leakage," which undermines the CARB's intent to reduce GHG emissions today and in the near future.

*Accordingly, IEP Recommends that the default emission factor be re-evaluated in upcoming amendments to the cap-and-trade and/or mandatory reporting regulation, i.e. before 2022* so that the default emissions rate is set at an accurate level that discourages market distortion, emissions leakage, resource shuffling and competitive advantages between in-state generators and imports. See attached report for more information.

**Using the IEPR Scenarios to Demonstrate Compliance with CPP is Appropriate.** IEP understands that the CEC/CPUC/CARB are considering using scenarios based on those developed in the Integrated Energy Policy Report (IEPR) process, with modifications as appropriate to reflect CPP needs, Scoping Plan analyses, SB 350 policies, etc., to demonstrate compliance with the CPP.[3] IEP supports these efforts. The IEPR is completed on a biennial basis, with an update year in between, which means that information is generally up to date. In addition, because much of the information in the IEPR, i.e. the demand forecast, etc. is used as the framework for other planning forums including the CPUC's Long-Term Procurement Plans (LTPP), the CAISO Transmission Planning Process (TPP), etc., CARB's use of this information in terms of a CPP compliance demonstration would foster consistency across agencies and subject matter. Furthermore, re-using existing planning frameworks avoids unnecessary work and multiple processes, forums, and competing results for stakeholders to review and comment.

**SB 350 Implementation:**

**The CEC's Mid-Case Demand Forecast Should Determine Appropriate GHG Targets.** During the CARB workshop, staff discussed SB 350 requirements which include ensuring the electricity sector's percentage of the economy wide GHG reduction of 40% from 1990 levels by 2030 is achieved.[4] With regards to determining what these targets and glide-paths will be, IEP recommends using the mid-case demand forecast developed through the CEC's IEPR process. This IEPR demand forecast includes assumptions associated with electricity demand, energy efficiency, electrification of the transportation sector, etc. and should provide a sound framework for understanding and developing current emissions profiles and emissions profiles on a going forward basis.

**The Utilities Should Receive Carbon Credit for Contracting with Biomass Facilities that Use Forest Waste Products to Generate Renewable Electricity.** In meeting the carbon reduction targets as directed by SB 350, Load Serving Entities (LSEs) should be awarded carbon credit (e.g. an allowance) for incremental energy purchased from biomass facilities, including contracting with existing facilities facing contract expiration, that use forest waste to generate renewable electricity pursuant to the Governor's Forest Proclamation (dated October 30, 2015).

[3] CARB Presentation (December 14, 2015), *Clean Power Plan Analysis and Options*, page 10

[4] CARB Presentation (December 14, 2015), *SB 350 Discussion*, page 16, 17.

Wildfires make a significant contribution to the level of carbon in the atmosphere. Biomass-fueled electric generation units can productively use forest products that if left in place would: (1) increase the intensity and occurrence of wild files; (2) increase $CO_2$/methane emissions left in the forest to bio-degrade; and (3) pose unhealthy and unnecessary health risks on local communities when forest waste products are open-field burned. Given the Governor's Proclamation, it is timely for the state to begin properly valuing these biomass resources and their added carbon reduction benefits.

**RPS Adjustment:**

IEP concurs with those at the December 14, 2015 workshop that the current CARB rules and guidelines regarding the RPS Adjustment have led to confusion and uncertainty in the RPS market, particularly regarding firming and shaping contracts. IEP further concurs that it makes sense for CARB to convene a joint workshop with the CPUC and CEC to discuss ways to coordinate the Cap-and-Trade and RPS programs in a manner that preserves the integrity of both programs.

IEP appreciates the opportunity to comment on CARB's workshop related to Clean Power Plan Rules and Electricity Topics in the Cap-and-Trade Regulation.

Respectfully Submitted,

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# Attachment 1

**Greenhouse Gas Emissions of Imported Electricity**

**Updated Assessment**

**July 2014**

Prepared by

ATKINS


## Summary

This paper is an Update to the *Assessment of Greenhouse Gas (GHG) Emissions from Imported Electricity,* which was completed by Atkins in October of 2013. These assessments use publicly-available data to develop a set of emission rates for a non-California entity under a variety of generation scenarios, for comparison with the California Air Resources Board's (ARB) default emission factor for unspecified electricity imports of 0.428 metric tons of carbon dioxide equivalent per megawatt hour ($MTCO_2e/MWh$) under the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions.

Arizona Public Service Company (APS) was used as a point of comparison in these assessments because of the utility's proximity to California and connectivity within the electric grid. Both the Initial Assessment and Updated Assessment of APS's generation scenarios used data from the U.S. Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID), with adjustments to calculations based on APS's 2012 and 2014 Integrated Resource Plans. This Updated Assessment resulted in a range of six emission factors ranging from 0.5076 $MTCO_2e/MWh$ to 0.8247 $MTCO_2e/MWh$ for 2010 and 2014. An additional emission factor of 0.8445 MT/CO2e for the 2010 APS Power Control Area (PCA) is included as an upper-bound of the estimates.

The entire range of emission rates calculated for both 2010 and 2014 are above the ARB default emission rate for unspecified electricity imports of 0.428 $MTCO_2e/MWh$. A comparison of 2009 emission rates computed using eGRID data in the Initial Assessment and 2010 emission rates computed using eGRID data in this Updated Assessment does not indicate significant reduction of emissions in the APS system over one year. While the comparison of 2010 emission rates with the 2014 projected emission rates suggests modest GHG emission reductions, APS appears focused on a business-as-usual trajectory for its planning horizon out to 2029, and therefore significant GHG emission reductions are unlikely over time.

The potential costs of unreported unspecified resources were calculated using reserve price of the most recent cap-and-trade auction in May of 2014, as well as the mean price of the first cap-and trade auction, which took place in November of 2012. Assuming an allowance price of \$11.34 per allowance ($MTCO_2e$), APS is in a position to avoid between \$25 million and \$76 million in allowance costs by not reporting resources above the default emission rate. Assuming an allowance price of \$15.60 per allowance, APS could be in a position to avoid between \$34 and \$105 million per year in allowances purchases. This level of avoided allowance costs creates a competitive advantage for out of state electric power entities and may reduce demand for allowances, artificially depressing market prices.

| Updated Assessment Generation Scenarios | 2010 emission rates (MTCO2e/ MWh) | 2010 percentage above ARB default emission rate | 2010 costs above default emission rate (\$11.34/MT) | 2010 costs above default emission rate (\$15.60/MT) | 2014 emission rates ($MTCO_2e$/ MWh) | 2014 percentage above ARB default emission rate | 2014 costs above default emission rate (\$11.34/MT) | 2014 costs above default emission rate (\$15.60/MT) |
|---|---|---|---|---|---|---|---|---|
| Total APS | 0.5332 | 25% | \$32 million | \$44 million | 0.5076 | 19% | \$25 million | \$34 million |
| APS excluding nuclear | 0.8027 | 88% | \$76 million | \$104 million | 0.7333 | 71% | \$66 million | \$91 million |
| APS excluding nuclear and renewable | 0.8087 | 89% | \$76 million | \$105 million | 0.8247 | 93% | \$76 million | \$105 million |

Table S1. Summary of findings of the Updated Assessment.

### Objectives of the Assessment

In order to compare an out-of-state entity's actual GHG emission rate to GHG emissions reported to the ARB using the default emission factor for unspecified electricity imports of 0.428 $MTCO_2e/MWh$, this assessment used publicly-available data to develop a set of emission rates for APS, as an example of a non-California entity.

The objective of this analysis was to calculate emission rates for APS using three generation scenarios:

1. APS's entire generation portfolio,
2. APS's generation portfolio excluding nuclear energy, and
3. APS's generation portfolio excluding nuclear and renewable energy.

Due to the availability of data, this study looked at these three generation scenarios for both 2010 and 2014. Additionally, it provides an emission rate for the entire APS Power Control Area (PCA), using eGRID, leading to a total of seven emission rates. The Initial Assessment looked at the same generation scenarios for the years 2009 and 2012, as well as a PCA emission rate for 2009 based on eGRID data.

**Description of Data**

This assessment relies on data from the EPA's eGRID, a comprehensive inventory of environmental attributes of electric power systems that is based on available plant-specific data for all U.S. electricity generating plants that provide power to the electric grid and report data to the U.S. government.[1] The 9th edition of eGRID is a compilation of 2010 data. In order to complete a thorough, objective, and up-to-date assessment of GHG emissions, this analysis used the eGRID for all sources of generation within APS's service territory for the 2010 portfolio, and used APS's 2014 Integrated Resource Plan (IRP) to make adjustments to APS's likely 2014 portfolio based on APS's share of ownership of a number of plants in 2014 and Power Purchase Agreements (PPAs) for a number of renewable resources. The APS 2014 IRP was used as the basis for adding renewable generation to the 2014 generation scenarios.

*Plant and Generator Information*

The plants listed in Table 1 were included in the eGRID data and therefore used in this Updated Assessment for the 2010 and 2014 generation scenarios. The nameplate capacity of Cholla, Four Corners, Navajo, Yucca, Palo Verde, Snowflake White Mountain, and Salton Sea were revised to reflect the APS-entitled nameplate capacity based on the percent of ownership listed in eGRID and whether the plant was known to have had a PPA in place for before 2010.[2] In many cases, APS-entitled nameplate capacity was further adjusted for 2014 generation scenarios, based on information the APS 2014 IRP.[3] Additional resources included in the 2014 generation scenarios are discussed later in this section.

Special attention was given to Four Corners, both in the Initial Assessment as well as in this Updated Assessment. The adjusted nameplate capacity for Four Corners in the Initial Assessment of Imported Electricity, which examined the 2009 and 2012 portfolios, was 791 MW.[4] This value was slightly lower than the eGRID data for 2010, which indicated that APS owned 39% of Four Corners in 2010, resulting in an APS-entitled nameplate capacity value of

[1] http://www.epa.gov/cleanenergy/energy-resources/egrid/faq.html#egrid8

[2] PPAs are according to APS's 2014 IRP

[3] This analysis conservatively assumed that APS owned the same percentage of each of the plants listed in Table 2 in 2009 as well as in 2012.

[4] APS 2012 IRP. P. 10.

879 MW. On December 30, 2013, APS purchased Southern California Edison's (SCE) 48% interest in each of Units 4 and 5 of Four Corners, acquiring 739 MW from SCE. As a result of the transaction, APS retired units 1, 2 and 3. The APS 2014 IRP indicates that the 2014 value for APS-entitled nameplate capacity from Four Corners is 970 MW.

In addition, according to eGRID, APS owned 29.1% of the output from the Palo Verde Nuclear Generating Station in 2010, which had a nameplate capacity of 4,209.3 MW and therefore resulted in 1,225 MW of APS-entitled nameplate capacity in 2010. This nameplate capacity is slightly higher than the nameplate capacity used in the Initial Assessment of Imported Electricity, which assumed 1,146 MW of APS-entitled nameplate capacity both for 2009 and 2012. The APS 2014 IRP lists the total nameplate capacity of the plant at 3,937 MW. Atkins used the eGRID data for 2010 (APS-entitled nameplate capacity of 1,225 MW) and the APS 2014 IRP data (1,146 MW) for the calculation of the 2014 emission rate.

| **Plant name** | **Plant primary fuel generation category** | **Plant nameplate capacity (MW) - eGRID** | **2010 APS-entitled nameplate capacity (MW)** | **2014 APS-entitled nameplate capacity (MW) - 2014 IRP** |
|---|---|---|---|---|
| *Cholla* | *Coal* | *1,129* | *714.76* | *647* |
| *Four Corners* | *Coal* | *2,270* | *878.79* | *970* |
| *Navajo* | *Coal* | *2,409* | *337.30* | *315* |
| Douglas | Oil | 21 | 21.40 | 15 |
| Ocotillo | Gas | 334 | 334.00 | 320 |
| Redhawk | Gas | 1,136 | 1136.00 | 1,000 |
| Saguaro | Gas | 436 | 435.50 | 176 |
| Sundance | Gas | 450 | 450.00 | 410 |
| West Phoenix | Gas | 1,207 | 1206.80 | 998 |
| *Yucca* | *Gas* | *386* | *272.82* | 233 |
| *Palo Verde* | *Nuclear* | *4,209* | *1224.91* | *1,146* |
| Prescott Airport | Solar PV | 2 | 2.10 | NA |
| *Snowflake White Mountain*[5] | *Biomass* | *27* | *10.00* | *14* |
| *Salton Sea*[6] | *Geothermal* | *185* | *10.00* | *10* |

**Table 1. APS 2010 generation resources included in eGRID data.**

[5] According to Renergy Holdings, APS has a PPA in place to purchase 10 MW of biomass power from Snowflake White Mountain before 2010.
[6] According to p. 13 of the APS 2014 IRP, APS executed a PPA with CalEnergy to purchase 10 MW of energy from the Salton Sea Geothermal Project in January of 2006.

*Excluded Resources*

The resources listed below in Table 2 are included in eGRID data as power plants within APS's service territory and PCA; however APS is not named as an owner of any share of the plant and have therefore been excluded from this analysis. Catalyst Paper Snowflake Mill is affiliated with Snowflake White Mountain Biomass, with whom APS has a PPA for 10 MW, however there is no evidence of a PPA with the coal portion of the Snowflake Mill. According to eGRID, Dry Lake Wind I and II are located in APS's service territory and PCA, however further research indicates that Salt River Project purchases 100% of output from Dry Lake I and II through a PPA.[7] Similarly, with regard to the Yuma Cogeneration gas plant, San Diego Gas & Electric purchases 100% of the power through a PPA with MidAmerican, and Falcon Power is the operator. Gila River Power Station, a 2,476 gas plant, was included in the APS service territory in the 2009 eGRID data, however in the 2010 version; it is listed within the Gila River Power Station LP service territory. Currently Entegra Power Group owns and operates the facility. According to the Entegra website, the Gila River Plant is interconnected to the Arizona power transmission network through two 500 kV ties and one 230 kV tie, both of which "provide access to energy markets throughout the southwest and allow the plant to sell power to serve the needs of the Arizona, New Mexico, southern Nevada, and southern California markets."[8] As such, none of the resources discussed above and described in Table 2 are included in this Updated Assessment.

| Plant name | Plant primary fuel generation category | Plant nameplate capacity (MW) - eGRID |
|---|---|---|
| Catalyst Paper Snowflake Mill | Coal | 70.50 |
| Dry Lake Wind II LLC | Wind | 65.10 |
| Dry Lake Wind LLC | Wind | 63.00 |
| Yuma Cogeneration Associates | Gas | 62.60 |
| Gila River Power Station | Gas | 2,476.0 |

**Table 2. eGRID resources excluded from the analysis.**

*Addition of New Resources for the 2014 Portfolios*

The 2014 generation scenarios included the addition of resources listed below in Table 3. These resources are all described in the APS 2014 IRP. The 2.1 MW Prescott Airport Solar

[7] http://www.srpnet.com/about/stations/drylakewind.aspx
[8] http://www.entegrapower.com/Gila.htm

Project was deleted from the 2010 generation sources and replaced with the 10 MW SunEdison Prescott Solar Plant for the 2014 generation scenarios.

| Plant name | Plant primary fuel generation category | 2014 APS-entitled nameplate capacity (MW) - 2014 IRP |
|---|---|---|
| Paloma Solar | Solar PV | 17 |
| Cotton Center | Solar PV | 17 |
| Hyder Solar | Solar PV | 16 |
| Hyder II Solar | Solar PV | 14 |
| Chino Valley | Solar PV | 19 |
| Foothills Plant | Solar PV | 35 |
| *Ajo Project | Solar PV | 5 |
| *SunEdison Prescott Project | Solar PV | 10 |
| *Saddle Mountain | Solar PV | 15 |
| *PSEG Badger-Desert Sky | Solar PV | 15 |
| *RE Gillespie | Solar PV | 15 |
| *Solana | CSP + TES | 270 |
| *Aragonne Mesa Wind Project | Wind | 90 |
| *High Lonesome Wind Project | Wind | 100 |
| *Perrin Ranch Wind Project | Wind | 99 |
| *Glendale Biogas Project | Biogas | 3 |
| *NW Regional Biogas Project | Biogas | 3 |

**Table 3. Additional APS 2014 generation resources.**

*Treatment of Power Purchase Agreements*

The APS 2014 IRP indicates an additional 2,460 MW of PPAs for conventional resources, which are not included in this assessment given a lack of data with regard to the fuel generation categories, capacity factors, emissions, and annual net generation. However, PPAs are included for 649 MW of renewable generation in 2014, due to the availability of details on these agreements in the APS 2014 IRP. It is worth noting that PPAs make up for 85% of the 767 MW of renewable resources included in the APS 2014 IRP. The inclusion of PPAs for renewable resources but not conventional resources in 2014 in this Updated Assessment will result in an extremely conservative APS portfolio emission rate for 2014, meaning that it will be significantly lower than the actual value due to the exclusion of conventional PPAs. To give some indication of the total APS portfolio of owned and operated generation, Atkins did analyze one generation scenario without consideration of any PPAs (renewable or conventional), which is included in the final table of the Appendix.

*Power Control Area Data*

The eGRID also categorizes generation by individual PCAs, which are described as "smaller regions of the power grid in which all power plants are centrally dispatched".[9] This breakdown of data includes many of the plants listed in Table 1, and provides aggregated values for annual net generation (MWh) and annual $CO_2$ equivalent emissions (tons); the two values from which an emission rate can be calculated. The plants included in APS's PCA in the eGRID are listed below in Table 4. The PCA data fully attributes all generation and emissions of the various power plants to APS, without adjusting for partial ownership as Atkins did in this Assessment. As Table 4 indicates, the PCA data does not include generation from the Navajo Power Plant (coal) or the Palo Verde Nuclear Generating Station, even though APS owns portions of both plants. The PCA calculation does include generation from Catalyst Paper Snowflake Mill and Yuma Cogeneration Associates, both of which were excluded from this Updated Assessment.

| APS PCA Plants |
|---|
| Catalyst Paper Snowflake Mill |
| Cholla |
| Douglas |
| Dry Lake Wind II LLC |
| Dry Lake Wind LLC |
| Ocotillo |
| Prescott Airport |
| Red Hawk |
| Saguaro |
| Snowflake White Mountain Power LLC |
| Sundance |
| West Phoenix |
| Yucca |
| Yuma Cogeneration Associates |
| Four Corners |

**Table 4. Power plants within the APS PCA.**

## Assumptions and Methodology

*Annual Net Generation Calculations*

To calculate annual net generation for the adjusted plants and generators in Table 1 for the 2010 generation scenarios, this analysis applied the capacity factors provided for the various

[9] http://www.epa.gov/cleanenergy/energy-resources/egrid/faq.html#egrid3

plants in eGRID to the adjusted nameplate capacity values to determine the APS-entitled annual net generation.

| Renewable resource | Capacity factor |
|---|---|
| Commercial and industrial solar PV | 21% |
| Parabolic trough, salt storage | 41% |
| Arizona wind[10] | 23% |
| Geothermal[11] | 96% |
| Biogas | 88% |
| Biomass | 85% |

Table 5. Capacity factor assumptions from the APS 2014 IRP.

For a number of generation resources in the 2014 portfolios, however, it was necessary to assume a capacity factor for various renewable resources in order to estimate the annual net generation from specific resources mentioned in the APS 2014 IRP but not included in the eGRID data.[12] In these instances, Atkins used the capacity factors from the APS 2014 IRP.[13] The assumed capacity factors for renewable resources are listed above in Table 5.

*Annual $CO_2$ Equivalent Emissions*

For the 2014 generation scenarios, one additional calculation was necessary to determine the emissions associated with renewable generation; in particular, geothermal and biomass/biogas. This analysis used an emission rate of .0272 $MTCO_2e/MWh$ for the Salton Sea Geothermal Project, which was based on 2010 generation and emissions data from eGRID.[14] This analysis also assumed an emission rate of 0.00 $MTCO_2e/MWh$ for the Glendale Biogas Project, based on the emission rate provided in the eGRID data for all other landfill gas plants.

In order to obtain the annual $CO_2$ equivalent emissions for the 2010 adjusted generation, this Assessment relied on the annual $CO_2$ equivalent emission rates associated with the plants provided in the eGRID, and applied them to the revised annual net generation values. In other words, the total adjusted annual emissions of all plants ($MTCO_2e$) were divided by the total

[10] The Arizona wind capacity factor estimate was also used for wind PPAs from New Mexico.
[11] The 2014 generation scenarios used the estimated capacity factor from the APS 2014 IRP (96%), rather than the actual eGRID data for the Salton Sea Geothermal Project, as an estimate. The 2010 eGRID capacity factor for the Salton Sea Geothermal Project was an average of 83% for Units 1-5.
[12] These resources were not listed in eGRID data because they were not online in 2010. The APS 2014 IRP lists "APS-entitled MW" but does not include capacity factors for specific resources.
[13] APS 2014 IRP. P. 288.
[14] The eGRID data lists this generation resource as belonging to Imperial Irrigation District, not APS.

adjusted annual net generation (MWh) of all plants in order to develop an emission rate ($MTCO_2e/MWh$) for each generation scenario.

*Costs*

Costs of potential underreporting due to the differences between these emission rates and the ARB default emission rates were calculated under two allowance prices: $11.34 per allowance ($MTCO_2e$) and $15.60 per allowance. $11.34 was the reserve price of the most recent cap-and-trade auction in May of 2014,[15] while $15.60 was the mean price of the first cap-and trade auction, which took place in November of 2012.[16] These figures are used as an upper and lower bounds of cost estimates. The potential total costs of allowances above the default emission rate were calculated by determining the annual emissions ($MTCO_2e$) that would be associated with the annual net generation for the year under a given scenario under the default emission rate of 0.428, and then subtracting that value from the actual metric tons emitted in the generation scenario. The allowance prices were then multiplied by the difference in emissions ($MTCO_2e$).

## Results

The results of the emissions assessment using adjusted 2010 eGRID data showed a range of emission rates for APS between 0.5076 $MTCO_2e/MWh$ and 0.8247 $MTCO_2e/MWh$, as shown in Table 6.

| Updated Assessment Generation Scenarios | 2010 Emission Rate ($MTCO_2e/MWh$) | 2014 Emission Rate ($MTCO_2e/MWh$) |
|---|---|---|
| Total APS portfolio | 0.5332 | 0.5076 |
| APS portfolio, excluding nuclear energy | 0.8027 | 0.7333 |
| APS portfolio, excluding nuclear and renewable energy | 0.8087 | 0.8247 |

Table 6. Emission rates for the Updated Assessment: APS generation scenarios in 2010 and 2014.

Table 7 shows the results of the Initial Assessment for the 2009 portfolio and 2012 projections.

| Initial Assessment Generation Scenarios | 2009 Emission Rate ($MTCO_2e/MWh$) | 2012 Emission Rate ($MTCO_2e/MWh$) |
|---|---|---|
| APS portfolio | 0.5241 | 0.5086 |
| APS portfolio, excluding nuclear generation | 0.6957 | 0.6686 |
| APS portfolio, excluding nuclear and renewable generation | 0.6950 | 0.7196 |

Table 7. 2009 and 2012 APS emission rates from the Initial Assessment.

*Power Control Area Results*

[15] http://www.arb.ca.gov/cc/capandtrade/auction/may-2014/results.pdf
[16] http://www.arb.ca.gov/cc/capandtrade/auction/november_2012/updated_nov_results.pdf

The eGRID categorizes and defines generation by individual PCA as, "a portion of an integrated power grid for which a single dispatcher has operational control of all electric generators". This breakdown of data includes many of the plants listed in the assessment and provides aggregated values for annual net generation (MWh) and annual CO2 equivalent emissions ($MTCO_2e$); the two values from which an emission rate can be calculated. The PCA data fully attributes all generation and emissions of the various power plants to APS, without adjusting for partial ownership. Based solely on the eGRID data with no adjustments, the overall emission rate for the entire APS PCA in 2010 was 0.8445 $MTCO_2e$/MWh. The PCA emission rate in the Initial Assessment of 2009 data was 0.8448 $MTCO_2e$/MWh. This indicates that between 2009 and 2010, the emission rate for the entire APS PCA decreased by 0.0003 $MTCO_2e$/MWh.

| **Power Control Area** | **PCA annual net generation (MWh)** | **PCA annual CO2 equivalent emissions (MT)** |
|---|---|---|
| Arizona Public Service Company | 27,506,392.8 | 23,230,502.9 |
| ***PCA Emission Rate*** | 0.8445 MT/CO2e | |

Table 8. Unadjusted emission rate for the APS PCA.

*Potential Costs of the ARB Default Rate for Unspecified Electricity Imports*

Assuming an allowance price of $11.34 (per allowance, or $MTCO_2e$), we calculate a range of potential avoided allowance costs between $25 million and $76 million per year, and at an allowance price of $15.60, the range of avoided allowance costs for APS could be between $34 and $105 million per year.

| **Updated Assessment Generation Scenarios** | **2010 costs above default emission rate ($11.34/MT)** | **2010 costs above default emission rate ($15.60/MT)** | **2014 costs above default emission rate ($11.34/MT)** | **2014 costs above default emission rate ($15.60/MT)** |
|---|---|---|---|---|
| Total APS | $32 million | $44 million | $25 million | $34 million |
| APS excluding nuclear | $76 million | $104 million | $66 million | $91 million |
| APS excluding nuclear and renewable | $76 million | $105 million | $76 million | $105 million |

Table 9. Potential costs of underreported emissions above ARB default rate.

## Discussion

This Updated Assessment produced similar results to the Initial Assessment in that the entire range of emission rates calculated for both 2010 and 2014 are above the ARB default emission rate for unspecified electricity imports of 0.428 $MTCO_2e$/MWh as shown in Table 10 and Figure 1 below. As described in Table 10, the relationship of these emission rates to the ARB default emission rate for unspecified imports ranges from 19% above the ARB default emission rate for the2014 total APS portfolio, to 93% above the ARB default emission rate for the 2014 APS generation portfolio excluding nuclear and renewable generation. The generation and emissions data from 2010 indicates that the emission rate of the total APS's generation portfolio in 2010 was 25% higher than the ARB default emission rate.

| Updated Assessment Generation Scenarios | 2010 Emission Rates ($MTCO_2e/MWh$) | Percent above ARB default rate | 2014 Emission Rates ($MTCO_2e/MWh$) | Percent above ARB default rate |
|---|---|---|---|---|
| APS portfolio | 0.5332 | 25% | 0.5076 | 19% |
| APS portfolio, excluding nuclear generation | 0.8027 | 88% | 0.7333 | 71% |
| APS portfolio, excluding nuclear and renewable generation | 0.8087 | 89% | 0.8247 | 93% |

Table 10. Comparison of emission rates to ARB default emission rate for unspecified imports.

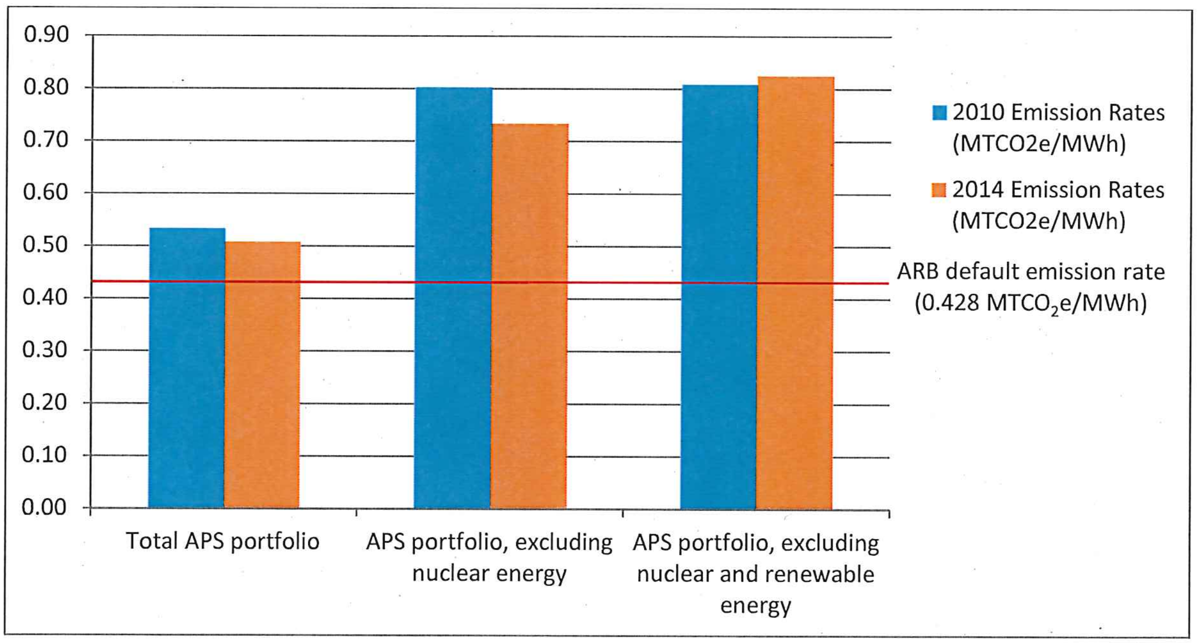


Figure 1. Comparison of 2010 and 2014 emission rates (in $MTCO_2e/MWh$) to ARB default emission rate for unspecified electricity imports.

*2010 vs. 2014 Generation Scenarios*

The results indicate that the 2014 GHG emission rate for APS's entire portfolio will likely decrease by 0.0256 $MTCO_2e/MWh$ from its 2010 portfolio. This can be explained by the addition of approximately 770 MW of new renewable generation, including both owned generation and PPAs. This figure does not consider the additional 2,460 MW of PPAs for conventional resources that were discussed in the APS 2014 IRP, however, and is therefore conservative. An assessment of the 2014 generation scenario without renewable or conventional PPAs yields an emission rate of 0.5450 $MTCO_2e/MWh$.

*Updated Assessment Compared to Initial Assessment*

The Initial Assessment and this Updated Assessment both use actual data from eGRID from 2009 and 2010. A comparison of 2009 emission rates to 2010 emission rates indicates that emissions increased slightly for the total portfolio between 2009 and 2010. It is not clear whether the difference is caused by the new data, changed assumptions, or an actual increase in emissions. As noted previously, a number of the plants included in the 2009 calculations were not included in the calculations to develop 2010 emission rates due to new information. However, both renewable and conventional generation was excluded based on up to date information regarding the plants, so it is unlikely to have had a profound effect on the results. The timeframe of 2009 to 2010 is too short to indicate an continuous trend, however the results do not indicate that APS is reducing emissions or that the APS portfolio is moving toward the ARB default emission rate.

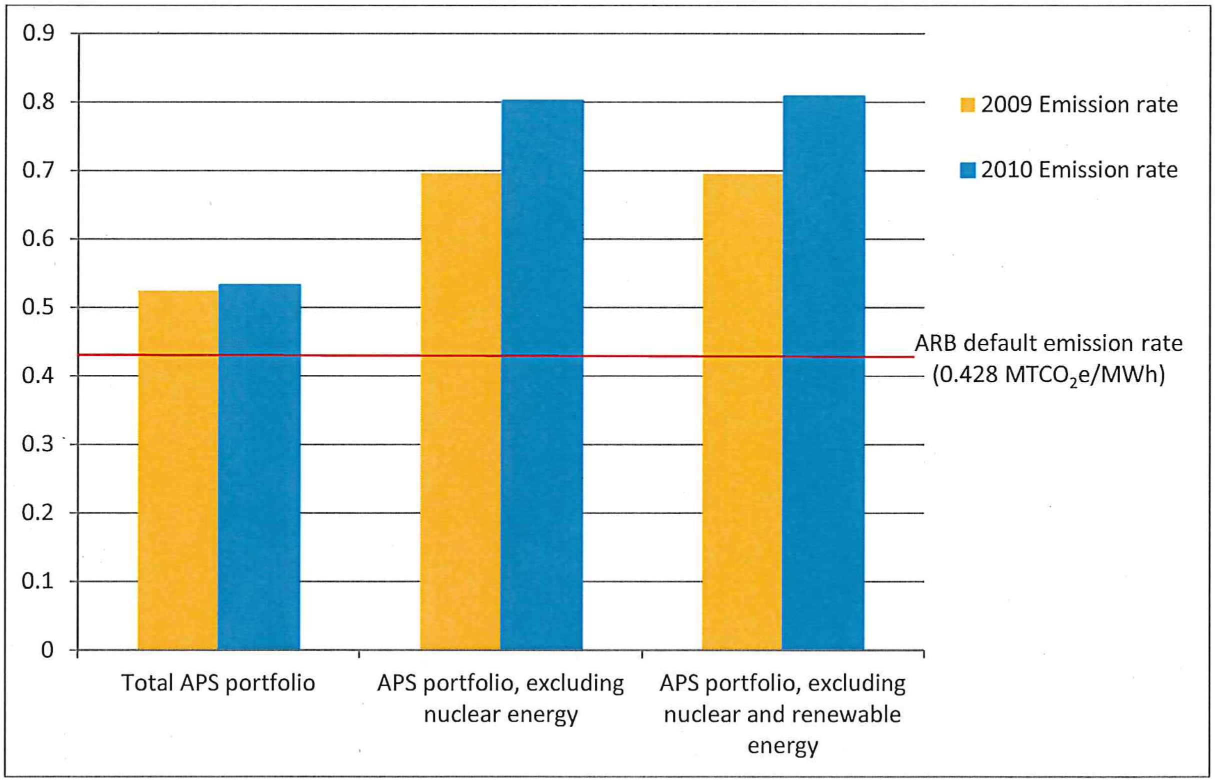


**Figure 2. Comparison of 2009 and 2010 APS emission rates (in $MTCO_2e/MWh$).**

Figure 3 illustrates the emission rate results of the Initial Assessment as well as this Updated Assessment. In all years, emission rates of the total APS portfolio are between 0.5000 and

0.5500 $MTCO_2e/MWh$.

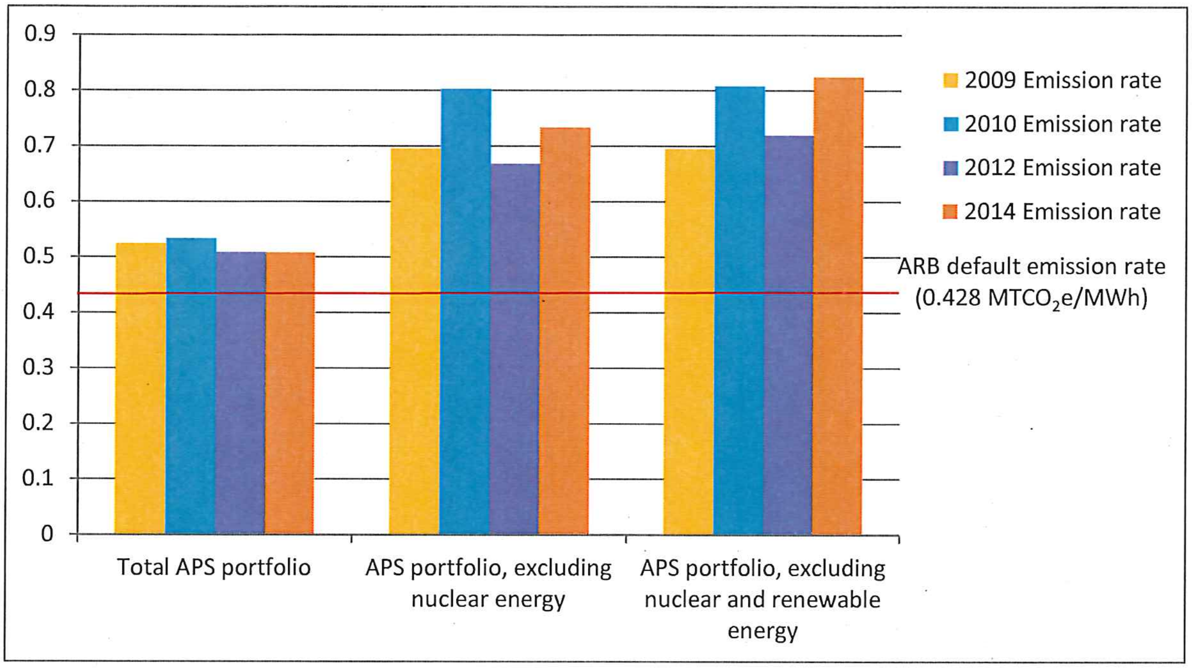


**Figure 3. Emission rates (in $MTCO_2e/MWh$) of all APS portfolios in 2009 and 2010 and projections for 2012 and 2014.**

*Power Control Area Emission Rate*

We observe a very minor difference in the PCA emission rate between 2009 and 2010 (a decrease in the emission rate by 0.0003 $MTCO_2e/MWh$), indicating that overall emissions in the Southwest region are well above the ARB default emission factor.

*Avoided Allowance Costs*

This Updated Assessment attempts to calculate the potential costs associated with unreported emissions above the ARB default emission rate. Avoided cost estimates for APS's generation scenarios are most likely in the tens of millions of dollars, if not higher, which can depress market prices for allowances. It can also encourage underreporting of higher-emitting resources by out of state electric power entities, reducing the effectiveness of the program and creating a competitive advantage for non-California participants.

*Integrated Resource Planning*

The APS 2014 IRP describes APS's plans to satisfy a need for 6,613 MW of additional resources and to continue operations of 6,412 MW of existing resources in 2029. The selected portfolio continues nuclear generation at current levels, and suggests a moderate increase in coal generation. In the 2029 resource portfolio, 24.5% will come from coal, 28.5% of from natural gas, 13.6% from renewable energy and distributed generation, and 15.3% will result from energy efficiency and demand response.[17] While some of the new generation will be free of GHG emissions, this planning regime is not likely to result in dramatic GHG emission reductions over time, and is therefore not likely to significantly result the total emission rate of the APS service territory or PCA over the next several years.

## Conclusion

The range of emission rates offered in this analysis is intended to provide a sample of possible generation scenarios, with a number of adjustments, in an attempt to see how emission rates might change over time and with new procurement decisions. While a two-year timeframe is a small window, the comparison of 2009 emission rates with 2010 emission rates does not indicate a reduction of emission within the APS system. The comparison of 2010 emission rates with the 2014 projected emission rates suggests modest improvements, however APS appears focused on a business-as-usual trajectory for its planning horizon out to 2029, and significant emission reductions are therefore unlikely over time. While it is difficult to assess the amount and type of generation resources that California is importing, it is important to look at the range of emission rates from neighboring areas to better understand the mix of generation in a system at a given time. In looking at APS as a neighboring utility, it is important to consider the potential unintended consequences of setting a default emission rate below actual levels, such as market distortion and emissions leakage.

[17] APS 2014 IRP. Executive Summary VII.

## Appendix A: Data Tables and Calculations for APS Generation Scenarios

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | Plant nameplate capacity (MW) - eGRID | Plant annual net generation (MWh) - eGRID | APS % of plant owned - eGRID | 2010 APS-entitled nameplate capacity (MW) | 2010 APS-entitled annual net generation (MWh) | Plant annual CO2e output emission rate (lb/MWh) - eGRID | APS CO2e emissions (MT) | GHG emission rate (MTCO2e/MWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cholla | APS | Coal | 0.7202 | 1,128.8 | 7,121,755 | 63% | 714.76 | 4,509,362 | 2327 | 4,758,947 | 1.0553 |
| Four Corners | APS | Coal | 0.6994 | 2,269.6 | 13,904,804 | 39% | 878.79 | 5,384,116 | 2083 | 5,085,998 | 0.9446 |
| Navajo | SRP/AP | Coal | 0.7785 | 2,409.3 | 16,429,593 | 14% | 337.30 | 2,300,285 | 2179 | 2,273,091 | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 21.4 | 359 | 100% | 21.40 | 356 | 3579 | 578 | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 334.0 | 55,777 | 100% | 334.00 | 55,884 | 1575 | 39,933 | 0.7146 |
| Redhawk | APS | Gas | 0.3393 | 1,136.0 | 3,376,012 | 100% | 1136.00 | 3,376,496 | 889 | 1,361,718 | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 435.5 | 8,741 | 100% | 435.50 | 8,774 | 1271 | 5,057 | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 450.0 | 107,797 | 100% | 450.00 | 107,617 | 1310 | 63,943 | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 1,206.8 | 1,719,691 | 100% | 1206.80 | 1,719,994 | 789 | 615,884 | 0.3581 |
| Yucca | APS | Gas | 0.1249 | 385.5 | 421,666 | 71% | 272.82 | 298,497 | 1294 | 175,251 | 0.5871 |
| Palo Verde | APS | Nuclear | 0.8461 | 4,209.3 | 31,199,935 | 29% | 1224.91 | 9,078,805 | 0 | 0 | 0.0000 |
| Prescott Airport | APS | Solar PV | 0.3023 | 2.1 | 5,561 | 100% | 2.10 | 5,561 | 0 | 0 | 0.0000 |
| *Snowflake White Mou | PPA | Biomass | 0.6613 | 27.2 | 157,559 | 37% | 10.00 | 57,922 | 78 | 2,037 | 0.0352 |
| *Salton Sea | PPA | Geothermal | 0.8280 | 184.8 | 1,336,000 | 5% | 10.00 | 72,533 | 60 | 1,974 | 0.0272 |
| 2010 generation and emissions | | | | | | | | 26,976,203 | | 14,384,411 | |
| 2010 APS emission factor | | | | | | | | | | | 0.5332 |

Figure 1A. Total APS 2010 portfolio.

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | Plant nameplate capacity (MW) - eGRID | Plant annual net generation (MWh) - eGRID | APS % of plant owned - eGRID | 2010 APS-entitled nameplate capacity (MW) | 2010 APS-entitled annual net generation (MWh) | Plant annual CO2e total output emission rate (lb/MWh) - | APS CO2e emissions (metric tons) | GHG emission rate (MTCO2e/MWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cholla* | *APS* | *Coal* | *0.7202* | *1,128.8* | *7,121,755* | *63%* | 714.76 | *4,509,362* | 2327 | *4,758,947* | 1.0553 |
| *Four Corners* | *APS* | *Coal* | *0.6994* | *2,269.6* | *13,904,804* | *38%* | 857.91 | *5,256,188* | 2083 | *4,965,153* | 0.9446 |
| *Navajo* | *SRP/AF* | *Coal* | *0.7785* | *2,409.3* | *16,429,593* | *14%* | 337.30 | *2,300,285* | *2179* | *2,273,091* | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 21.4 | 359 | 100% | 21.40 | *356* | 3579 | *578* | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 334.0 | 55,777 | 100% | 334.00 | *55,884* | 1575 | *39,933* | 0.7146 |
| Redhawk | APS | Gas | 0.3393 | 1,136.0 | 3,376,012 | 100% | 1,136.00 | *3,376,496* | 889 | *1,361,718* | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 435.5 | 8,741 | 100% | 435.50 | *8,774* | 1271 | *5,057* | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 450.0 | 107,797 | 100% | 450.00 | *107,617* | 1310 | *63,943* | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 1,206.8 | 1,719,691 | 100% | 1,206.80 | *1,719,994* | 789 | *615,884* | 0.3581 |
| *Yucca* | *APS* | *Gas* | *0.1249* | *385.5* | *421,666* | *71%* | 272.82 | *298,497* | *1294* | *175,251* | 0.5871 |
| Prescott Airport | APS | Solar PV | 0.3023 | 2.1 | 5,561 | 100% | 2.10 | *5,561* | 0 | *0* | 0.0000 |
| *Snowflake White Mou | PPA | Biomass | 0.6613 | 27.2 | 157,559 | 37% | 10.00 | *57,922* | 78 | *2,037* | 0.0352 |
| *Salton Sea | PPA | Geothermal | 0.8280 | 184.8 | 1,336,000 | 5% | 10.00 | 72,533 | 60 | *1,974* | 0.0272 |
| *2010 generation and emissions, excluding nuclear energy* | | | | | | | | 17,769,470 | | 14,263,566 | |
| *2010 APS emission rate, excluding nuclear energy* | | | | | | | | | | | 0.8027 |

**Figure 2A. APS 2010 portfolio, excluding nuclear energy.**

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | Plant nameplate capacity (MW) - eGRID | Plant annual net generation (MWh) - eGRID | APS % of plant owned - eGRID | 2010 APS-entitled nameplate capacity (MW) | 2010 APS-entitled annual net generation (MWh) | Plant annual CO2e total output emission rate (lb/MWh) - eGRID | APS CO2e emissions (metric tons) | GHG emission rate (MTCO2e/MWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cholla* | *APS* | *Coal* | *0.7202* | *1,128.8* | *7,121,755* | *63%* | 714.76 | *4,509,362* | *2327* | *4,758,947* | 1.0553 |
| *Four Corners* | *APS* | *Coal* | *0.6994* | *2,269.6* | *13,904,804* | *38%* | 857.91 | *5,256,188* | *2083* | *4,965,153* | 0.9446 |
| *Navajo* | *SRP/AP* | *Coal* | *0.7785* | *2,409.3* | *16,429,593* | *14%* | 337.30 | *2,300,285* | *2179* | *2,273,091* | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 21.4 | 359 | 100% | 21.40 | *356* | 3579 | *578* | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 334.0 | 55,777 | 100% | 334.00 | *55,884* | 1575 | *39,933* | 0.7146 |
| Redhawk | APS | Gas | 0.3393 | 1,136.0 | 3,376,012 | 100% | 1,136.00 | *3,376,496* | 889 | *1,361,718* | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 435.5 | 8,741 | 100% | 435.50 | *8,774* | 1271 | *5,057* | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 450.0 | 107,797 | 100% | 450.00 | *107,617* | 1310 | *63,943* | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 1,206.8 | 1,719,691 | 100% | 1,206.80 | *1,719,994* | 789 | *615,884* | 0.3581 |
| *Yucca* | *APS* | *Gas* | *0.1249* | *385.5* | *421,666* | *71%* | 272.82 | *298,497* | *1294* | *175,251* | 0.5871 |
| *2010 generation and emissions, excluding nuclear and renewable energy* | | | | | | | | 17,633,453 | | 14,259,554 | |
| *2010 APS emission rate excluding nuclear and renewable energy* | | | | | | | | | | | 0.8087 |

Figure 3A. APS 2010 portfolio, excluding nuclear and renewable energy.

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | 2014 APS-entitled nameplate capacity (MW) - 2014 IRP | 2014 APS-entitled annual net generation (MWh) | Plant 2010 CO2e total output emission rate (lb/MWh) - eGRID if available | APS-owned 2014 CO2e emissions (lbs) | APS-owned 2010 CO2e emissions (metric tons) | 2014 GHG emission rate (MTCO2e/MWh) |
|---|---|---|---|---|---|---|---|---|---|
| Cholla | APS | Coal | 0.7202 | 647 | 4,081,892 | 2,327 | 9,497,109,808 | 4,307,817 | 1.0553 |
| Four Corners | APS | Coal | 0.6994 | 970 | 5,942,942 | 2,083 | 12,376,489,836 | 5,613,881 | 0.9446 |
| Navajo | SRP/APS | Coal | 0.7785 | 315 | 2,148,193 | 2,179 | 4,679,967,124 | 2,122,797 | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 15 | 250 | 3,579 | 893,475 | 405 | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 320 | 53,541 | 1,575 | 84,347,465 | 38,259 | 0.7146 |
| Red Hawk | APS | Gas | 0.3393 | 1,000 | 2,972,268 | 889 | 2,642,670,526 | 1,198,695 | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 176 | 3,546 | 1,271 | 4,505,840 | 2,044 | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 410 | 98,051 | 1,310 | 128,438,596 | 58,259 | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 998 | 1,422,401 | 789 | 1,122,866,784 | 509,324 | 0.3581 |
| Yucca | APS | Gas | 0.1249 | 233 | 254,931 | 1,294 | 329,971,840 | 149,673 | 0.5871 |
| Palo Verde | APS | Nuclear | 0.8461 | 1,146 | 8,493,964 | 0 | 0 | 0 | 0.0000 |
| Paloma Solar | APS | Solar PV | 0.2100 | 17 | 31,273 | 0 | 0 | 0 | 0.0000 |
| Cotton Center | APS | Solar PV | 0.2100 | 17 | 31,273 | 0 | 0 | 0 | 0.0000 |
| Hyder Solar | APS | Solar PV | 0.2100 | 16 | 29,434 | 0 | 0 | 0 | 0.0000 |
| Hyder II Solar | APS | Solar PV | 0.2100 | 14 | 25,754 | 0 | 0 | 0 | 0.0000 |
| Chino Valley | APS | Solar PV | 0.2100 | 19 | 34,952 | 0 | 0 | 0 | 0.0000 |
| Foothills Plant | APS | Solar PV | 0.2100 | 35 | 64,386 | 0 | 0 | 0 | 0.0000 |
| *Ajo Project | PPA | Solar PV | 0.2100 | 5 | 9,198 | 0 | 0 | 0 | 0.0000 |
| *SunEdison Prescott Project | PPA | Solar PV | 0.2100 | 10 | 18,396 | 0 | 0 | 0 | 0.0000 |
| *Saddle Mountain | PPA | Solar PV | 0.2100 | 15 | 27,594 | 0 | 0 | 0 | 0.0000 |
| *PSEG Badger-Desert Sky | PPA | Solar PV | 0.2100 | 15 | 27,594 | 0 | 0 | 0 | 0.0000 |
| *RE Gillespie | PPA | Solar PV | 0.2100 | 15 | 27,594 | 0 | 0 | 0 | 0.0000 |
| *Solana | PPA | CSP + TES | 0.4100 | 270 | 969,732 | 0 | 0 | 0 | 0.0000 |
| *Aragonne Mesa Wind Project | PPA | Wind | 0.2300 | 90 | 181,332 | 0 | 0 | 0 | 0.0000 |
| *High Lonesome Wind Project | PPA | Wind | 0.2300 | 100 | 201,480 | 0 | 0 | 0 | 0.0000 |
| *Perrin Ranch Wind Project | PPA | Wind | 0.2300 | 99 | 199,465 | 0 | 0 | 0 | 0.0000 |
| *Salton Sea Geothermal | PPA | Geothermal | 0.9600 | 10 | 84,096 | 60 | 5,045,760 | 2,289 | 0.0272 |
| *Glendale Biogas Project | PPA | Biogas | 0.8800 | 3 | 23,126 | 0 | 0 | 0 | 0.0000 |
| *NW Regional Biogas Project | PPA | Biogas | 0.8800 | 3 | 23,126 | 0 | 0 | 0 | 0.0000 |
| *Snowflake White Mountain | PPA | Biomass | 0.8500 | 14 | 104,244 | 0 | 0 | 0 | 0.0000 |
| 2014 generation and emissions | | | | | 27,586,029 | | | 14,003,443 | |
| 2014 APS emission rate | | | | | | | | | 0.5076 |

**Figure 4A. 2014 APS portfolio, including renewable PPAs and not including conventional PPAs.**

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | 2014 APS-entitled nameplate capacity (MW) - 2014 IRP | 2014 APS-entitled annual net generation (MWh) | Plant 2010 CO2e total output emission rate (lb/MWh) - eGRID if | APS-owned 2014 CO2e emissions (lbs) | APS-owned 2010 CO2e emissions (metric tons) | 2014 GHG emission rate (MTCO2e/MWh) |
|---|---|---|---|---|---|---|---|---|---|
| Cholla | APS | Coal | 0.7202 | 647 | 4,081,892 | 2,327 | 9,497,109,808 | 4,307,817 | 1.0553 |
| Four Corners | APS | Coal | 0.6994 | 970 | 5,942,942 | 2,083 | 12,376,489,836 | 5,613,881 | 0.9446 |
| Navajo | SRP/AP | Coal | 0.7785 | 315 | 2,148,193 | 2,179 | 4,679,967,124 | 2,122,797 | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 15 | 250 | 3,579 | 893,475 | 405 | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 320 | 53,541 | 1,575 | 84,347,465 | 38,259 | 0.7146 |
| Red Hawk | APS | Gas | 0.3393 | 1000 | 2,972,268 | 889 | 2,642,670,526 | 1,198,695 | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 176 | 3,546 | 1,271 | 4,505,840 | 2,044 | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 410 | 98,051 | 1,310 | 128,438,596 | 58,259 | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 998 | 1,422,401 | 789 | 1,122,866,784 | 509,324 | 0.3581 |
| Yucca | APS | Gas | 0.1249 | 233 | 254,931 | 1,294 | 329,971,840 | 149,673 | 0.5871 |
| Paloma Solar | APS | Solar PV | 0.2100 | 17 | 31,273 | 0 | 0 | 0 | 0.0000 |
| Cotton Center | APS | Solar PV | 0.2100 | 17 | 31,273 | 0 | 0 | 0 | 0.0000 |
| Hyder Solar | APS | Solar PV | 0.2100 | 16 | 29,434 | 0 | 0 | 0 | 0.0000 |
| Hyder II Solar | APS | Solar PV | 0.2100 | 14 | 25,754 | 0 | 0 | 0 | 0.0000 |
| Chino Valley | APS | Solar PV | 0.2100 | 19 | 34,952 | 0 | 0 | 0 | 0.0000 |
| Foothills Plant | APS | Solar PV | 0.2100 | 35 | 64,386 | 0 | 0 | 0 | 0.0000 |
| *Ajo Project | PPA | Solar PV | 0.2100 | 5 | 9,198 | 0 | 0 | 0 | 0.0000 |
| *SunEdison Prescott Project | PPA | Solar PV | 0.2100 | 10 | 18,396 | 0 | 0 | 0 | 0.0000 |
| *Saddle Mountain | PPA | Solar PV | 0.2100 | 15 | 27,594 | 0 | 0 | 0 | 0.0000 |
| *PSEG Badger-Desert Sky | PPA | Solar PV | 0.2100 | 15 | 27,594 | 0 | 0 | 0 | 0.0000 |
| *RE Gillespie | PPA | Solar PV | 0.2100 | 15 | 27,594 | 0 | 0 | 0 | 0.0000 |
| *Solana | PPA | CSP + TES | 0.4100 | 270 | 969,732 | 0 | 0 | 0 | 0.0000 |
| *Aragonne Mesa Wind Project | PPA | Wind | 0.2300 | 90 | 181,332 | 0 | 0 | 0 | 0.0000 |
| *High Lonesome Wind Project | PPA | Wind | 0.2300 | 100 | 201,480 | 0 | 0 | 0 | 0.0000 |
| *Perrin Ranch Wind Project | PPA | Wind | 0.2300 | 99 | 199,465 | 0 | 0 | 0 | 0.0000 |
| *Salton Sea Geothermal | PPA | Geothermal | 0.9600 | 10 | 84,096 | 0 | 0 | 0 | 0.0000 |
| *Glendale Biogas Project | PPA | Biogas | 0.8800 | 3 | 23,126 | 0 | 0 | 0 | 0.0000 |
| *NW Regional Biogas Project | PPA | Biogas | 0.8800 | 3 | 23,126 | 0 | 0 | 0 | 0.0000 |
| *Snowflake Biomass Project | PPA | Biomass | 0.8500 | 14 | 104,244 | 0 | 0 | 0 | 0.0000 |
| 2014 generation and emissions, excluding nuclear energy | | | | | 19,092,065 | | | 14,001,154 | |
| 2014 APS emission rate excluding nuclear energy | | | | | | | | | 0.7333 |

Figure 5A. 2014 APS portfolio, excluding nuclear energy.

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | 2014 APS-entitled nameplate capacity (MW) - 2014 IRP | 2014 APS-entitled annual net generation (MWh) | Plant 2010 CO2e total output emission rate (lb/MWh) - eGRID if available | APS-owned 2014 CO2e emissions (lbs) | APS-owned 2010 CO2e emissions (metric tons) | 2014 GHG emission rate (MTCO2e/MWh) |
|---|---|---|---|---|---|---|---|---|---|
| Cholla | APS | Coal | 0.7202 | 647 | 4,081,892 | 2,327 | 9,497,109,808 | 4,307,817 | 1.0553 |
| Four Corners | APS | Coal | 0.6994 | 970 | 5,942,942 | 2,083 | 12,376,489,836 | 5,613,881 | 0.9446 |
| Navajo | SRP/AP | Coal | 0.7785 | 315 | 2,148,193 | 2,179 | 4,679,967,124 | 2,122,797 | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 15 | 250 | 3,579 | 893,475 | 405 | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 320 | 53,541 | 1,575 | 84,347,465 | 38,259 | 0.7146 |
| Red Hawk | APS | Gas | 0.3393 | 1000 | 2,972,268 | 889 | 2,642,670,526 | 1,198,695 | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 176 | 3,546 | 1,271 | 4,505,840 | 2,044 | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 410 | 98,051 | 1,310 | 128,438,596 | 58,259 | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 998 | 1,422,401 | 789 | 1,122,866,784 | 509,324 | 0.3581 |
| Yucca | APS | Gas | 0.1249 | 233 | 254,931 | 1,294 | 329,971,840 | 149,673 | 0.5871 |
| 2014 generation and emissions, excluding nuclear and renewables | | | | | 16,978,014 | | | 14,001,154 | |
| 2014 APS emission rate excluding nuclear and renewable energy | | | | | | | | | 0.8247 |

**Figure 6A. APS 2014 portfolio, excluding nuclear and renewable energy.**

| Plant name | Plant owner | Plant primary fuel generation category | Plant capacity factor - eGRID | 2014 APS-entitled nameplate capacity (MW) - 2014 IRP | 2014 APS-entitled annual net generation (MWh) | Plant 2010 CO2e total output emission rate (lb/MWh) - eGRID if available | APS-owned 2014 CO2e emissions (lbs) | APS-owned 2010 CO2e emissions (metric tons) | 2014 GHG emission rate (MTCO2e/ MWh) |
|---|---|---|---|---|---|---|---|---|---|
| Cholla | APS | Coal | 0.7202 | 647 | 4,081,892 | 2,327 | 9,497,109,808 | 4,307,817 | 1.0553 |
| Four Corners | APS | Coal | 0.6994 | 970 | 5,942,942 | 2,083 | 12,376,489,836 | 5,613,881 | 0.9446 |
| Navajo | SRP/AP | Coal | 0.7785 | 315 | 2,148,193 | 2,179 | 4,679,967,124 | 2,122,797 | 0.9882 |
| Douglas | APS | Oil | 0.0019 | 15 | 250 | 3,579 | 893,475 | 405 | 1.6233 |
| Ocotillo | APS | Gas | 0.0191 | 320 | 53,541 | 1,575 | 84,347,465 | 38,259 | 0.7146 |
| Red Hawk | APS | Gas | 0.3393 | 1,000 | 2,972,268 | 889 | 2,642,670,526 | 1,198,695 | 0.4033 |
| Saguaro | APS | Gas | 0.0023 | 176 | 3,546 | 1,271 | 4,505,840 | 2,044 | 0.5764 |
| Sundance | APS | Gas | 0.0273 | 410 | 98,051 | 1,310 | 128,438,596 | 58,259 | 0.5942 |
| West Phoenix | APS | Gas | 0.1627 | 998 | 1,422,401 | 789 | 1,122,866,784 | 509,324 | 0.3581 |
| Yucca | APS | Gas | 0.1249 | 233 | 254,931 | 1,294 | 329,971,840 | 149,673 | 0.5871 |
| Palo Verde | APS | Nuclear | 0.8461 | 1,146 | 8,493,964 | 0 | 0 | 0 | 0.0000 |
| Paloma Solar | APS | Solar PV | 0.2100 | 17 | 31,273 | 0 | 0 | 0 | 0.0000 |
| Cotton Center | APS | Solar PV | 0.2100 | 17 | 31,273 | 0 | 0 | 0 | 0.0000 |
| Hyder Solar | APS | Solar PV | 0.2100 | 16 | 29,434 | 0 | 0 | 0 | 0.0000 |
| Hyder II Solar | APS | Solar PV | 0.2100 | 14 | 25,754 | 0 | 0 | 0 | 0.0000 |
| Chino Valley | APS | Solar PV | 0.2100 | 19 | 34,952 | 0 | 0 | 0 | 0.0000 |
| Foothills Plant | APS | Solar PV | 0.2100 | 35 | 64,386 | 0 | 0 | 0 | 0.0000 |
| 2014 generation and emissions, excluding PPAs | | | | | 25,689,051 | | | 14,001,154 | |
| 2014 APS emission rate, excluding PPAs | | | | | | | | | 0.5450 |

Figure 7A. 2014 APS portfolio, excluding renewable and conventional PPAs.