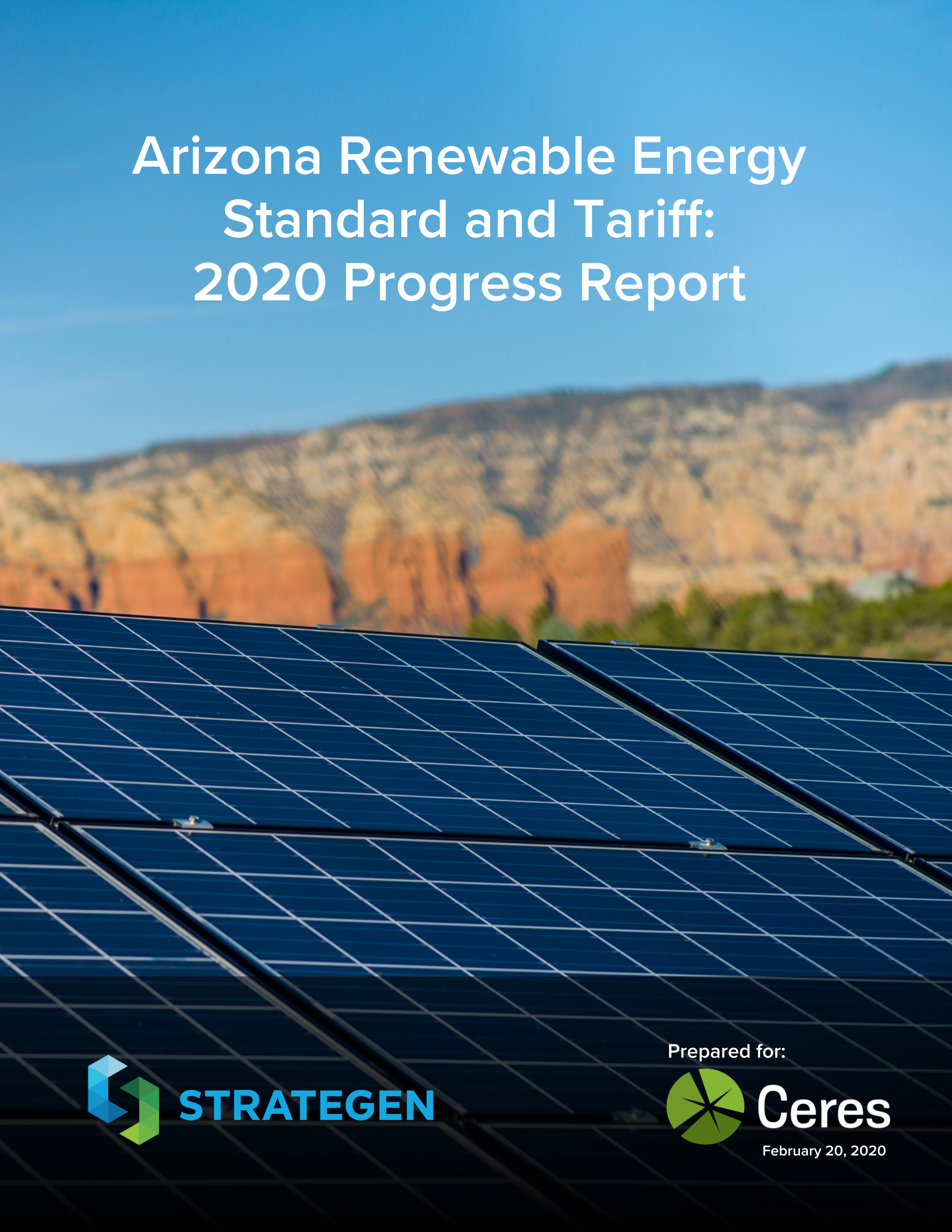

Arizona Renewable Energy Standard and Tariff: 2020 Progress Report

STRATEGEN

Prepared for:

Ceres

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Prepared for:

Ceres

Prepared by:

Strategen Consulting, LLC
2150 Allston Way, Suite 400
Berkeley, California 94704
www.strategen.com

Edward Burgess
Maria Roumpani
Melanie Davidson
Santiago Latapí
Jennifer Gorman

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Executive Summary

The Arizona Renewable Energy Standard and Tariff ("REST"), established in 2006, has been a key driver of investments in renewable energy ("RE") technologies in the state. Arizona Public Service ("APS") and Tucson Electric Power ("TEP") together comprise nearly half of Arizona retail electricity sales and are both under the jurisdiction of the Arizona Corporation Commission ("ACC"). As such, they are subject to the 15% RE standard by 2025 established by REST. As of 2018, both APS and TEP exceeded REST requirements with RE resources totaling 14.3% and 15.8% of their retail sales, respectively.[1]

Implementation of the REST has delivered significant benefits in the form of avoided energy and generation capacity costs, reduced carbon emissions, reduced criteria air pollutants, water savings, increased investment in the state for a growing new industry, and technology cost reductions. Based on the benefits which could be readily quantified, Strategen estimates that from 2008 to 2018, gross benefits to utility customers and the public from implementing the REST have totaled over $1.5 billion for APS and over $469 million for TEP.[2]

From 2008 to 2018, gross benefits to utility customers and the public from implementing the REST have totaled nearly $2 billion.

Benefits of the REST are evident in several areas:

- **AVOIDED FUEL COSTS:** Adoption of renewable energy under the REST achieved significant cost savings from avoided fuel costs associated with conventional electricity production. In APS territory this contributed to $787 million in savings; in TEP territory it contributed to $235 million.
- **REDUCED PEAK DEMAND COSTS:** By 2018, both APS and TEP had renewable resources that equaled about 9% of their total peak demand. Renewables displaced capacity resources and led to cumulative avoided conventional peak generation capacity costs from 2008-2018 that equaled $297 million for APS and $82 million for TEP.
- **REDUCED CARBON EMISSIONS:** The displacement of conventional fossil fuel generation with renewable generation has also led to CO_2 emissions reductions in Arizona, with the REST responsible for an estimated 3% reduction in annual tons emitted (economy-wide) from 2008 to 2016. Using a relatively conservative value for the social cost of carbon, the societal benefit from these avoided CO_2 emissions equates to $234 million from APS and $75 million from TEP.
- **REDUCED AIR POLLUTANTS:** Criteria pollutant emission reductions (SOx, NOx and PM2.5) from increased clean energy adoption have resulted in health-related benefits valued at$185 million for APS and $61 million for TEP.

[1] For REST compliance purposes, REST-eligible resources are slightly below these levels as explained in Section 3.1.

[2] This reflects a combination of direct benefits to these utilities' customers (e.g. reduced fuel costs), as well as societal benefits experienced by the public at large (e.g. reduced air pollution). Gross benefits do not reflect the incremental costs to implement the REST.

- **REDUCED WATER CONSUMPTION:** On an annual basis, the APS and TEP renewable energy portfolios are saving more than 7,000 acre-feet (>8.6 million cubic meters) of water, a precious and scarce resource in the Southwest desert.

- **BILLIONS OF DOLLARS INVESTED:** Due to the support of the REST, the Arizona solar industry has thrived with an estimated $11.6 billion in investments, stimulating job growth and market development.

- **REDUCED CLEAN ENERGY COSTS:** From 2008 to 2018, median solar PV installation costs in Arizona declined by 53%, helping lower the price of PV projects state-wide.

Importantly, the benefits summarized above and attained through the REST were achieved with minimal impact to the ratepayer. REST surcharges have comprised a very small fraction of customer bills to date, falling within the 2-3% range for APS and 3-5% range for TEP.

Strategen anticipates that the benefits of deploying additional renewable energy in the future will significantly exceed the costs if implemented in a smart and strategic manner that integrates lessons learned from REST implementation to date. Going forward, the deployment of renewable resources ramping up to 45% by 2030 could result in a billion dollars of net benefits of generation costs alone for Arizona in the next ten years.[3]

[3] Not including additional costs for transmission

1. Introduction

Investments in the U.S. electricity system have been heavily influenced by federal and state policies that have provided support to virtually all types of generation resources. An important set of policies that have emerged over the last decade is renewable energy ("RE") portfolio standards, which aim to encourage investment in RE technologies such as wind, solar, geothermal and biomass. RE portfolio standards generally require electric utilities to procure a designated fraction of the energy used to serve retail customers from qualifying renewable resources. Arizona enacted its own Renewable Energy Standard and Tariff, known collectively as REST, in 2006. It requires affected utilities to achieve RE resources equal to 15% of retail electricity sales by 2025.

This progress report reflects on the efficacy of the Arizona REST policy from 2008 to 2018. The goal of the historical review is to provide a quantitative and qualitative assessment of the policy's benefits and costs, as well as the goals achieved and lessons learned to date.

As Arizona considers future policy options, including the adoption of more ambitious renewable and clean energy targets, it is instructive to recognize where the state has been and provide a full view of the impact of the REST.

This report is organized into the following sections:

- A brief **background** on Arizona's electricity system and the REST policy
- A review of the financial and policy **benefits** achieved by REST
- A review of the total and incremental **costs** required to implement the REST
- **Conclusions** about the efficacy of the REST and recommendations for future policy directions for the state
- An appendix that provides details on the **methods and data** sources used to evaluate Arizona's REST

2. Background

2.1. Overview of the Arizona Electricity System

As of 2018, the Arizona electricity system served 3.1 million retail customers, with total retail sales of approximately 78,346 GWh. Generation resources in the state created approximately 111,925 GWh of power in 2018, of which around 30,744 GWh came from coal, 37,168 GWh from natural gas, 31,097 GWh from nuclear, and 12,872 GWh from RE resources (including 6,982 GWh of hydroelectric power).[4]

Historically, a large share of this generation has been used to provide power to neighboring states. Of the state's total generation in 2018, 23% was exported. For comparison, this figure represents approximately a third of the retail sales for that year.[5]

Arizona's electricity customers are served by two types of utilities – those regulated under the jurisdiction of the Arizona Corporation Commission (ACC) and those that are not. The unregulated utilities are primarily publicly owned entities (such as Salt River Project) and have their own processes and governance structures for setting forward-looking energy policies.

Through its unique authority embedded in the Arizona state constitution, the ACC also plays a quasi-legislative role and is responsible for establishing energy policy goals for utilities under its jurisdiction, including the REST.

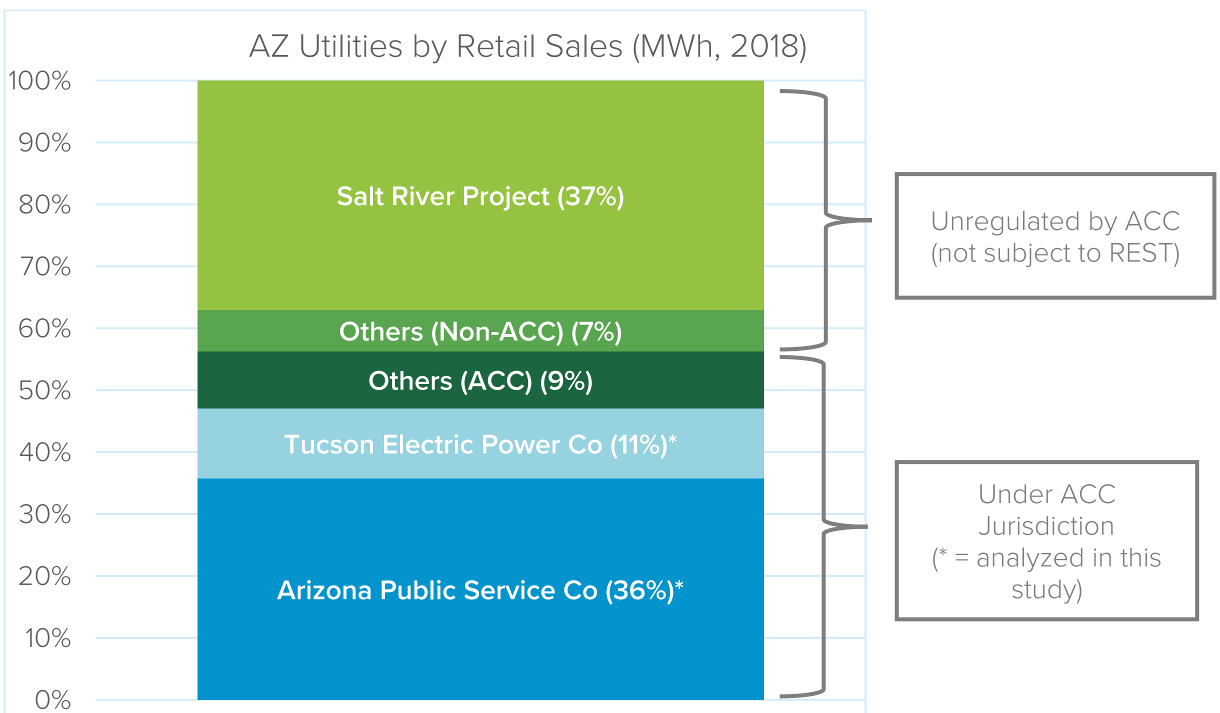

Figure 1. Data Source: U.S. Energy Information Administration - 2018 Utility Bundled Retail Sales- Total (data from EIA Form 861)

[4] EIA, *Generation (Electric power industry generation by primary energy source).* https://www.eia.gov/electricity/state/arizona/xls/az.xlsx

[5] EIA, *Source-Disposition (Supply and disposition of electricity).* https://www.eia.gov/electricity/state/arizona/xls/az.xlsx

Of the utilities under the ACC jurisdiction and subject to the REST policy (and any future revisions of this policy), the investor-owned utilities Arizona Public Service ("APS") and Tucson Power Electric ("TEP") are the largest. Together, they represent nearly half of Arizona's retail electricity sales and over 80% of ACC-jurisdictional electricity sales. As such, APS and TEP are the primary focus of this report.

According to recent REST reporting documents filed with the ACC, in 2018 APS and TEP had renewable energy resources installed on their systems that produced energy equal to 14.3% and 15.8% (respectively) of their retail electricity sales.

Both APS and TEP have made voluntary pledges in recent years to increase their share of energy from clean energy sources. In January 2020, APS announced its goal of 65% clean energy by 2030 and 100% clean energy by 2050, which is the most ambitious goal announced thus far by an Arizona electric company.[6] TEP's "30 by 30 Plan" aims to provide customers with 30% renewable power by 2030.[7] The charts below illustrate the approximate share of renewable energy resources in recent years relative to other resources (note that these percentages differ slightly from the percentages reported in the REST documentation since they reflect total generation resources planned rather than the percent of retail sales).[8]

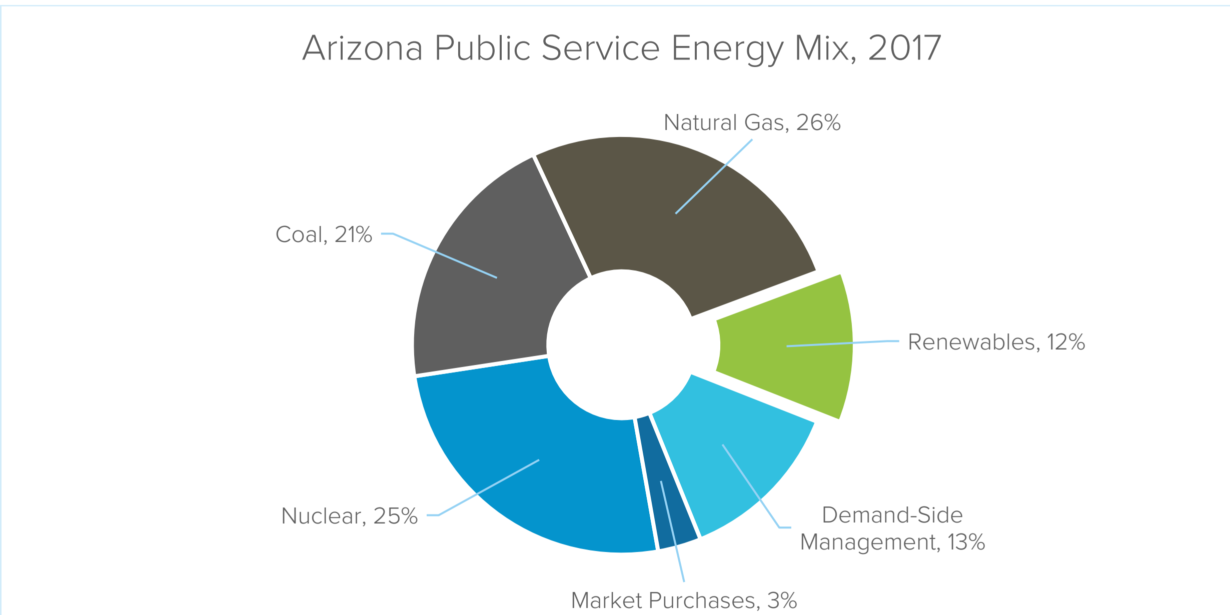

Figure 2. APS Energy Mix as reported in the APS 2017 Integrated Resource Plan[9]

[6] APS, *APS sets course for 100 percent clean energy future*. https://www.aps.com/en/About/Our-Company/Newsroom/Articles/APS-sets-course-for-100-percent-clean-energy-future
[7] TEP, *Where We're Going Next*. https://www.tep.com/renewable-goals/
[8] Generation resource percentages shown may differ from the percent retail sales due to line losses and demand-side management.
[9] APS, *2017 Integrated Resource Plan*. https://www.aps.com/-/media/APS/APSCOM-PDFs/About/Our-Company/Doing-business-with-us/Resource-Planning-and-Management/2017IntegratedResourcePlan.ashx

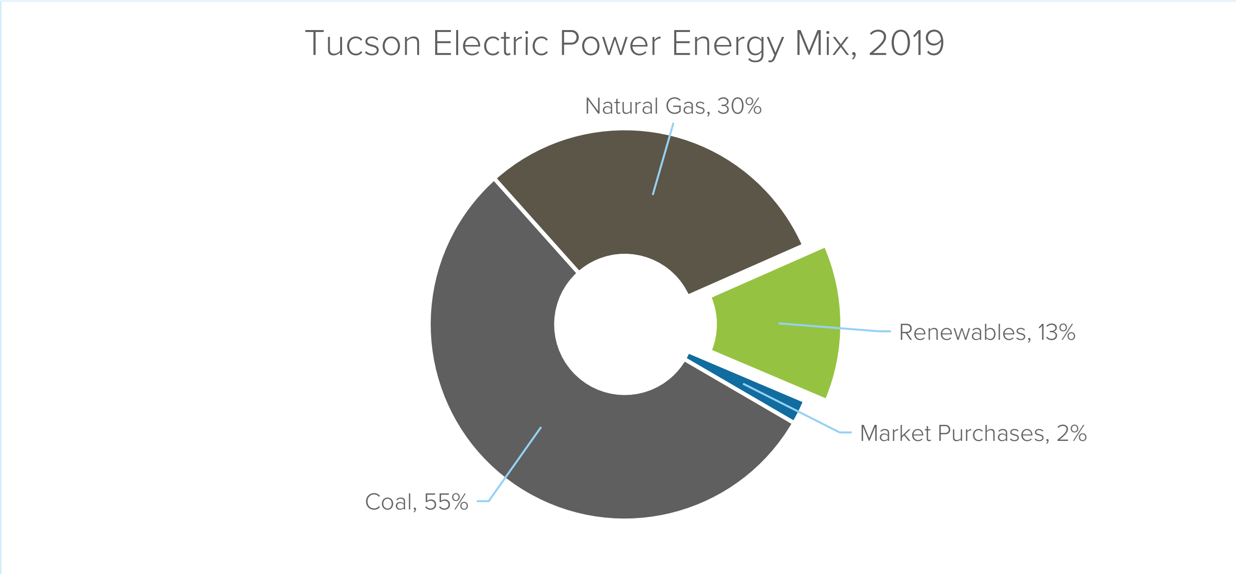

Figure 3. TEP Energy Mix as reported on TEP.com[10]

2.2 Renewable Energy Standard & Tariff (REST) Overview

The REST rule adopted by the ACC requires affected utilities to procure increasing amounts of electricity from eligible renewable sources with an overall target of 15% renewable energy by 2025. Additionally, the target includes a distributed generation ("DG") carveout of 30%, meaning 30% of the 15% total (or 4.5% overall) must come from distributed renewable sources, such as rooftop solar. Furthermore, the REST specifies that 50% of the DG target must come from non-residential sites and the other 50% from residential installations. As Arizona utilities have sought to comply with this requirement, they have developed annual REST Implementation Plans that describe the generation resources and programs they will use to meet their compliance obligations. The incremental costs of RE resources (e.g., above market generation costs and DG program incentives) are recovered through a surcharge on customer bills which is approved through a tariff separate from standard retail rates.

[10] TEP, *ESG/Sustainability Performance*. https://www.tep.com/esg/

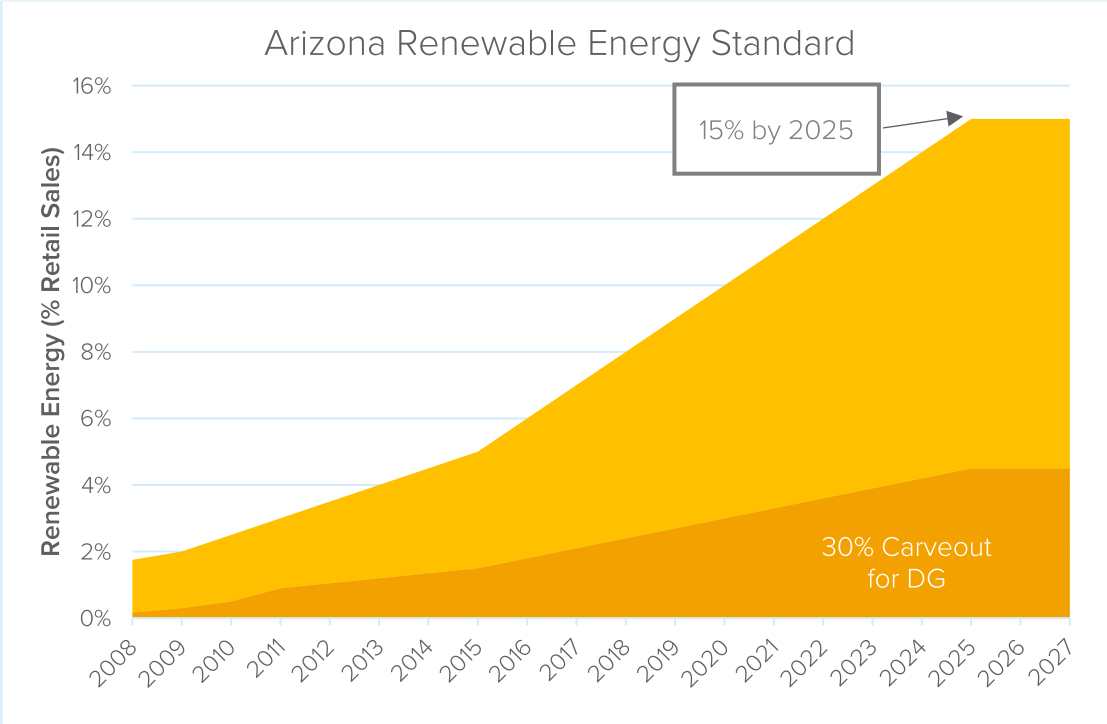

Figure 4. Arizona REST requirements per year with DG carveout.

In addition to the REST obligations, there have been other drivers of RE procurement over this same time period. For example, as a result of a negotiated settlement in the APS 2009 General Rate Case, procurement for RE resources was significantly accelerated. The multi-party settlement agreement included a provision (which the ACC ultimately approved) requiring 10 percent of APS resources to come from renewable energy by the year 2015, thereby doubling the 5 percent by 2015 required by REST in that year.

2.3 Comparison to Other States

Over the last few years, several states and utilities in the Western U.S. have adopted ambitious RE or clean energy targets. For example, the following laws have recently been enacted:

- April 2019: 100% carbon free electricity supply by 2045 in Washington[11]
- April 2019: 50% RE by 2030 and an aspirational goal of 100% by 2050 in Nevada[12]
- March 2019: 50% RE by 2030 and 100% zero-carbon energy by 2045 in New Mexico[13]
- September 2018: 100% zero-carbon energy by 2045 in California[14]
- March 2016: 50% RE by 2040 in Oregon[15]

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[11] State of Washington 66th Legislature, *Senate Bill 5116*. http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Senate%20Bills/5116.pdf
[12] Nevada Legislative Counsel Bureau, *SB 358*. https://www.leg.state.nv.us/App/NELIS/REL/80th2019/Bill/6651/Overview
[13] New Mexico Legislature, *SB 489*. https://www.nmlegis.gov/Sessions/19%20Regular/final/SB0489.pdf
[14] California Legislative Information, *Senate Bill No. 100*. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB100
[15] Oregon Legislative Assembly, *Senate Bill 1547*. https://olis.leg.state.or.us/liz/2016R1/Downloads/MeasureDocument/SB1547/Enrolled

The Arizona RE standard ranks below similar renewable or clean energy standards adopted by other states in the region. The table below illustrates Arizona's position relative to its neighbors for clean energy requirements. As shown, Arizona ranks seventh out of eleven states in the region, surpassing only the three Western states that have no binding renewable or clean energy requirements (i.e., does not include voluntary goals).

Table 1. Western U.S. States Ranked by Renewable and/or Clean Energy Standards Currently in Effect

Rank	State	Renewable/ Clean Energy Standard
1=	WA	100%
1=	NM	100%
1=	CA	100%
4=	OR	50%
4=	NV	50%
6	CO	30%
7=	MT	15%
7=	**AZ**	**15%**
8=	ID, WY, UT	0%

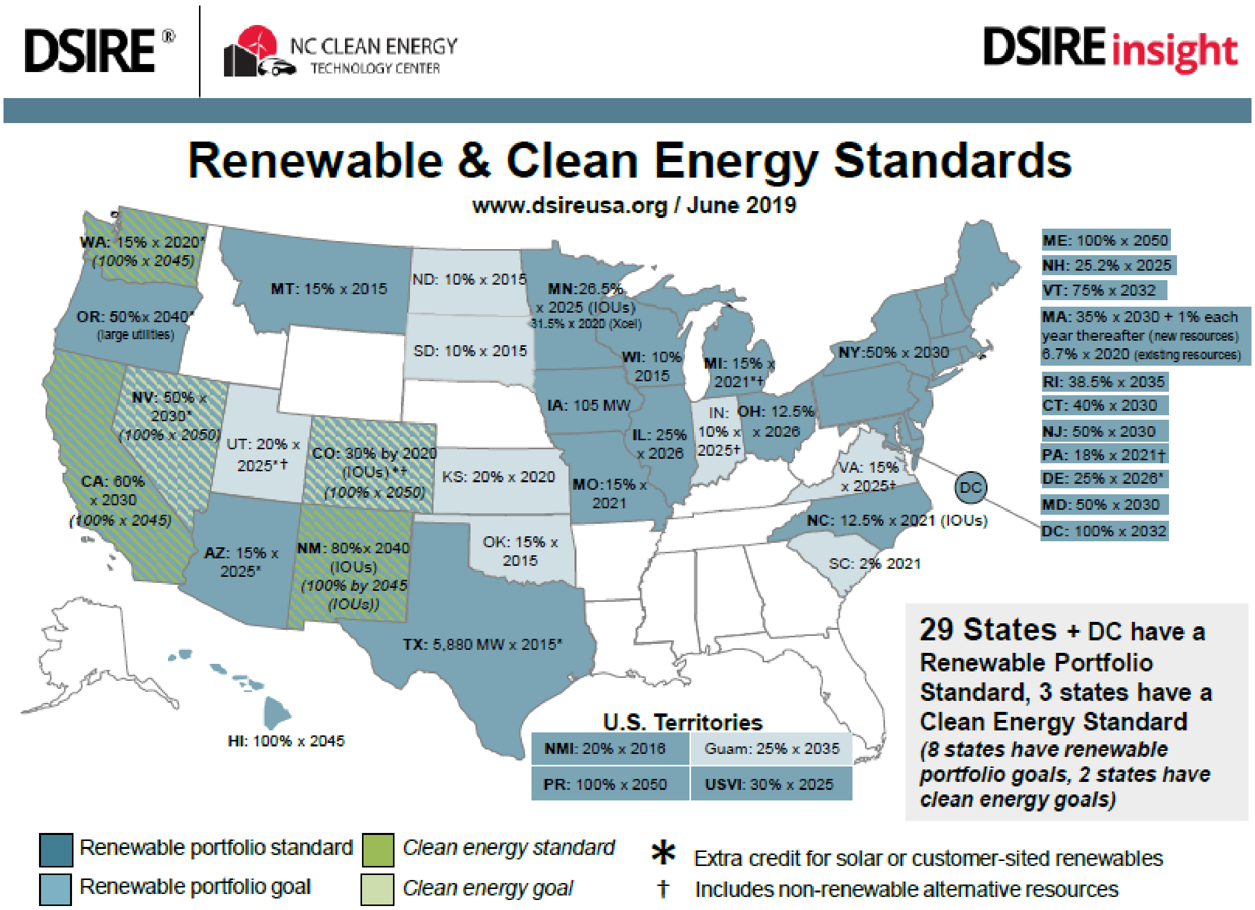

Figure 5. Renewable Portfolio Standards and Clean Energy Standards published by DSIRE[16]

2.4 REST Benefits and Costs

For this report, we conducted a high-level evaluation of the benefits and costs associated with REST. The categories of costs and benefits evaluated are listed below and described in more detail in Sections 3 and 4.

<u>REST Benefits Evaluated</u>

- Avoided Conventional Energy Costs
  - Reduced fuel consumption (e.g., coal, natural gas) and purchased power costs[17]
  - Reduced variable operations and maintenance costs
  - Reduced line losses (for DG)
- Avoided Conventional Capacity Costs
  - Reduced natural gas peaker plant needs
- Emissions Reductions

[16]Database of State Incentives for Renewables & Efficiency, *Renewable & Clean Energy Standards*. https://www.dsireusa.org/resources/detailed-summary-maps/

[17] In addition to directly avoiding purchased power costs, RE can also have the effect of reducing the market price for any remaining purchased power by shifting the supply curve downward. This is also known as the Demand Reduction Induced Price Effect ("DRIPE") but was not evaluated as part of this study.

    - Reduced CO_2 Emissions
    - Reduced Criteria Pollutant Emissions (NO_x, SO_x, PM2.5)
- Water Savings
- RE Technology Cost Reductions
- Local Investment & Jobs

REST Costs Evaluated

- Total RE Costs
    - REST program expenses
        - "Above market" cost of RE generation
        - DG incentive costs[18]
        - Other program administration costs
    - RE costs in base fuel rates

[18] Note on DG: In Arizona and in other states there has been considerable debate regarding the value and cost of DG resources to other non-participant retail customers. More specifically, distributed resource owners generally receive value from retail rate avoidance and/or net metering. This is viewed by some as a cross-subsidy that constitutes a "cost" to non-participants. Others contend that these costs are simply an artifact of retail rate design or are outweighed by the value DG creates for the system. This report does not express a view on this matter as costs and benefits are evaluated from a utility-system or societal perspective. As such, any costs associated with DG are limited to direct subsidies paid through RES programs, while cross-subsidies that may be embedded in retail rates are not considered.

3. Arizona REST Benefits

3.1 Total Renewable Energy Production

In 2018, APS and TEP achieved total RE levels on their systems equal to 14.3% and 15.8% (respectively) of retail electricity sales. Meanwhile, each company's RE resources that counted towards the REST policy (i.e. "RES Resources") totaled 10.8% and 10.4%, respectively, as a fraction of retail sales.[19] Both of these amounts surpassed the REST requirement in that year of 8% and are ahead of the 2020 requirement of 10%. In 2018, APS generated 2,992 GWh from RES resources, which is equivalent to the consumption of approximately 243,000 Arizona households.[20] Meanwhile, TEP's 2018 RES resources generated 924 GWh, equal to approximately 75,000 Arizona households. The total amount of renewable energy on both utilities systems, including distributed resources that did not receive an incentive through the REST program, is even larger.

Table 2. APS RES Resources based on annual REST Compliance Reporting.

Year	RES Resources (MWh)	RE Generation (MWh)	Distributed RE (MWh), w/ incentive	RES Resources (% of Retail Sales)	Distributed RE (MWh), no incentive	Total Renewables (% of Retail Sales)
2008	585,114	567,789	17,325	2.02%	--	2.02%
2009	590,581	541,196	49,385	2.10%	--	2.10%
2010	703,770	572,357	131,413	2.54%	--	2.54%
2011	964,086	677,567	286,519	3.42%	--	3.42%
2012	1,507,021	1,003,523	503,498	5.29%	--	5.29%
2013	1,913,285	1,216,910	696,375	6.80%	--	6.80%
2014	2,710,644	1,948,737	761,907	9.83%	109,236	10.23%
2015	2,835,779	2,075,444	760,335	10.15%	246,672	11.03%
2016	2,871,942	2,076,138	795,804	10.27%	481,251	11.99%
2017	2,905,708	2,124,373	781,335	10.37%	715,829	12.93%
2018	2,992,274	2,202,285	789,989	10.75%	983,625	14.28%

Table 3. TEP RES Resources based on annual REST Compliance Reporting.

Year	RES Resources (MWh)	RE Generation (MWh)	Distributed RE (MWh), w/ incentive	RES Resources (% of Retail Sales)	Distributed RE (MWh), no incentive	Total Renewables (% of Retail Sales)
2008	188,400	181,176	7,224	3.10%	--	3.10%

[19] Both APS and TEP have significant shares of rooftop solar installations for which an incentive was *not* provided through the REST program. While these non-incentivized RE resources contribute towards the overall amount of RE on each utility's system, they generally do not count towards the REST requirements. As such, the "Total Renewables" on each utility's system is greater than the "RES Resources" that are counted towards compliance with the REST.

[20] Assumes AZ household consumption of 12,336 kWh/year.

2009	32,000	323,616	8,384	3.54%	--	3.54%
2010	347,485	324,705	22,780	3.74%	--	3.74%
2011	330,006	274,985	55,020	3.54%	--	3.54%
2012	481,945	325,095	156,850	5.20%	--	5.20%
2013	515,471	1,743,884	169,401	5.56%	11,434	5.68%
2014	647,805	2,504,405	206,239	7.07%	36,565	7.47%
2015	808,724	2,634,789	200,990	8.93%	79,971	9.82%
2016	952,610	2,667,312	204,630	10.71%	148,685	12.38%
2017	928,908	2,689,455	216,253	10.41%	209,942	12.76%
2018	924,189	2,783,458	208,816	10.38%	477,443	15.75%

3.2 Cumulative Overall Benefits

Over the last decade, implementation of the REST by APS and its customers has yielded over $1.5 billion in gross benefits from renewable energy, while implementation by TEP and its customers has yielded over $469 million in gross benefits.[21] These numbers represent only the categories of benefits that were specifically quantified in this study in terms of their monetary value (e.g., energy, capacity, CO_2 emissions and criteria pollutant emissions) and does not reflect other benefits such as water savings, technology cost reductions and job creation.

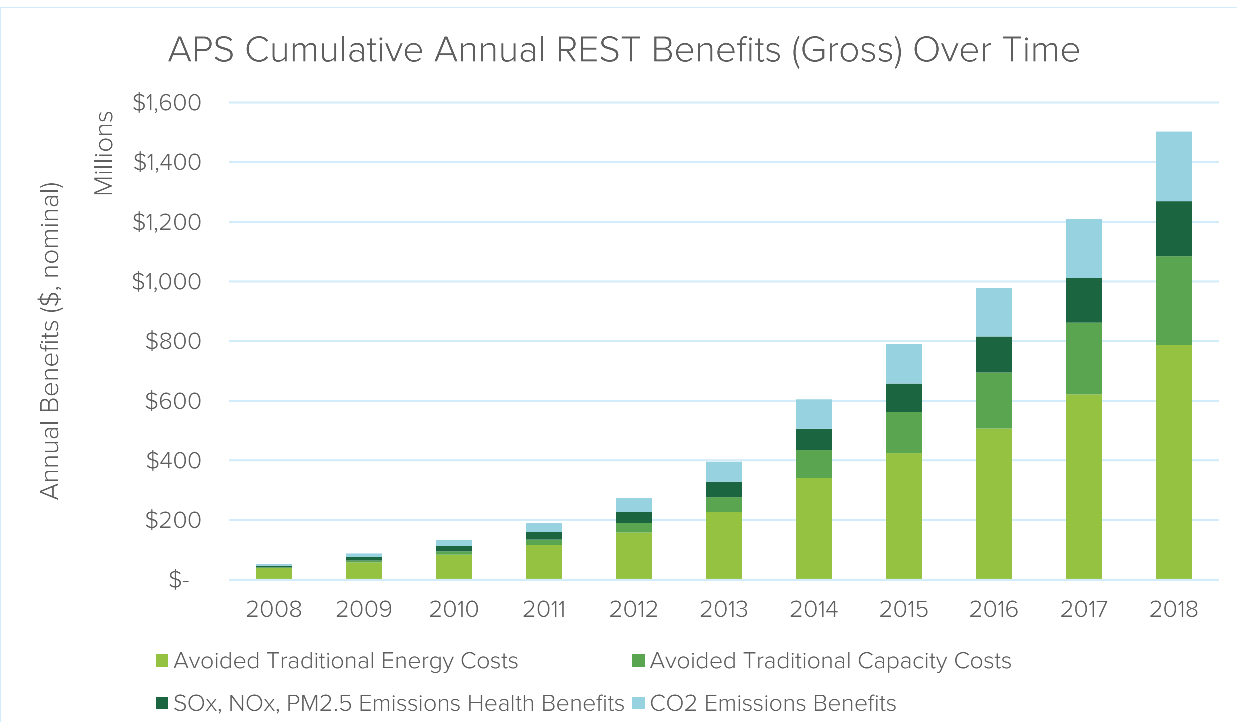

Figure 6. Cumulative Annual REST Benefits for APS (2008 through 2018) from Arizona Public Service generation.[22]

[21] Includes benefits from non-incentive DG.
[22] Cumulative benefits reflect the sum of benefits as described in sections 3.3 through 3.7 below.

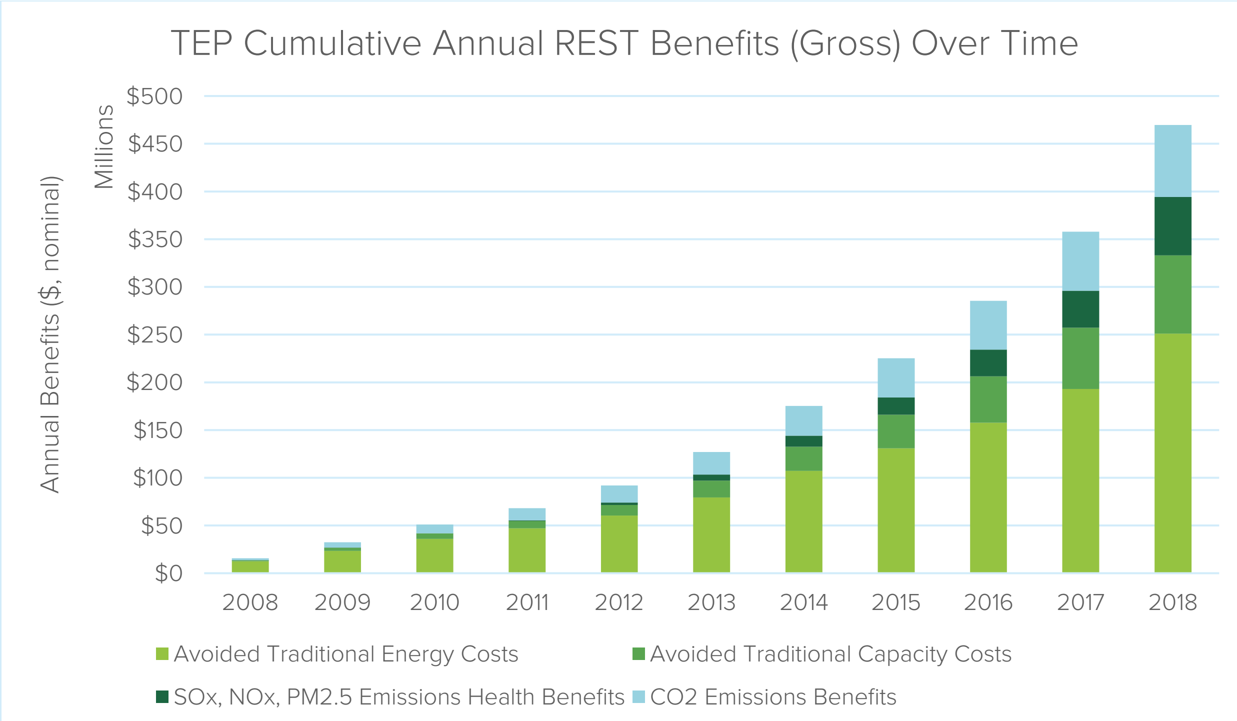

Figure 7. Cumulative Annual REST Benefits (2008 through 2018) from Tucson Electric Power generation.[23]

Table 4. APS Annual Energy Benefits.

Year	Avoided Conventional Energy Costs	Avoided Conventional Capacity Costs	SO_x, NO_x, PM2.5 Emissions Health Benefits	CO_2 Emissions Benefits
2008	$38,664,791	$2,590,000	$5,815,842	$5,957,395
2009	$19,551,204	$3,346,560	$5,524,260	$6,394,573
2010	$25,829,036	$4,816,815	$6,367,712	$7,548,860
2011	$32,281,384	$7,456,430	$7,616,105	$10,204,055
2012	$42,013,214	$12,800,315	$11,993,501	$16,218,532
2013	$68,692,559	$18,105,915	$15,231,457	$21,118,481
2014	$114,570,039	$43,102,683	$20,039,033	$30,960,187
2015	$82,398,029	$46,535,812	$22,248,681	$33,799,099
2016	$83,224,937	$48,857,825	$25,683,981	$31,194,012
2017	$113,878,414	$53,150,992	$30,139,817	$33,607,866
2018	$165,853,079	$56,466,594	$33,924,218	$36,926,380

Table 5. TEP Annual Energy Benefits.

[23] Ibid.

Year	Avoided Conventional Energy Costs	Avoided Conventional Capacity Costs	SO_x, NO_x, PM2.5 Emissions Health Benefits	CO_2 Emissions Benefits
2008	$12,457,214	$1,212,934	$82,953	$1,906,449
2009	$10,946,227	$2,128,893	$73,824	$3,586,603
2010	$12,646,254	$2,263,838	$65,355	$3,741,629
2011	$10,951,022	$2,218,760	$369,706	$3,477,892
2012	$13,446,115	$3,308,356	$1,899,203	$5,144,598
2013	$18,913,408	$6,546,098	$3,849,031	$5,775,143
2014	$27,844,191	$7,587,634	$5,255,420	$7,583,616
2015	$23,609,582	$9,968,251	$6,556,790	$9,787,979
2016	$26,860,331	$13,394,069	$9,753,054	$10,245,114
2017	$35,395,470	$15,493,798	$10,800,332	$10,700,629
2018	$57,933,251	$17,870,208	$22,550,769	$13,492,443

3.3 Avoided Conventional Energy Costs

One of the primary benefits of RE resources is the fact that they have nearly no operational costs. In addition, they can displace costs from conventional resources such as fuel expenses (e.g., coal, natural gas), variable operations and maintenance costs, and transmission line losses in the case of DG.

Adding zero marginal cost energy such as renewables to the system tends to displace generation resources that are operating on the margin to meet electric loads.[24] In recent years, these marginal sources have typically been either coal or natural gas, depending on the level of demand and prevailing commodity prices. Thus, the total avoided energy cost from renewables can be approximated by the marginal cost of energy during the times the renewable resources are generating electricity. We estimated the total avoided conventional energy costs due to RE additions on APS' system to be approximately $166 million annually (in 2018) or $787 million cumulatively (2008-2018). For TEP, the equivalent avoided conventional energy fuel cost was approximately $58 million annually (2018) or $251 million cumulatively (2008-2018).[25] These benefits are expected to increase over time as the RE resources already deployed will continue to produce fuel cost savings well into the future.

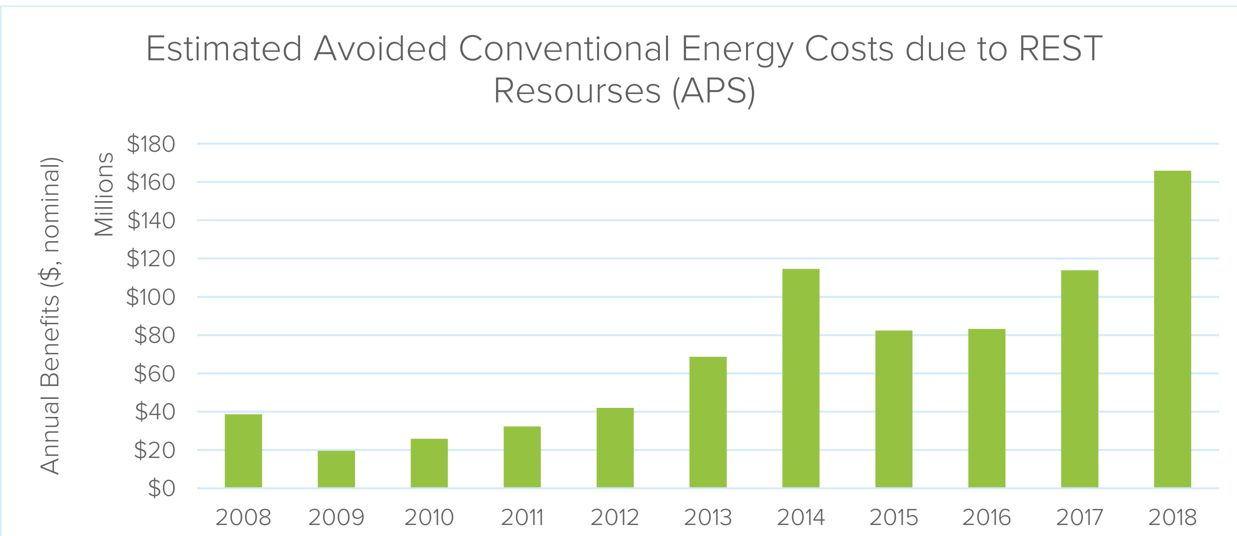

Figure 8. Estimated Avoided Conventional Energy Costs

Notably, the addition of RE resources provides a natural hedge against fuel price volatility. For example, natural gas prices historically rise and fall substantially from year to year, creating potential spikes in fuel expenses for Arizona utilities. Currently, gas commodity prices have been low and stable due to sustained production of shale gas using horizontal drilling and hydraulic fracturing techniques. However, there have still been fluctuations in recent years due to high demand for

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[24] A generation resource that is operating "on the margin" refers to the resource that would need to be ramped up (or down) in real time to accommodate an increase (or decrease) in electricity system demand. Electricity system operators generally dispatch the least expensive resources first, while reserving the most expensive resources for periods of highest demand. As such, the marginal resource displaced by RE will tend to be the most expensive resources operating at that moment in time, but this will vary over time based on supply and demand.

[25] Avoided energy generation costs were estimated based on SNL Power Palo Verde Spot Power Index Annual Average Prices (assumes RE generation occurs 75% during the on-peak period, 7am-10pm).

energy in Southern California and the Southwest region, coupled with constraints on gas pipelines and storage facilities. For example, the chart above illustrates a substantial increase in the energy value of RE in the year 2014, partly due to higher gas fuel prices that year.

3.4 Avoided Conventional Generation Capacity Costs

In addition to avoiding conventional energy generation, renewable resources are also able to displace the need to build new generation capacity that is used to meet peak demand, which in Arizona typically occurs in the summer months. While renewable resources have different capabilities than conventional fossil fuel generation resources, they generally can provide a meaningful contribution towards meeting each utility's peak demand. For example, the table below shows APS' most recent assessment of its resource portfolio's ability to meet its summer peak. Renewable resources contributed approximately 688 MW towards APS' summer peaking needs.

Table 6. APS Peak Resources

Renewable Resource	2019 Resources (MW peak)
Large Scale[26]	*508*
Solar	424
Wind	55
Other RE	29
Distributed (cumulative contribution)[27]	*180*
Total RE	688
Total APS 2018 Peak Demand	7,320

Notably, the Solana Concentrating Solar Power (CSP) resource has contributed a substantial share to this overall total and is the single largest capacity resource in APS' REST portfolio. While this resource has incurred a large overall cost, it also has significant value in terms of providing on-peak capacity to the APS system.

[26] 2019 Summer Preparedness Workshop (April 30, 2019)
[27] APS IRP Stakeholder Forum (April 4, 2019)

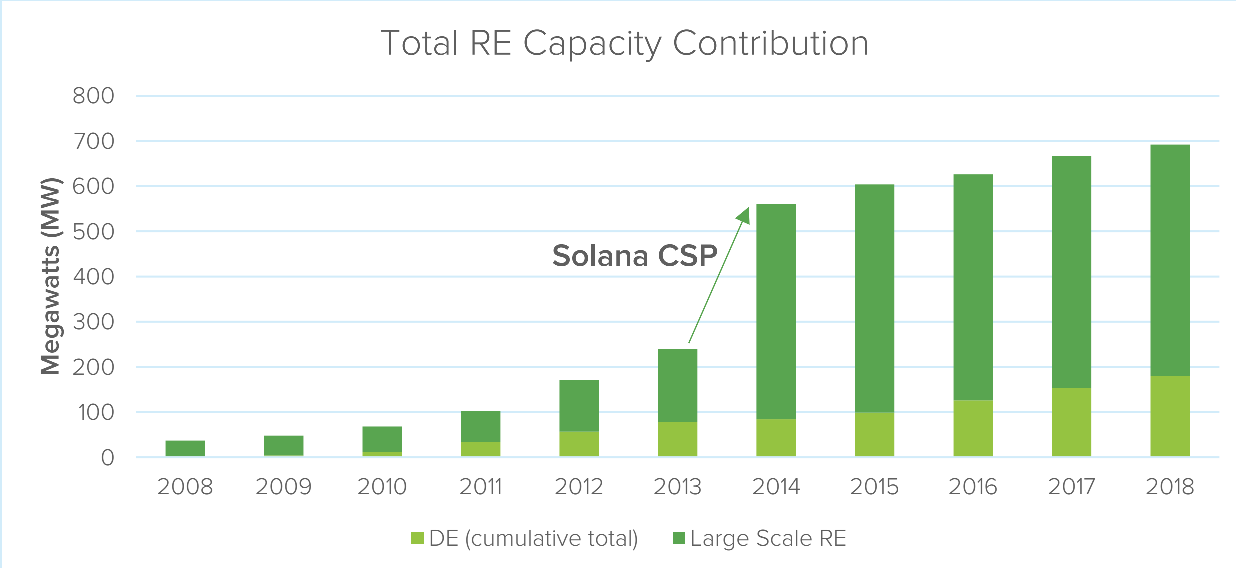

Figure 9. Illustration of capacity contribution of RE resources on APS' system over time.

The RE contribution of 688 MW peak equates to approximately 9% of APS' total peak demand needs, or roughly the equivalent of avoiding more than six new 102 MW natural gas-fired combustion turbines. For comparison, APS' most recent conventional plant addition (the Ocotillo Modernization Project) consisted of five new natural gas-fired combustion turbines that were of a similar size (510 MW total).

We estimate that the 688 MW of capacity resources displaced by RE is equal to:

- $56 M annually in avoided conventional power plant capacity costs.
- $297 M in cumulative avoided conventional power plant capacity costs (2008-2018).[28]

For TEP, RE resources have contributed approximately 219 MW towards meeting peak demand, as shown in the table below.

Table 7. TEP Peak Resources

Renewable Resource	2018 Resources (MW peak)
Large Scale[29]	*134*
Distributed (cumulative contribution)[30]	*85*
Total RE	219
Total TEP 2018 Peak Demand	2,388

The RE contribution of 219 MW peak equates to approximately 9% of TEP's total peak demand needs and is roughly the same as avoiding ten new 20 MW reciprocating engines. For comparison, TEP's most recent plant addition (the TEP RICE project) consisted of 10 new natural gas-fired RICE units.

[28] Conservatively assumes avoided capacity costs of $70/kW-yr in 2008 escalated at the rate of inflation. For comparison, the Ocotillo Modernization Project used LMS 100 turbine technology which ranges from $96-119/kW-yr (assuming a capital cost of $1,150-1,430/kW, 32-year economic life and 7.5% cost of capital).

[29] Based on projected 2018 deployment in 2017 TEP IRP

[30] Based on projected 2018 deployment in 2017 TEP IRP

We estimate that the 219 MW of capacity resources that were displaced by RE are equal to:

- $18 M annually in avoided conventional power plant capacity costs.
- $82 M in cumulative avoided conventional power plant capacity costs (2008-2018).[31]

Since the RE resources deployed today will continue to contribute capacity throughout their operating life, these avoided capacity benefits are expected to continue rising.

3.5 CO_2 Emissions Reductions

In recent years, electricity has accounted for approximately half of Arizona's energy-related carbon dioxide (CO_2) emissions. Thus, policies such as the REST that have displaced conventional fossil fuel generation with renewables have played a role in limiting the state's overall contribution to climate change. According to the U.S. Energy Information Administration, Arizona's energy-related CO_2 emissions have declined from about 102 million metric tons (MMT) in 2008 to 87 MMT in 2016, about a 10% decline. A meaningful portion of this reduction is attributable to RE deployed under the REST. In 2018, we estimate that RE deployed by APS and TEP helped avoid approximately 3.2 MMT in annual emissions, or about a 3% overall reduction relative to 2005 levels (economy-wide). This finding is consistent with the fact that APS and TEP have both achieved over 10% RE, and that the REST applies to half of Arizona's utilities, which in turn represent half of statewide emissions.

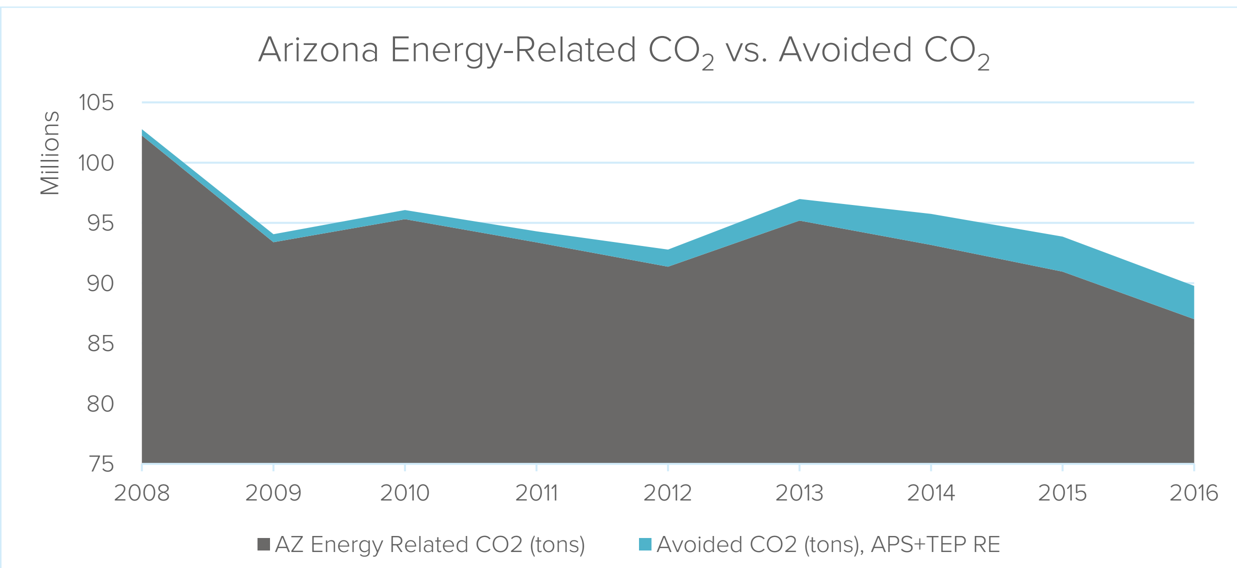

Figure 10. Annual energy-related carbon dioxide emissions in Arizona[32] and avoided CO_2 attributable to the REST.[33]

The monetary value of these avoided CO_2 emissions can be estimated as a benefit of the REST policy. There are a wide range of estimates for the societal costs of CO_2 emissions (or conversely, the benefits of avoiding those emissions); the most widely-used estimate of damages is the federal

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[31] Conservatively assumes avoided capacity costs of $70/kW-yr in 2008 escalated at the rate of inflation. For comparison, the TEP RICE Project used reciprocating engine technology, which is approximately $100/kW-yr (assuming a capital cost of $1,200/kW, 32-year economic life and 7.5% cost of capital).

[32] U.S. Energy Information Administration, *Arizona energy-related carbon dioxide emissions by year, unadjusted*. https://www.eia.gov/environment/emissions/state/analysis/

[33] Avoided CO_2 emissions were calculated for both APS and TEP assuming they displaced representative fossil plants on each utility's system. For APS, the Four Corners coal plant and the Redhawk natural gas plant were used, while for TEP the Four Corners coal plant and Luna natural gas plant were used. In both cases the share of coal versus natural gas that was on the margin (and thus displaced by RE) was estimated based on the price of natural gas in that year.

Social Cost of Carbon, which calculates the "Central" value for damages at approximately $52/metric ton in 2020.[34] Colorado recently passed legislation specifying $46/ton as an appropriate value.[35] For this analysis, we opted for a more conservative estimate linked to Arizona utility planning assumptions for the compliance cost of carbon – a value that utilities often use to reflect the potential costs of complying with future climate regulations. In its Integrated Resource Plan, APS assumes a CO_2 cost of approximately $15/ton beginning in the mid-2020s. This in turn is based upon California's CO_2 allowance pricing program[36] using 2016 values escalated at rate of 2.5% per year. Using this value as a proxy for the benefit of avoided CO_2 we estimated the avoided CO_2 benefit for each year of the REST program for APS and TEP. Note that this approach does not account for the full societal benefits (or avoided damages) from the avoided emissions of CO_2.

Based on these assumptions, the cumulative calculated CO_2 benefit from 2008 through 2018 was approximately $234 million for APS and $75 million for TEP, or about $309 million total. These benefits are projected to continue growing as the RE resources already deployed continue to avoid CO_2 emissions for years to come.

3.6 Criteria Pollution Emissions Reductions (NO_x/SO_x/PM2.5)

In addition to CO_2, conventional fossil fuels also emit criteria pollutants that are harmful to public health. These pollutants include NO_x which is a precursor to ground-level ozone (smog), SO_2 which can harm human respiratory systems and produce haze, and fine particulate matter (PM 2.5) which also contributes to health problems. By displacing fossil fuel generation, renewable resources, including those supported by the REST, have contributed to a reduction in these emissions.

The reduction in criteria pollutants from REST resources was calculated based on emission rates at representative power plants on APS and TEP's system, as reported in the S&P Global database. These totals were then compared to the total emissions from power plant sources in Arizona as reported by the U.S. Environmental Protection Agency (EPA). The charts below show this comparison for NO_X and SO_2.

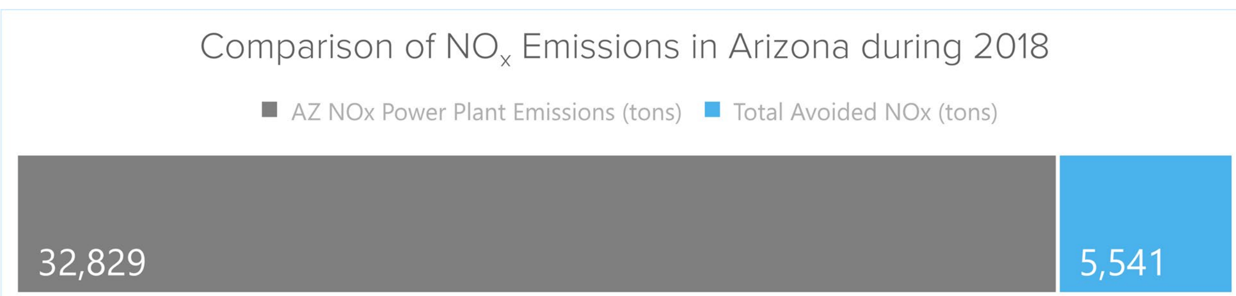

Figure 11. Estimated avoided NO_x from the REST. In 2018, this was estimated to equate to approximately 17% of Arizona's total NOx Power Plant Emissions[37]

[34] Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. 2016. Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis. The working group identifies the "central value" as $42/metric ton in 2007 dollars; we escalate that to 2020 dollars based on inflation.

[35] Colorado General Assembly, *SB19-236*. https://leg.colorado.gov/bills/sb19-236

[36] CO_2 allowances are the compliance and trading mechanism used by the state of California to implement its a greenhouse gas emissions cap program ("cap and trade"). The program was developed to limit CO_2 emissions as required by state law.

[37] United States Environmental Protection Agency, *Power Plant Emission Trends*. https://www.epa.gov/airmarkets/power-plant-emission-trends

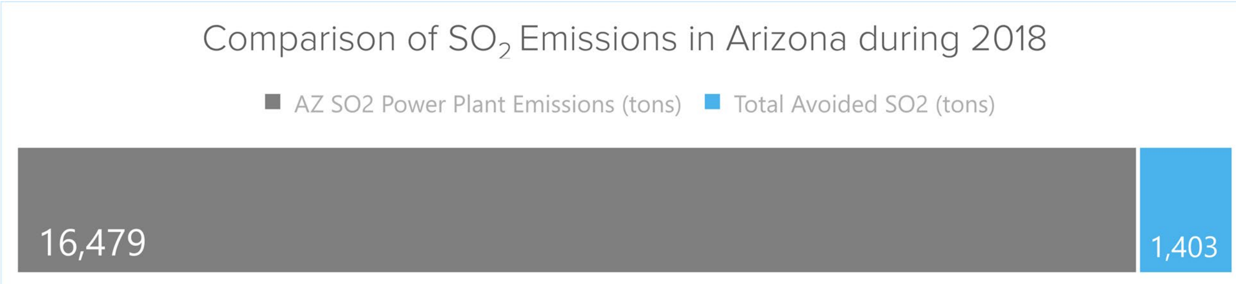

Figure 12. Estimated avoided SO_2 from the REST. In 2018, this was estimated to equate to approximately 9% of Arizona's total NOx Power Plant Emissions.[38]

The monetary benefits of criteria pollutant emissions reductions (SO_x, NO_x and PM2.5) were also quantified using the EPA's 2019 Emissions Health Benefits per kWh report. This report provides benefits in terms of $/kWh on a regional basis for wind, solar, and baseload resources.[39] Using the EPA's estimates for benefits, we find that REST resources deployed from 2008-2018 have yielded approximately $185 million in cumulative benefits for APS and $61 million in benefits for TEP. As with the other benefits, the RE resources already in place should continue to produce emissions savings, increasing these estimated benefits over time.

3.7 Water Savings

In the desert Southwest, water resources are scarce and valuable. The power sector is a large consumer of water resources, using water as a coolant for thermal power plants fueled by coal, natural gas or uranium. In contrast, many renewable resources, including solar photovoltaic ("PV") and wind, use no water. As such, increased deployment of RE can help offset the need to use water with conventional fossil fuel resources, allowing it to serve other purposes such as domestic and agricultural use. Over time, Arizona's utilities have become more water efficient as they have incorporated more RE and made other improvements to their thermal fleet.

APS recently reported that its fleet-level water intensity has declined from approximately 520 gal/MWh to 450 gal/MWh from 2012 to 2017. Based on this trajectory, we estimated the annual water savings associated with RE deployed by APS to meet the REST requirement. As the water efficiency of the fleet improves, each MWh of RE saves proportionally less water. However, the overall growth in RE has increased total water savings. Based on a fleet-level water intensity of approximately 430 gal/MWh in 2018, we estimate that APS' RE portfolio is saving approximately 5,200 acre-feet of water each year (or over 1.6 billion gallons). Figure 13 shows this avoided water consumption per year. TEP's avoided water consumption was estimated assuming APS' water intensity per MWh.

Avoided NO_x and SO_2 emissions were calculated assuming avoided generation emissions from representative coal and natural gas plants on APS and TEP's systems. The Four Corners coal plant and Redhawk natural gas plant were used for APS, while the Four Corners coal plant and Luna natural gas plant were used for TEP. Plant emissions estimates were obtained from S&P Global database. The relative share of coal and natural gas was approximated based on natural gas prices and related plant dispatch in each year.

[38] *Ibid.*

[39] Assumes a 3% discount rate and averaging low and high estimates.

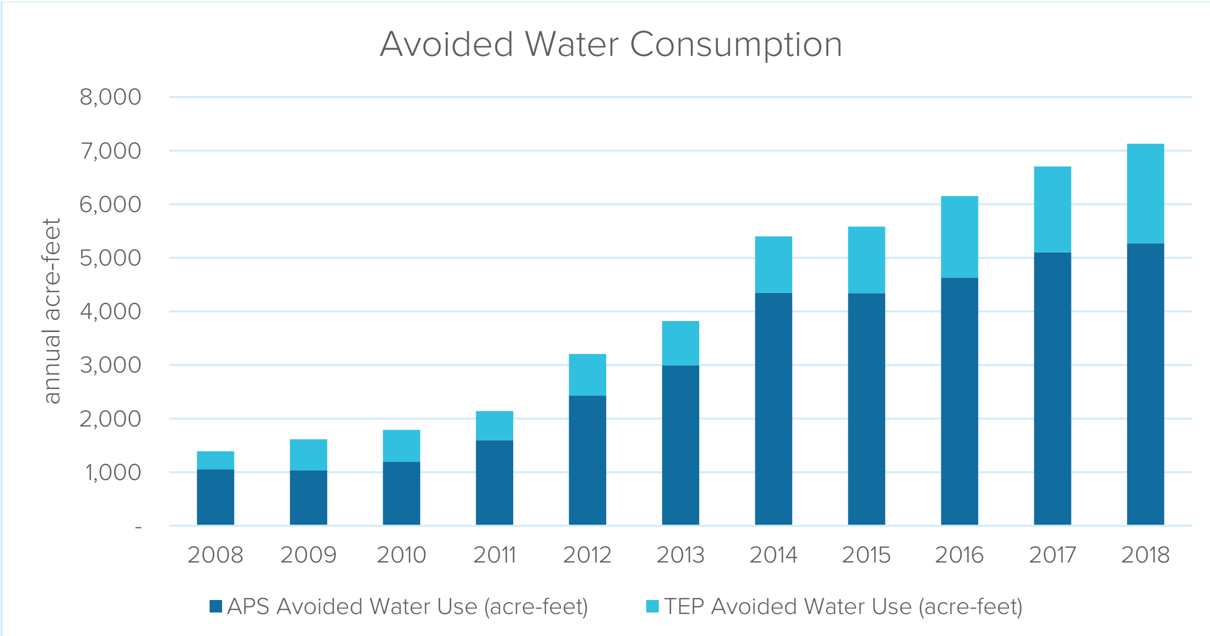

Figure 13. Estimated Avoided Water Consumption per year for APS and TEP. Annual water Intensity (gal/MWh) retrieved from APS' 2019 IRP Stakeholder Forum Presentation. Water intensity for TEP was assumed similar to APS on a per MWh basis.[40]

As shown in Figure 14, conventional generation displaced by RE resources would have consumed approximately 7,129 acre-feet of water in 2018. For comparison, the USGS estimated Maricopa County (Arizona's most populous county) to have self-supplied domestic water consumption of approximately 6,200 acre-feet in 2015.[41]

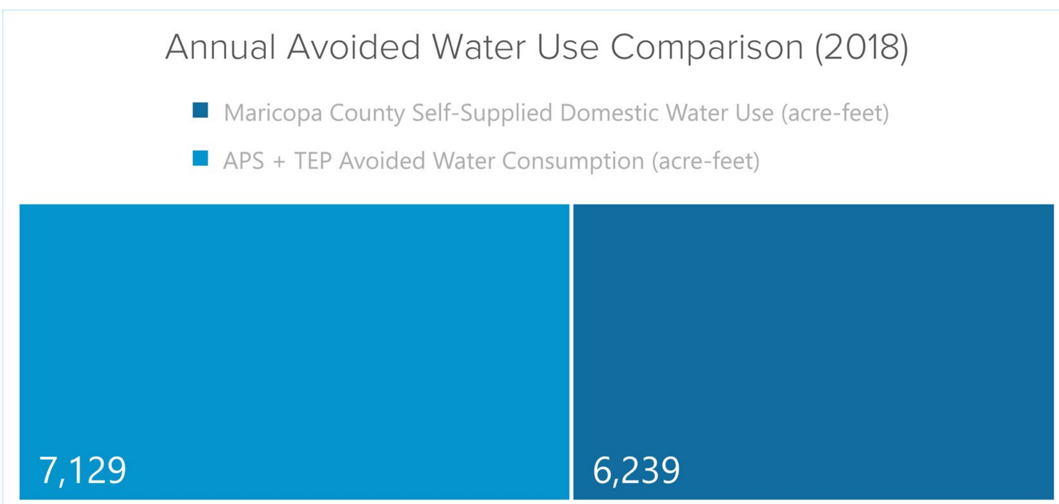

Figure 14. Comparison of annual Maricopa County self-supplied domestic water usage with avoided water consumption in 2018. Maricopa County data utilizes latest millions of gallons per day estimate provided by USGS.

[40] Arizona Public Service, *IRP Stakeholder Meeting*. https://docket.images.azcc.gov/0000197598.pdf
[41] United States Geological Service , *Water Use Data for Arizona*. https://waterdata.usgs.gov/az/nwis/water_use?format=html_table&rdb_compression=file&wu_area=County&wu_year=2015&wu_county=013&wu_category=DO&wu_county_nms=Maricopa%2BCounty&wu_category_nms=Domestic

Alternatively, the 7,129 acre-feet of water saved could satisfy the needs of around 43,593 Arizona residents[42], which is roughly 28% of the state's annual population increase from 2017 and 2018 (or about 155,376[43] new residents).

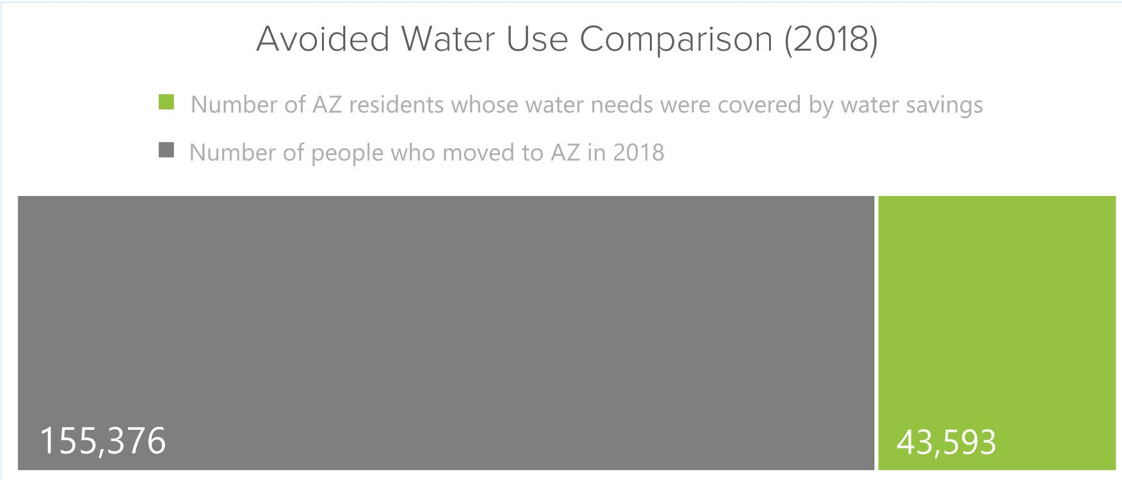

Figure 15. Comparison of number of new Arizona residents with Avoided Water Consumption equivalence.

3.8 Renewable Energy Technology Costs Reductions

A fundamental aspect of any policy intended to promote the deployment of emerging technologies (including the REST at the time of its adoption) is that it can help to stimulate new investment and market activity, ultimately driving down the cost of future deployment. This effect has indeed happened in Arizona, where RE technology costs have declined over time. While many factors driving this decline are global in nature (e.g., solar PV panel prices), many are also local or regional (e.g., experience of local project installers). The chart below demonstrates the cost declines for solar PV installations in Arizona based on data compiled by Lawrence Berkeley National Lab. From 2008 to 2018, the median installation cost declined from over $7/W to just over $3/W, a 53% reduction.

This reduction in cost stands to provide significant benefits to future electricity customers through lower costs to install distributed resources or deploy large-scale renewables. For any forward-looking assessment of RE policy, it is therefore crucial to account for these cost declines since any incremental costs borne by RE deployment until now under the REST are likely to be significantly diminished for future RE deployment.

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[42] United States Geological Service, *Water Use Data for Arizona*. https://waterdata.usgs.gov/az/nwis/water_use?format=html_table&rdb_compression=file&wu_area=County&wu_year=2015&wu_county=013&wu_category=DO&wu_county_nms=Maricopa%2BCounty&wu_category_nms=Domestic

[43] Census Bureau, *Population Clock*. https://www.census.gov/popclock/

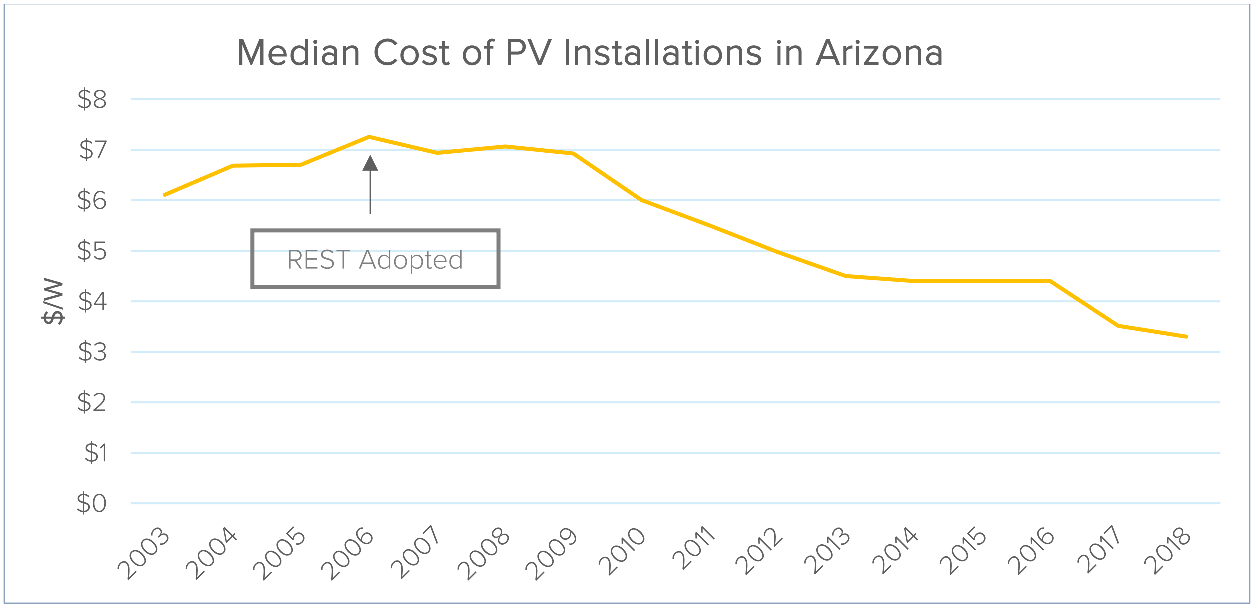

Figure 16. Median price per watt determined using Berkeley Lab's 2019 Tracking the Sun Public Data File[44], which collects project-level data on residential and non-residential photovoltaic systems.

3.9 Local Investment and Jobs

RE has also been a source of local investment and job creation in the state of Arizona. Compared to other states in the U.S., Arizona has relatively few naturally occurring conventional fossil fuel resources. Virtually no natural gas, coal or uranium is extracted within the state's boundaries and is instead imported from elsewhere. Until recently, one exception to this was the Kayenta coal mine on the Navajo Nation. However, with the recent closure of the Navajo Generating Station and the Kayenta mine, no major coal mines remain.

In contrast, Arizona has substantial RE resource potential, especially in the form of solar energy, which has been a source of growing investment and jobs as these resources are deployed. According to the Solar Energy Industries Association, solar industry investment totaled $11.6 billion in Arizona—more than $735 million was invested in 2018 alone. There are 571 solar companies operating in the state, of which eight are manufacturers and 268 are installers or developers.[45] The solar industry is also a major source of employment in the state, with more than 7,500 jobs reported in 2018.

Table 8. Solar Industry Jobs in Arizona. Source: The Solar Foundation

Year	Installation	Manufacturing	Sales & Distribution	Project Development	Other	Total
2015	2,549	2,400	1,095	584	294	**6,922**
2016	3,399	1,987	927	540	457	**7,310**
2017	3,629	2,889	782	550	531	**8,381**
2018	3,383	2,551	689	496	404	**7,524**

[44] Berkeley Lab, *Tracking the Sun*. https://emp.lbl.gov/tracking-the-sun
[45] Solar Energy Industries Association, *Arizona Solar Spotlight*. https://www.seia.org/sites/default/files/2019-12/Arizona.pdf

3.9.1 Benefits in Rural Arizona

Investments in RE resources have the potential to stimulate the economic development of rural areas. According to the Organisation for Economic Co-operation and Development, some of the benefits that RE resources may provide in these communities are:

- New sources of revenue to support public services and infrastructure
- Jobs and business opportunities
- Innovations in products, practices and policies
- Capacity building and community empowerment
- Affordable and reliable energy[46]

A report prepared for The Western Way found that around 47% of total installed solar and wind capacity in Arizona is in rural areas. The report estimated that from 2001 and 2017, solar and wind development activity in rural Arizona generated $9.4 billion in direct and indirect benefits. [48,49]

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[46] OECD, *Linking Renewable Energy to Rural Development*. https://www.oecd.org/regional/linkingrenewableenergytoruraldevelopment.htm

[48] The Western Way, *The Economic Benefits of Arizona Rural Renewable Energy Facilities*. https://static1.squarespace.com/static/5734cf71b6aa60fb98e91bf2/t/5c926754fa0d604271b0b424/1553098585894/Western+Way_AZ+Rural+Renewable+Econ+Impact_+Final.pdf

[49] Although the study covers the years from 2001 (before the REST was adopted) to 2017, total capacity before 2009 was insignificant (less than 0.7% of today's capacity).

4. Arizona REST Costs

The implementation of the REST has included enhanced scrutiny in terms of utility cost accounting. Due to the REST surcharge there has been a need to track the expenditures that are directly tied to the REST policy, namely the incremental costs to procure RE resources. This section of the report attempts to describe the key drivers of these costs, identify lessons learned, and point out where historical costs for RE may not necessarily reflect future costs for RE.

4.1 Cost of REST Over Time

4.1.1 APS

As shown in the chart below, APS REST expenses have fluctuated over time, but remained within a stable range. Key drivers of costs from year to year include: 1) the ramp-up and subsequent elimination of DG incentives (particularly those associated with non-residential solar production-based incentives); 2) the completion of the Solana CSP plant; and 3) the completion of APS-owned RE generation resources that were subsequently moved into base rates (meaning they are no longer funded through the REST surcharge).

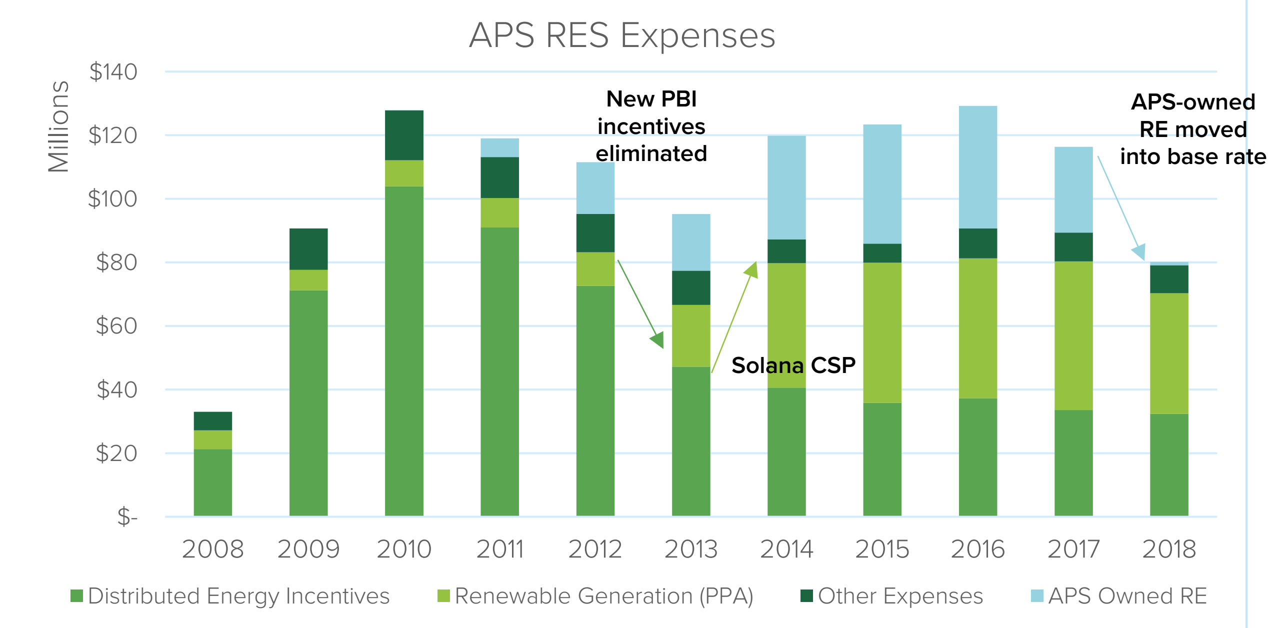

Figure 17. APS REST expenses

To understand the magnitude of these expenses, it is useful to visualize them along with the annual fuel and purchased power costs as reported by APS parent company, Pinnacle West, for the years 2011 to 2018.

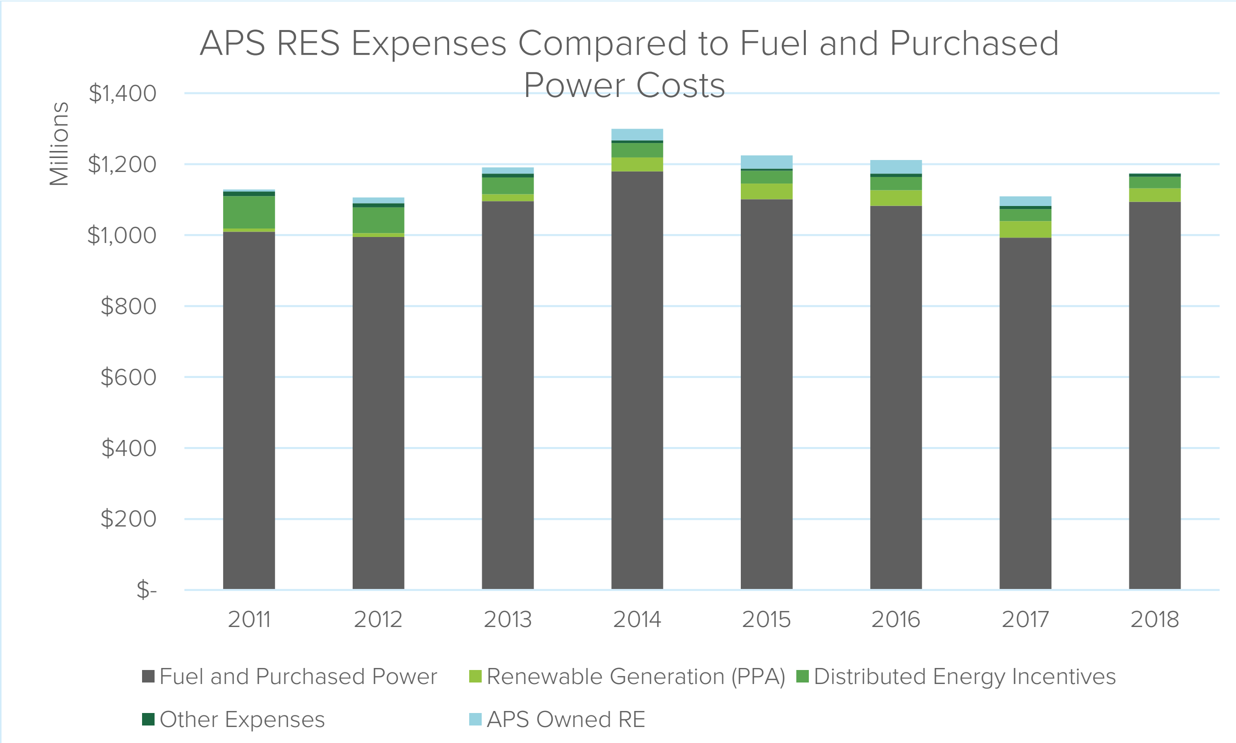

Figure 18. APS REST expenses with Fuel and Purchased Power Costs.[50]

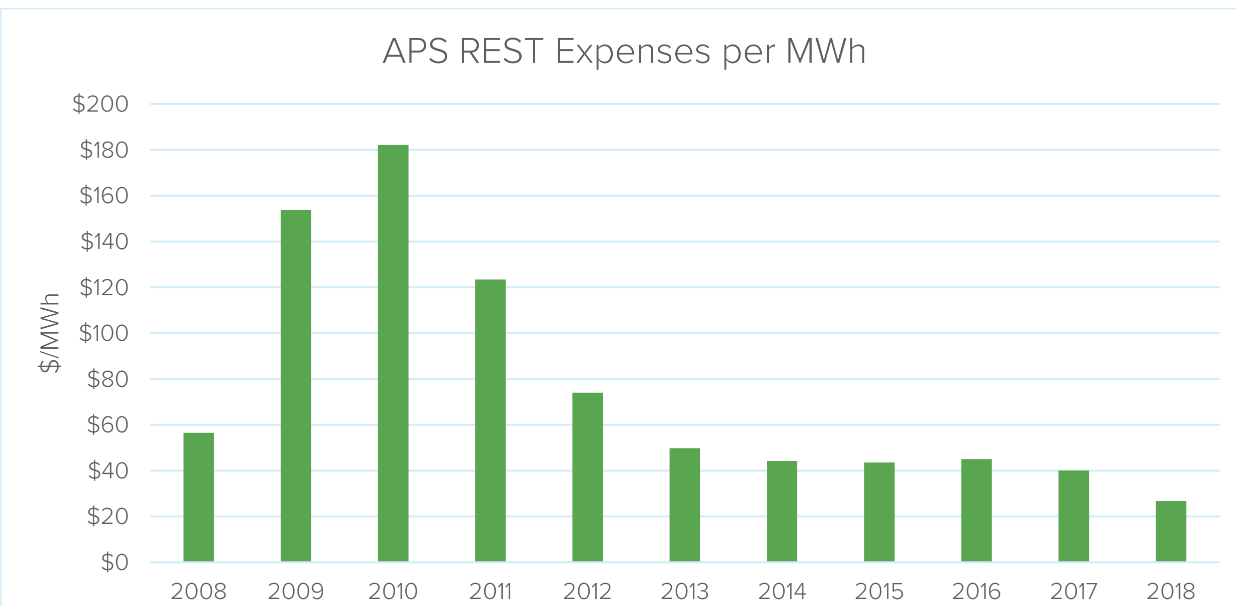

Figure 19. APS REST expenses per MWh. Note that this does not reflect any RE-related cost that are recovered through base fuel rates. Some costs for utility-owned RE generation that were initially recovered through the REST have been transferred to base rates.

[50] Pinnacle West Capital Corporation, *Annual Statistical Report*. http://www.pinnaclewest.com/investors/reports/default.aspx

4.1.2 TEP

TEP REST expenses have increased in recent years, primarily due to increased renewable generation program costs. Meanwhile, DG incentive costs have remained flat after a steady decline in the early 2010s.

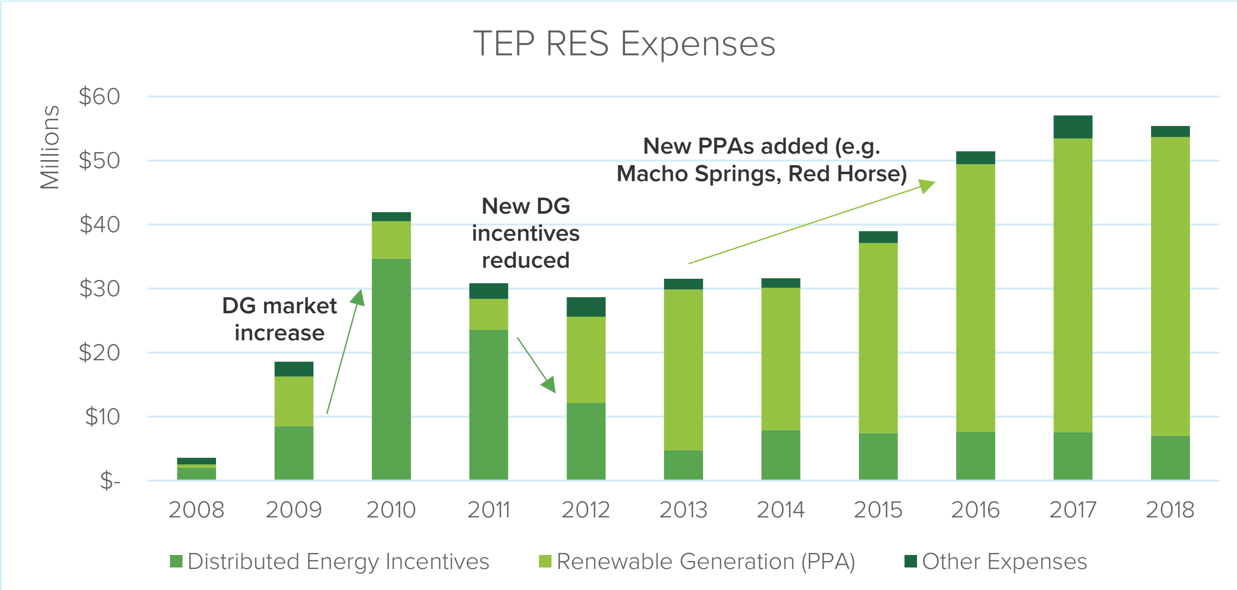

Figure 20. TEP REST Expenses.

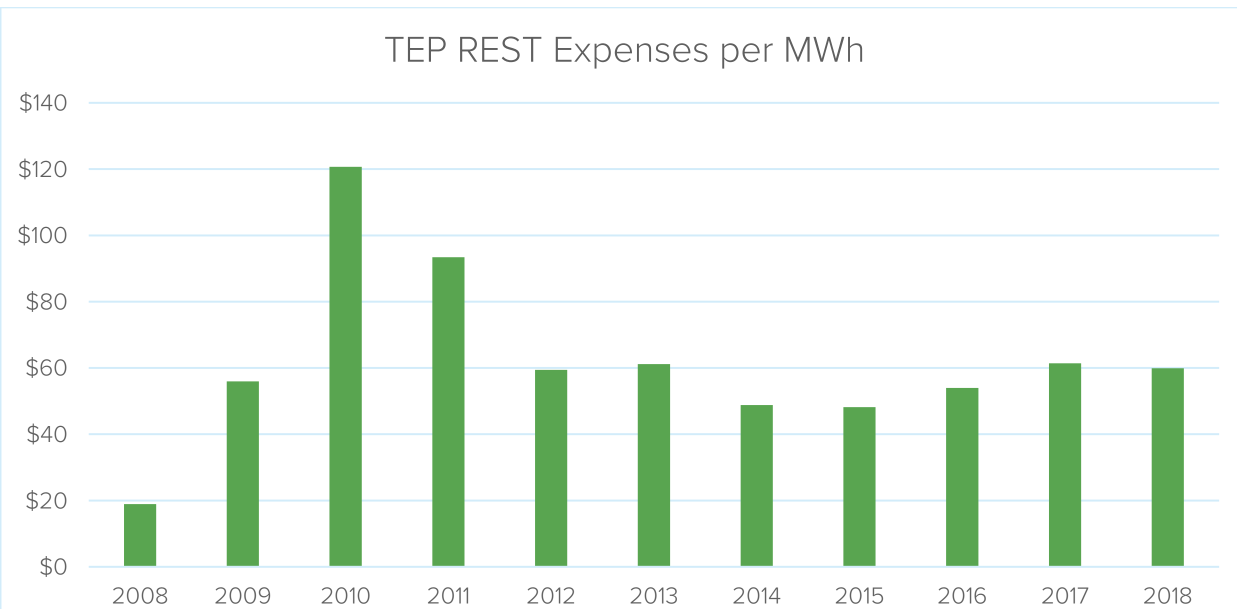

Figure 21. TEP REST Expenses per MWh. Note that this does not reflect any RE-related cost that are recovered through base fuel rates. Some costs for utility-owned RE generation that were initially recovered through the REST have been transferred to base rates.

4.2 Bill Impacts

Customer bill impacts of the REST programs were estimated for both APS and TEP. Generally, REST surcharges have typically remained within the $3-4/month range for APS and $3-5/month range for TEP, or no more than 5% of the total monthly bill. Individual customer bill impacts have also been limited due to a monthly REST surcharge cap that was approved by the ACC.[51] Thus, the REST surcharge cannot exceed a certain predetermined level each month, with many customers that have higher energy consumption paying the full capped amount. Meanwhile, the average REST surcharge has remained a small fraction of the overall retail bill.

4.2.1 APS

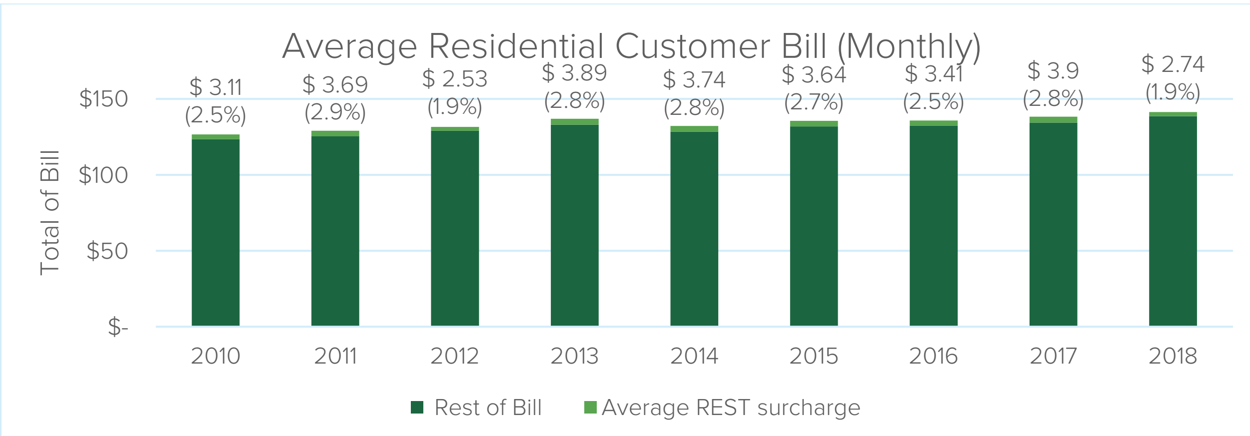

Figure 22. Average APS customer bill with REST surcharge breakdown.[52]

4.2.2 TEP

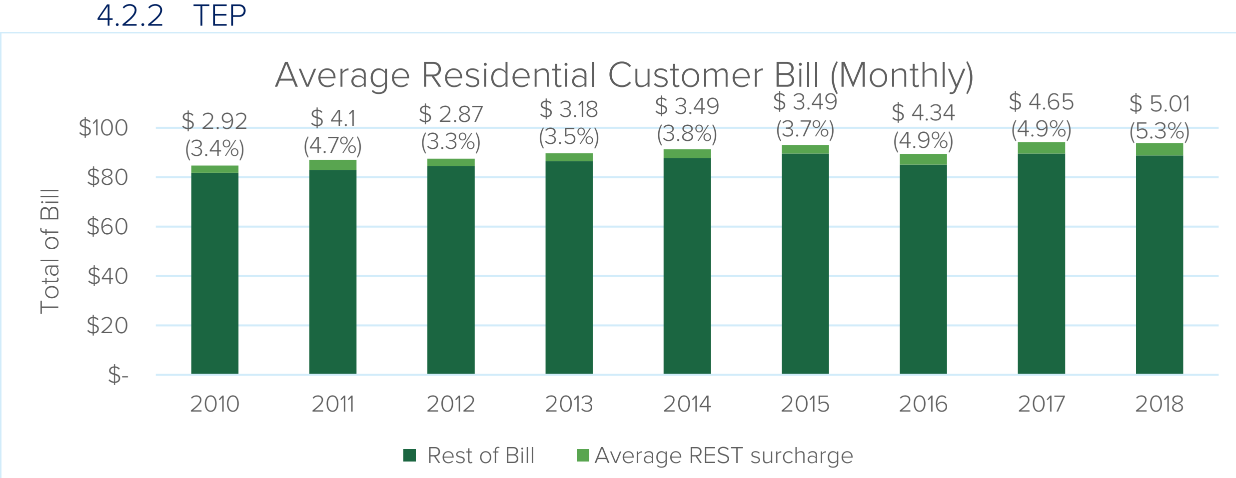

Figure 23. Average TEP customer bill with REST surcharge breakdown[53].

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[51] Monthly caps on the residential REST surcharge were reported for APS and TEP the RES Implementation plans. Average REST surcharges for APS were reported from years 2016 through 2018. These surcharges were, on average, 91.11% of the monthly surcharge cap. Surcharges before 2016 were estimated by assuming the same relationship.

[52] Total revenues per average residential customer are reported by Pinnacle West in their Annual Statistical Reports. These were used to determine annual and monthly bills for average residential customers. Average REST Surcharges were reported in recent Implementation Plans.

[53] Average TEP customer bills estimated using annual residential electric sales, average revenue per kWh and average number of retail customers reported in 10-K forms. Surcharges were estimated to be 91.11% of the monthly surcharge cap (assumes similar relationship to APS customers).

4.3 Legacy RE Cost Items Unlikely to be Reproduced

Under Arizona's current REST, two major historical RE cost categories exist that are unlikely to be representative of future RE deployments:

- Committed Performance-Based Incentive ("PBI") payments for non-residential DG
- Committed Power Purchase Agreement ("PPA") payments for concentrating solar power (CSP) with thermal storage

Both cost items are extremely unlikely to be incurred going forward if additional RE deployment were pursued for the following reasons:

- The only CSP plant deployed in Arizona was the Solana Generating Station, which part of a federal loan guarantee program under the American Recovery and Reinvestment Act ("ARRA"). At the time, this was a novel and promising technology with the advantage of being able to store energy and generate electricity after sunset. However, since Solana was approved in 2009, solar PV has emerged as a more competitive form of solar generation. CSP is thus unlikely to be pursued further due to higher costs (versus solar PV plus battery storage) and the lack of similar financing mechanisms.
- Incentive programs for DG have been phased out in Arizona and are unlikely to be reinstated. Committed PBI payments prior to 2014 are currently being amortized (e.g., over a 20-year period). More than 50% of existing commitments have been paid off.

As an illustration, the table below highlights these two major legacy costs items as a portion of the ongoing APS REST program budget. As shown, these two items comprise a significant share, approximately 72% of the current APS REST program budget, while accounting for only 32% of total expected REST production.[54] However, as noted these costs are not very representative of RE costs going forward. In fact, most of the renewable energy delivered through the REST is paid for by only a small portion of the total budget, which we estimate to be less than a $1.00 monthly bill impact.

Table 9. Legacy Costs vs. Total REST Program Budget (APS)

REST Resource	Total 2020 Program Budget ($M)
Renewable Generation – Total	$40.8
Solana CSP (est.)	*$30.4*
Customer Sited DG – Total	$36.6
2009-2013 non-residential PBI Payments (est.)	*$32.0*
Total 2020 REST Budget	$86.3
Solana + 2009-2013 PBIs	*$62.4 (72%)*

These other REST project costs are more representative of future deployments (e.g., for utility-scale solar PV) and are also much smaller costs both overall and on a $/MWh basis, and have been relatively competitive with conventional resources. Going forward, it is expected that incremental

[54] 32% based on 3,294 GWh total REST production, 845 GWh from Solana, and 195 GWh from non-residential PBI. Data from 2020 APS RES Implementation Plan.

amounts of these types of RE costs will continue to become ever more competitive with conventional resources, and even less costly in many cases.

4.3.1 Solana CSP

The Solana Generating Station located in Gila Bend, AZ is a 280 MW concentrating solar thermal plant that uses parabolic trough mirrors to heat a fluid system that powers steam turbine generators. It also includes a molten salt thermal storage system with six hours of storage that allows power to be generated well after sunset. The plant first became operational in 2013 and is a significant proportion of APS total RE portfolio. In the late 2000s, when the plant was first contemplated, it was less clear which type of solar technologies would ultimately prove to be most cost-competitive, and solar thermal was a novel and promising technology. Since then, solar PV has advanced to become the dominant form of solar energy in the market, in addition to becoming one of the lowest-cost forms of any generation technology. Meanwhile, solar thermal technology has advanced much less rapidly and remains a much higher-cost form of RE. In addition, battery storage technology, which can be readily paired with solar PV, has also advanced more rapidly in terms of cost than molten salt as a form of energy storage. The Solana plant was also unique in that it benefited from a federal loan guarantee program that was part of the ARRA – a program that is no longer available. Given these factors, we find it highly unlikely that many new solar thermal plants will be built in the near future.

4.3.2 Distributed Generation Incentive Programs

Like all forms of energy, RE resources have benefited from incentive programs aimed to encourage the development of new technologies. However, unlike many of the persistent subsidies for conventional fossil fuel energy (e.g., depletion allowances for oil and gas), those that apply to renewables have been designed to phase down over time. Some of the major incentives for RE deployment have included federal tax credits, such as the investment tax credit (which typically applies to solar PV projects) and the production tax credit (which typically applies to wind projects). Both tax credits are scheduled to phase out over the next few years.

In addition to these, some incentive programs have been developed at the state or utility level. In Arizona, utilities subject to the REST historically used incentive programs for DG in order to ensure compliance with the DG carve out provision of the REST. Today, these incentive programs have been phased out for new DG projects.

Historically, two main forms of DG incentive programs were used in Arizona for this purpose: 1) upfront incentives (UFI) which were primarily used to encourage adoption of residential rooftop solar PV; and 2) PBIs which were primarily used to encourage adoption of non-residential solar systems. The chart below shows the gradual decline in APS' UFI program, which reached $0/W by 2014.

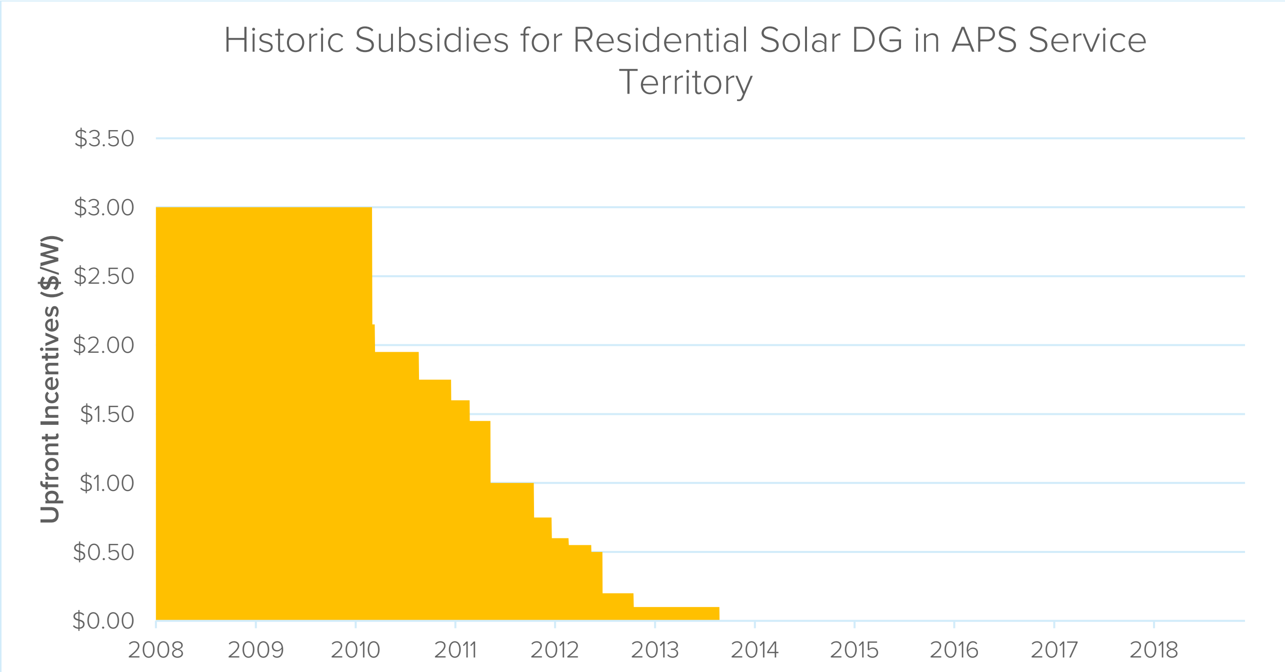

Figure 24. Upfront Incentives for distributed energy declined to zero in the 2014 timeframe.[55]

For the PBI program, incentive payments were committed for new projects deployed from 2009 to 2013 but have been eliminated for projects deployed since then. These incentive payments were typically committed for a period of about 10 or 15 years. As such, some of the PBI payments for these earlier projects are still being paid out today. However, this remaining commitment is declining each year and should be largely paid off within the next decade.

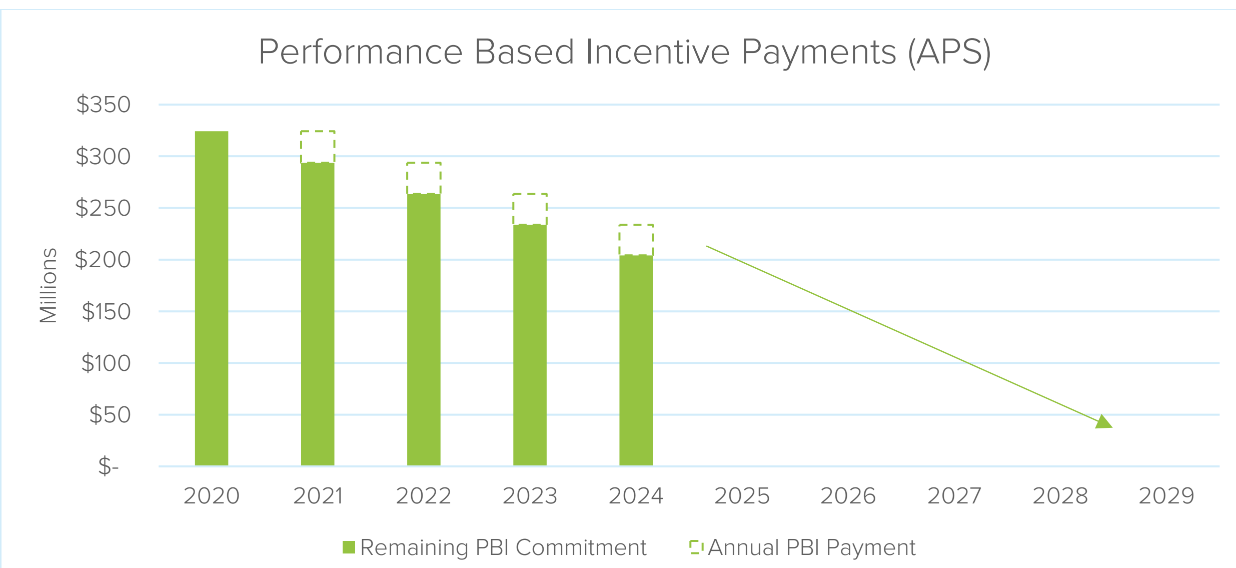

Figure 25. Committed Performance Based Incentives (PBI) for DG will be paid off over next several years[56]

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[55] APS, *2013 REST Compliance Report.* https://docket.images.azcc.gov/0000152762.pdf

[56] APS, *2020 REST Implementation Plan*, Exhibit 3C. https://docket.images.azcc.gov/0000198837.pdf

4.4 Historical versus recent costs for new RE projects

In addition to the legacy items described previously, the cost for competitive RE resources has also shifted dramatically over the last decade. Accordingly, recent estimates for new RE project costs are significantly lower than reflected in the current RE resource portfolio Arizona utilities have developed to meet the REST requirements. We estimate that going forward, new RE resources would be two to three times less costly than some of the existing RE resources in the REST portfolio, and in many cases less costly than existing conventional resources (e.g., coal) or new conventional resources (e.g., new natural gas).

The chart below illustrates estimated historic costs (based on publicly available information) from a representative sample of existing Arizona RE generation resources and a selection of new RE resource bid prices received by an Arizona utility (TEP). While some information in the relevant reports has been redacted due to confidentiality, this represents a best approximation of relevant costs using public data.

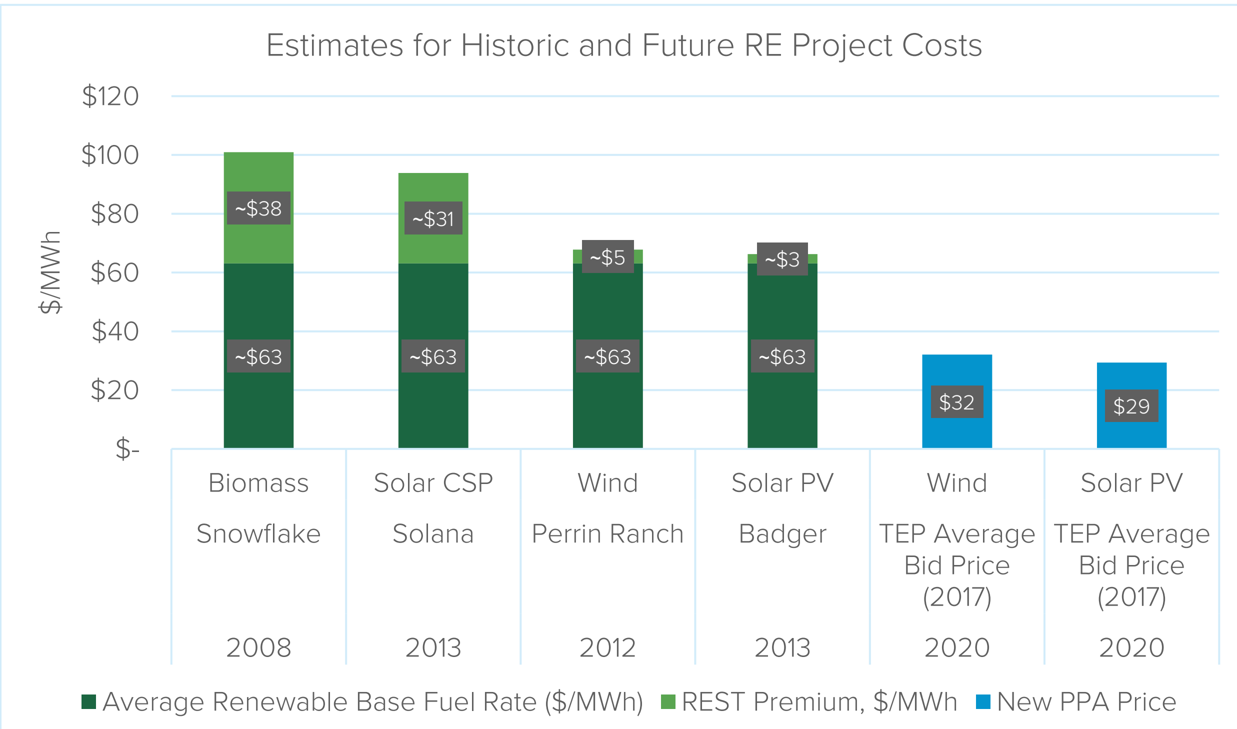

Figure 26. Total estimated RE resource costs for selected existing RE projects (green) included APS' REST portfolio compared to total RE resource costs for new RE projects (blue) based on average bid prices received by TEP.[57] Existing RE resource project costs were approximated based upon a combination of above market "REST Premium" generation resource costs (light green) [58] recovered through the REST surcharge and average base RE costs (dark green) recovered through APS' base fuel rate.[59]

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[57] Tucson Electric Power & UNS Electric, Inc., *Response to the Notice of Inquiry.* https://images.edocket.azcc.gov/docketpdf/0000187768.pdf

[58] Detailed above market RE cost data are reported by APS in annual REST Compliance Reports and implementation plans but are redacted as "competitively confidential." For this analysis, above market costs for each project were estimated from APS' 2020 REST Implementation Plan using the 5-year projected RES costs reported in Exhibit 3B and 5-year projected generation (MWh) in Exhibit 2A.

[59] The remaining portion of RE resource costs not recovered through the REST surcharge are recovered through base fuel rates. For APS these base fuel rates were updated as part of its 2017 general rate case (Docket No. E-01345A-16-0036).

4.4.1 TEP Cost of Energy by Resource Type (2020 – 2030)

In addition to the reduction in costs for new RE resources compared to past RE projects, RE also performs better than conventional resources. Figure 27 illustrates this using data compiled by TEP.

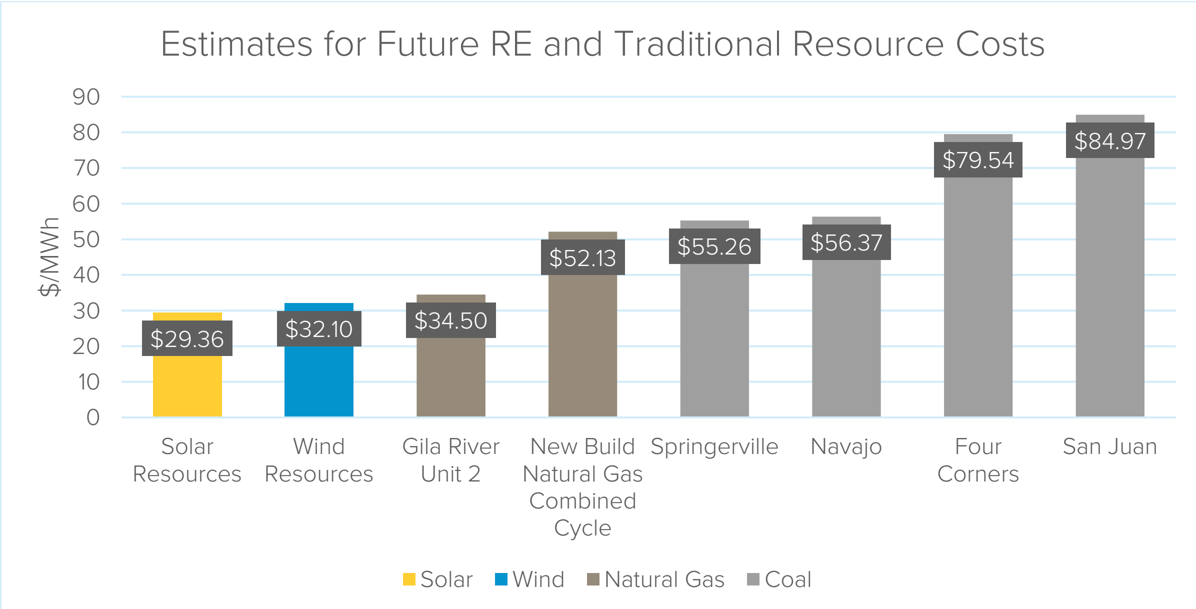

Figure 27. Cost Comparison Chart from TEP's Response to a Notice of Inquiry[60]. Cost comparisons based on TEP's price projections for its coal facilities. Renewable cost estimates are based on data from TEP's competitive bidding processes and recent requests for proposals.

Caveats on Future Cost Analysis

While the cost analysis above shows a promising future for renewable resources, a few caveats must be considered when making these types of comparisons:

- The costs shown are partly reflective of two key federal tax credits (investment tax credit for solar, and production tax credit for wind) that are due to phase down over the next few years.[61] Thus, there may be a modest increase in some project costs in future years. However, these increases will likely be offset by continued technology cost declines (particularly for solar PV). Additionally, both tax credits have "safe harbor" provisions that may enable them to be applied to projects that have undergone development or equipment purchases prior to the expiration dates. The IRS has provided guidance on what projects may qualify for these provisions which could allow these tax benefits to extend several years into the future.

Attachment PME-4DR of APS' application in this case shows actual renewable base fuel costs in the 2015 test year to be $131 million for 2,323 GWh produced, or approximately 6.27 cents/kWh ($63/MWh). This reflects an average of all RE generation and individual project costs may differ from what is displayed in the chart. Additionally, these renewable base fuel costs include generation associated with company owned facilities which may differ substantially from renewable resources purchased through a PPA.

[60] Tucson Electric Power & UNS Electric, Inc., *Response to the Notice of Inquiry.* https://images.edocket.azcc.gov/docketpdf/0000187768.pdf

[61] The Taxpayer Certainty and Disaster Tax Relief Act of 2019 extended the production tax credit to 60% of its original value for projects that commence construction in 2020. Meanwhile, the 30% investment tax credit for large commercial projects is schedule to phase down to 10% by 2022, though projects that claim safe harbor may be able to receive full credit if they are completed within four years.

- The resource costs shown do not necessarily factor in certain costs for transmission upgrades or renewable integration, which may be needed in some cases to deliver RE resources to load. In some cases, existing transmission lines that no longer serve conventional fossil fuel resources could be repurposed.

Despite these issues, we believe the costs shown are indicative of the new paradigm of competitive RE resources.

4.5 Net Benefits of the REST

As explained in Section 4, the cost of RE resources in Arizona has declined substantially over the course of the last decade under the REST. Thus, while the historical costs of RE have been high, this dynamic will not necessarily hold true for future RE deployments due to technology improvements.[62]

Recent estimates for RE resource costs are now much lower than they have been historically, and lower in many cases than conventional alternatives. Meanwhile, the benefits accrued over the history of the REST are anticipated to scale up in a similar fashion as additional RE is deployed. While it is difficult to know precisely what the specific benefits of RE might be on a per-unit basis (e.g., $/MWh, or future avoided energy costs per MWh of RE), Strategen assumes the benefits will be similar in terms of orders of magnitude to those realized in the last decade. Similarly, while there is no perfect prediction for the cost of RE resources in the future, it is reasonable to assume that the underlying technology costs will be lower than historical levels. In fact, if the REST program were replicated again using current RE technology costs, we estimate that the cumulative net benefits would be on the order of $670 million or greater for APS alone.[63]

As shown in the figure below, the estimated benefits for RE deployment exceeded actual costs in 2018 and this trend is anticipated to continue into the future.[64] To understand this trend, it is instructive to explore a future scenario to understand how benefits will compare to costs moving forward. Although somewhat speculative, this exercise provides insight into what future RE deployments could bring (e.g., with an increase in the RE requirement). To perform this analysis, REST-related benefits were computed for APS using a method identical to that presented in Section 3.2 for the past, and then projected to the future assuming a benefit per MWh equal to the historic average. However, given the dramatic reduction of renewable technology costs over the last decade, we assumed RE technology costs will be substantially lower for new deployments. These lower costs may be partially offset by the phase out of federal tax credits over the next few years but are still expected to be lower than historical levels.[65]

Assuming a 0.5% load growth and a 45% REST target, we estimate that the deployment of renewable resources could result in $1 billion of net benefits from generation-related costs in the next ten years

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[62] Note that the comparison of historical costs and benefits in this study includes relatively conservative assumptions for certain inputs. For example, the assumed benefit of CO2 reduction is lower than many estimates, such as those adopted into law in Colorado. Meanwhile, the assumed avoided capacity costs are based on capital costs that are lower than those for projects recently constructed by APS and TEP.

[63] Assumes REST-related benefits identical to those computed in Section 3.2, and RE costs similar to those recently reported for wind and solar PV deployed in 2020 as reported by TEP. For firm resources (e.g. CSP, biomass), a solar + storage resource was assumed with a cost of $60/MWh).

[64] Under a scenario with less conservative CO_2 benefit (e.g. $52/ton), positive net benefits were also observed in 5 out of the 6 most recent historical years.

[65] For this analysis, the projected total cost of future RE deployment was based on the TEP future cost data presented in the above section (assuming a 15% increase to the wind costs in future years, due to the phase-out of the tax credit).

for APS.[66] The calculated net benefits will further increase if technology costs continue to decline below the TEP estimates.

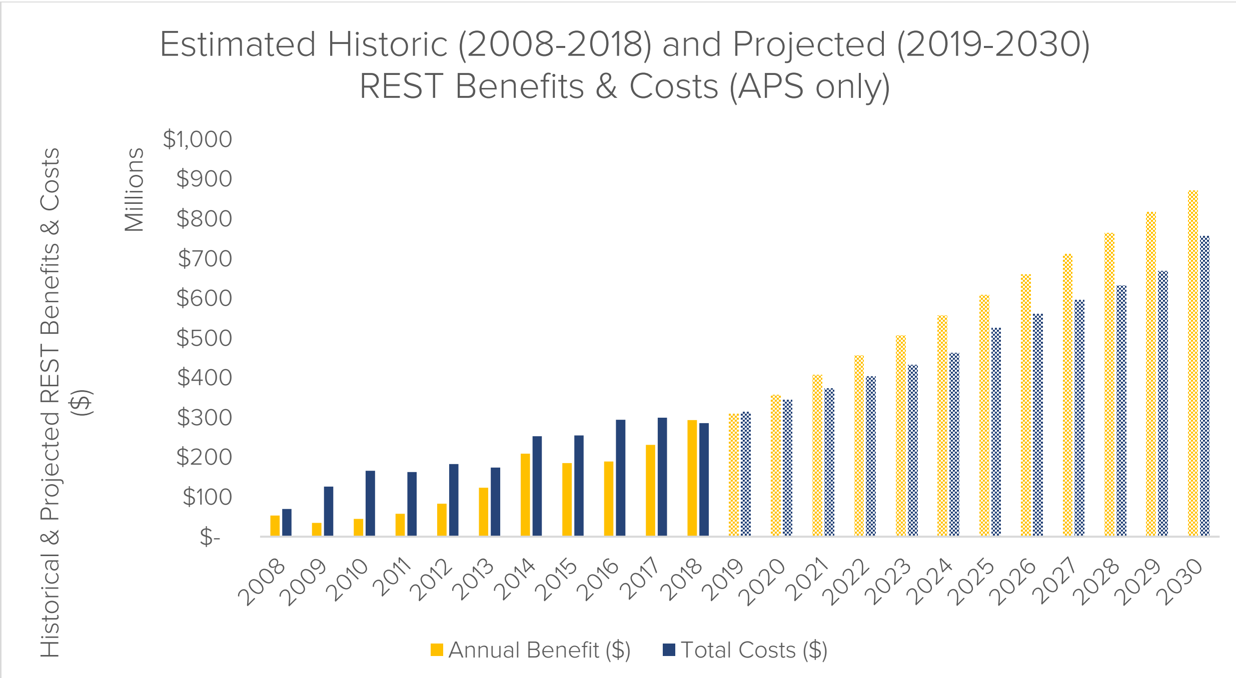

Figure 28. Historical and Projected REST Benefits and Costs

[66] Does not include additional transmission costs that may be necessary to accommodate additional renewable energy deployment.

5. Conclusions

Arizona's REST target ranks seventh out of eleven states in the region, and of the Western States that do have a binding renewable or clean energy requirement, it ranks last. This position makes the state much less competitive than its peers for attracting investments from global corporations that increasingly have ambitious Environmental, Social, and Governance (ESG) goals which require cleaner sources of energy.

Nonetheless, the state's efforts through the REST policy have shown significant benefits to date. The Arizona utilities subject to the REST, (e.g. APS and TEP), have been able to acquire benefits from avoided energy and generation costs, water savings, pollution reduction and technology cost reductions, while the state has seen benefits from increased investment and local job creation.

In addition to monetizable benefits, the expansion of renewable resources to utility energy generation portfolios provides other benefits that are difficult to assign a monetary value. For example, a diverse generation portfolio provides a natural hedge against potential future fuel price volatility and brought local investments and jobs to the state.

Based on the analysis of the monetizable benefits, implementation of the REST by APS has yielded over $1.5 billion in gross benefits, while implementation by TEP has yielded over $469 million in gross benefits for nearly $2 billion in gross benefits state-wide. These benefits are expected to increase over time as the RE resources already deployed will continue to produce emissions savings and avoided energy costs well into the future, without additional costs.

It is sensible to presume that future benefits from the REST will be of a similar order of magnitude to those realized in the last decade. The cost of renewable resources in Arizona has declined substantially over the course of the last decade under the REST. Thus, in potential future iterations of the policy, technology costs will be a less significant factor, especially as legacy costs (i.e., early large-scale renewables and DG incentives) which have dominated the early REST costs are paid off over time.

Going forward, Strategen anticipates that additional deployment of RE resources could yield significant net benefits. For example, if the REST program to date were replicated using current RE costs, our estimate is that the cumulative net benefits would be on the order of $670 million or greater for APS alone. As Arizona considers new policy options, the significant net benefits resulting from the REST make the adoption of more ambitious clean energy targets a promising policy to further reduce emissions, protect public health, provide cost savings to ratepayers, spur economic development across the state, and establish Arizona as a renewable energy leader in the Western United States.

STRATEGEN

Appendix A: Methods and Data Sources

1. Data Sources and ACC Reporting Requirements

Utilities subject to Arizona's REST are required to file annual REST Implementation Plans ("IP") and annual RES Compliance Reports ("CR") with the ACC. These documents provided much of the data and information used to carry out the analysis of this study. Strategen relied upon information included in these reports including the following:

- REST Resources
  - Capacity (MW)
  - Annual production (total MWh)
- REST Program Revenue & Expenses
- DG Program Incentive Costs
- REST Tariff Adjustments

The table below provides links to all these reports for APS and TEP.

Table 10. Links to Compliance Reports and Implementation Plans.

Year	APS	TEP
2008	IP I CR	CR
2009	IP I CR	IP I CR
2010	IP I CR	IP I CR
2011	IP I CR	IP I CR
2012	IP I CR	IP I CR
2013	IP I CR	IP I CR
2014	IP I CR	IP I CR
2015	IP I CR	IP I CR
2016	IP I CR	IP I CR
2017	IP I CR	IP I CR
2018	IP I CR	IP I CR

2. Benefit and Cost Evaluation

The REST was evaluated in terms of both costs and benefits. Benefits include those that can be readily quantified, such as avoided energy costs, as well those that reflect broader policy objectives, like technology cost reductions. Costs can also be considered from multiple perspectives. For example, the REST surcharge is designed to recover the incremental cost of RE resources that are considered to be "above market" or in excess of conventional resource costs.

These costs generally include incentive payments for distributed resources, as well as the portion of large-scale resources deemed to be above the marginal cost of comparable conventional generation. Marginal cost of comparable conventional generation can be estimated by examining the hourly marginal production cost of energy during the times RE resources are generating.

In addition to these above market costs, a portion of renewable generation resource costs are also recovered in base fuel rates. Base fuel rates are intended to recover fuel and purchased power costs and includes some amount of RE costs that are not considered to be in excess of market costs for conventional resources. Additionally, the renewable component of base fuel costs includes some amount of utility-owned generation.

Below is a more complete list and description of the benefits and costs evaluated. All dollar values reported are in nominal dollars and have not been adjusted for inflation.

REST Benefits Evaluated

- Avoided Conventional Energy Costs
  - Reduced fuel consumption (e.g. coal, natural gas)
  - Reduced variable operations and maintenance costs
  - Reduced line losses (for distributed RE)
- Avoided Conventional Capacity Costs
  - Reduced natural gas peaker plant needs
- Emissions Reductions
  - Reduced CO_2 Emissions
  - Reduced Criteria Pollutant Emissions (NO_x, SO_x, PM2.5)
- Water Savings
- RE Technology Cost Reductions
- Local Investment & Jobs

REST Costs Evaluated

- Total RE Costs
  - REST program expenses
    - "Above market" cost of RE generation
    - DG incentive costs
    - Other program administration costs
  - RE costs in base fuel rates

3. Net Benefits

To estimate future net benefits, Strategen first projected future renewable energy deployment and its associated benefits and costs. Future RE deployment was based on a 0.5% load growth for APS, and a linear increase of RE penetration reaching 45% of the load by 2045. Total RE benefits were calculated based on the historical benefit per MWh averaged over years 2008-2018 and multiplied by the projected annual renewable generation. Benefits on a per-unit basis consist of avoided costs and can thus fluctuate with natural gas prices or to a lesser extent with market saturation with renewable resources. Averaging the per-unit benefit over the last ten years provides a reasonable proxy for future benefits and captures some of that fluctuation which has occurred in the past.

Total costs were calculated as the sum of costs from historical and future deployment. For past installations the 2018 base cost and REST expenses were assumed to persist until 2045, while the cost of RE from new installations was based on a projected cost per incremental MWh. This cost was calculated as a blended average of the TEP reported bid prices, assuming 20% wind resources, 50% solar, and 30% firm resources.67 After 2025, the incremental cost was assumed to increase by 15% to reflect the phase out of tax credits. The projected net benefits are shown in Figure 28 and amount to a billion dollars over the years 2020 to 2030 for APS.

[67] For firm resources, a solar + storage resource was assumed with a cost of $60/MWh

Strategen
Berkeley, CA | Portland, OR
+1 510-665-7811
info@strategen.com
www.strategen.com