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BEFORE THE ARIZONA CORPORATION COMMISSION

TOM FORESE CHAIRMAN	BOB BURNS COMMISSIONER	DOUG LITTLE COMMISSIONER
ANDY TOBIN COMMISSIONER	BOYD DUNN COMMISSIONER	

IN THE MATTER OF THE APPLICATION OF ARIZONA PUBLIC SERVICE COMPANY FOR A HEARING TO DETERMINE THE FAIR VALUE OF THE UTILITY PROPERTY OF THE COMPANY FOR RATEMAKING PURPOSES, TO FIX A JUST AND REASONABLE RATE OF RETURN THEREON, TO APPROVE RATE SCHEDULES DESIGNED TO DEVELOP SUCH RETURN.	**DOCKET NO. E-01345A-16-0036** **DOCKET NO. E-01345A-16-0123**
IN THE MATTER OF FUEL AND PURCHASED POWER PROCUREMENT AUDITS FOR ARIZONA PUBLIC SERVICE COMPANY.	**ENERGY FREEDOM COALITION OF AMERICA'S NOTICE OF FILING REDACTED DIRECT TESTIMONY (RATE DESIGN) OF JAMES A. HEIDELL**

Energy Freedom Coalition of America ("EFCA") hereby provides notice of filing the Redacted Direct Testimony (Rate Design) of James A. Heidell in the above referenced matter. A copy of Mr. Heidell's un-redacted Direct Testimony will be provided to the Legal Department and to Arizona Public Service Company ("APS"). Parties who have signed the APS Protective Agreement will be able to view the confidential portion of Mr. Heidell's testimony by accessing the APS Rate Case website.

Respectfully submitted this 3rd day of February, 2017.

/s/ Court S. Rich
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Attorney for Energy Freedom Coalition of America

Original and 13 copies filed on the 3rd day of February, 2017 with:

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Docket No. E-01345A-16-0036 & E-01345A-16-0123

DIRECT TESTIMONY OF JAMES A. HEIDELL

On Behalf of Energy Freedom Coalition of America

February 3, 2017

REDACTED Confidential Information

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I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q. Would you please state your name, affiliation, and address?

A. My name is James A. Heidell. I am a Director at PA Consulting Group. My business address is 1700 Lincoln Street, Suite 1550, Denver, CO 80203.

Q. On whose behalf are you filing this testimony?

A. I am filing this testimony on behalf of Energy Freedom Coalition of America.

Q. Please summarize your background and experience.

A. I have worked in the energy industry for the past 35 years primarily specializing in electricity and utilities working on issues related to resource planning, rates, analysis of electricity markets, and the analysis of the economics of financial transactions for utilities and wholesale generation. My academic background includes a BSE in civil engineering from Tufts University, a MS in engineering economics from Stanford University, and an MBA in finance from the University of Washington. I am a Chartered Financial Analyst.

My work experience includes ten years at Puget Sound Energy in various positions in the regulatory and financial planning departments. For the past 15 years I have worked primarily at NERA Economic Consulting and PA Consulting on matters related to utility regulation, modeling of the economics of wholesale market transactions, and economic analysis of alternative energy. My C.V. is provided as Attachment JAH-1.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to demonstrate how current and future residential and small commercial customers with distributed solar facilities (rooftop solar, or distributed generation) are being unfairly discriminated against through APS' proposed cost allocation and rate design. My analysis is divided into four major topics.

- First, I evaluate the cost of service study put forth by Arizona Public Service Company (APS, or the Company) and propose changes to the Company's proposal to better align cost causation with cost recovery, i.e. the portion of the revenue requirement assigned to each customer class.
- Second, I evaluate the rate design that APS proposes to apply to non- grandfathered customers with rooftop solar.
- Third, I propose an electric-storage friendly rate option.
- Fourth, I analyze the continued viability of rooftop solar under the APS rate proposal for non-grandfathered customers who are interested in installing on-site distributed generation.
- Finally, I review various APS programs and policies as they relate to customers with rooftop solar.

II. SUMMARY OF DIRECT TESTIMONY

Q. Please provide a summary of the findings in your testimony that support the Commission's adoption of your proposed cost of service and rate design for non-grandfathered on-site distributed generation customers.

A. Based upon my professional experience, review of documents in this proceeding, and analysis that I have conducted, I conclude the following.

1. APS' ECOSS

i. While the Commission in Docket No. E-00000J-14-0023[1] concluded that rooftop solar customers should be in a separate rate class, my recommendation is that for cost of service and rate design purposes they should not be treated as a separate rate class, for the following reasons: 1) the electricity usage of these customers is similar to the usage of the larger residential classes they are currently part of, 2) no customer should be discriminated against based upon the types

[1] Attachment JAH-4

of investments and actions that they take to control how much and when they purchase electricity from the utility, 3) there is a wide variation of electricity use and load factors among the (non-rooftop solar) residential customers due to residential dwelling size and patterns of occupancy and those customers are not put into separate rate classes, and 4) any customer that uses multiple energy resources or switches an appliance from electricity to natural gas is a partial requirements customer of APS, and 5) it is discriminatory to separate out only partial requirements customers that use rooftop solar to meet part of their energy demands.

ii. APS erred in its cost of service study when it allocated costs to distributed generation customers based upon those customers' total electric usage (defined by APS as "site loads") versus the electric usage they actually purchase from APS ("delivered loads"). APS currently has over 55,000 residential rooftop solar customers and in this rate case has analyzed the hourly data of over 37,000[2] such customers. This group of customers is large enough to adequately capture the actual collective contribution made to the demands on the APS system. The proposed APS treatment is discriminatory in that no other group of customers are allocated costs based upon hypothetical demands or consumption that they otherwise would use but for taking action to reduce or control how much electricity they purchase from the utility.

iii. The allocation of distribution system costs based on non-coincident peak demand does not effectively match cost allocation with cost causation for the distributed generation customers. Rooftop solar customers peak later than both non-rooftop solar customers and typical distribution substations. Distribution substations and the primary distribution system are designed to meet the peak ***coincident*** demand on those facilities.

iv. The APS calculation of any unique costs associated with new rooftop solar customers going forward is incorrect since the revenues used are based on total site loads rather than delivered loads, and also do not reflect the pro forma revenues that will be recovered based upon charging for delivered load.

v. The APS calculation of the alleged unique costs associated with grandfathered net energy metering (NEM) customers is overstated since it does not account for the customer

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[2]Attachment JAH-5

funded benefits that accrue to the utility due to reduced power purchases and reductions in peak use of the utility's infrastructure.

2. APS' Proposed Rate Design

i. Rooftop solar customers are not being "subsidized" and therefore should not receive more than the average rate increase. After correcting for the inappropriate cost allocations in the APS embedded cost of service study (ECOSS) and accounting for the value of reduced energy and demand to the utility in a manner similar to how energy efficiency is valued, the class is paying above 100% parity.[3] In comparison, non-solar residential customers are presently paying 87.1% of their cost of service.

ii. The development of applicable rates for non-grandfathered rooftop solar customers is fundamentally flawed since it is based upon the asserted cost of service for what is essentially a non-existent rate class. If and when APS signs up customers under the post net energy metering rate those customers will pay for all their delivered energy, so the Company calculated ratio of costs to revenues is incorrect. When a pro forma adjustment is made to account for the delivered energy, the residential solar customers on energy only rates are at 88.9% of parity at existing rates and residential solar customers on demand rates are paying 110.7% of parity. After factoring in the revenues from the proposed rate increase, the rooftop solar customers are at parity with their cost of service.

3. APS Programs and Policies for Rooftop Solar Customers

i. The imposition of mandatory demand rates for virtually all residential customers is not appropriate and discourages efficient use of electricity. The seasonal on-peak demand proposal is an outdated, blunt approach to sending price signals, as time of use and critical peak pricing are better, more targeted rate design approaches. Even though the utility has large amounts of costs that do not vary with throughput in the short term (kWh consumption), the common practice in the industry is to recover cost incurred on behalf of residential customers on a volumetric basis.

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[3] Workbooks B - 2015TY COSS Working Model.xlsx, Workbook C - 2015TY COSS Working Model.xlsx Workbook A_ Allocation Factors 2015TY.xlsx

ii. Customers with rooftop solar should have the same mix of rate options and access to the same rate schedules as customers without solar. The range of rooftop solar customers' electric consumption and load factors is similar to their non-solar counterparts. These rate options should include the current seasonal inclining block energy rates, TOU rates, and TOU rates coupled with demand rates.

iii. APS's proposed cost of service treatment and rate design treatment for non-grandfathered customers who install distributed energy systems will effectively make new installations of rooftop solar not cost effective in APS' service territory. Ending the growth in rooftop solar is not in the interests of the citizens of Arizona; distributed solar provides economic benefits to all utility customers and economic benefits to Arizona through local job creation and reduced environmental impacts.

4. The Future of Rooftop Solar in Arizona

i. Rooftop solar competition is good for consumers in Arizona and the APS Solar Partner Program should not be expanded under the current APS rate proposal that makes it uneconomic for the private sector to install rooftop solar. The electricity produced by a rooftop solar system is the same regardless of the ownership. However, expansion of the Solar Partner Program would allow APS to install and recover the costs of rooftop solar under the protection of its monopoly status, while ending a competitive industry in Arizona that has created thousands of jobs and offered energy choices to thousands of Arizona citizens.[4]

The APS arguments about cost-shifting are incorrect and reflect a discriminatory approach to embedded cost allocation that inappropriately characterizes rooftop solar customers as being subsidized. Rooftop solar customers who reduce their electricity purchases from APS are exercising the same rights to manage their energy usage as customers who reduce electricity purchases through energy efficiency and switching to other energy sources. In fact, the reduction in annual use from residential solar customers from 2011 – 2015 is on the order of one third of the reduction attributable to residential energy efficiency measures and programs.[5] The

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[4] Attachment JAH-6
[5] Attachment JAH-7

residential customers who participated in programmatic energy efficiency are not characterized as being subsidized or penalized with over-allocation of costs and limited rate choices.

III. CREATION OF A SEPARATE RATE CLASS FOR ROOFTOP SOLAR CUSTOMERS IS DISCRIMINATORY

Q. Are you recommending that the Commission reconsider its treatment of the rooftop solar customers as a separate rate class?

A. Yes. There are variety of ways that a customer can reduce their electricity usage and be a partial requirements utility customer by the definition proposed by APS. Foremost, energy efficiency and demand side management are widely recognized as resources.[6] Therefore, customers utilizing energy efficiency and other demand side management offerings are actually meeting their needs with resources other than just the utility's service. There is no justification for singling out only rooftop solar for reducing consumers' usage and demand. Likewise, by this definition, a customer that reduces their electricity usage by switching heating or appliances to natural gas effectively becomes a partial requirements customer of APS. While these examples do not include customers exporting electricity to the grid, this is not relevant from the cost of service perspective because no specific distribution costs associated with exported energy have been identified.

The treatment of exported energy does not require creating a separate class of customers for the determination of the cost of energy delivered and utility facilities used to serve those customers. Generators are not allocated cost for using the distribution grid to deliver their product and nor should rooftop solar customers. Cost of service is used to allocate the costs of generating and delivering electricity to each class of customers and not for compensating or charging generation sources for injecting power into the utility grid.

The value of exported energy is determined through a separate process just as the value of energy efficiency programs are valued through a separate process – the societal cost test. The

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[6] Attachment JAH-8

payments for excess energy are allocated in the cost of service study but it does not require creating a separate class of customers to allocate the costs.

Q. In an ECOSS study what are the considerations for creating separate rate classes?

A. According to the NARUC Electric Utility Cost Allocation Model, these considerations include: the nature of the service provided, load characteristics, size of load, and voltage characteristics.

Q. Is the service provided to residential customers with and without rooftop solar the same?

A. Yes, both groups of residential customers have 120/240 single phase service from the distribution system and have relatively similar peak loads and usage.

Q. Does the amount of electricity purchased from APS for the rooftop solar customers differ significantly from their non-solar counterparts?

A. No, based upon my analysis of the historical electricity use, there is a wide variation in the use of electricity within the residential customer class and I have found that the subset of rooftop solar customers display a similar variation in use.[7] For example, based on delivered load in the summer, the majority of both the residential solar and non-solar customers purchase electricity in the 750-2,500 kWh per month range, while in the winter a majority of both customer groups typically purchase below 750 kWh per month. This analysis is based on actual APS sales data provided by the Company. A breakdown of summer and winter bill sizes is shown in Figure *1* and Figure *2* respectively. These graphs highlight both the large variation in monthly energy use among residential customers as well as the fact that the range of electricity

[7] Attachment JAH-9

use is similar, with the exception that there are more low volume electricity users in the non-solar group.

Figure 1: Residential Solar and Non-Solar Customer Summer Delivered Consumption

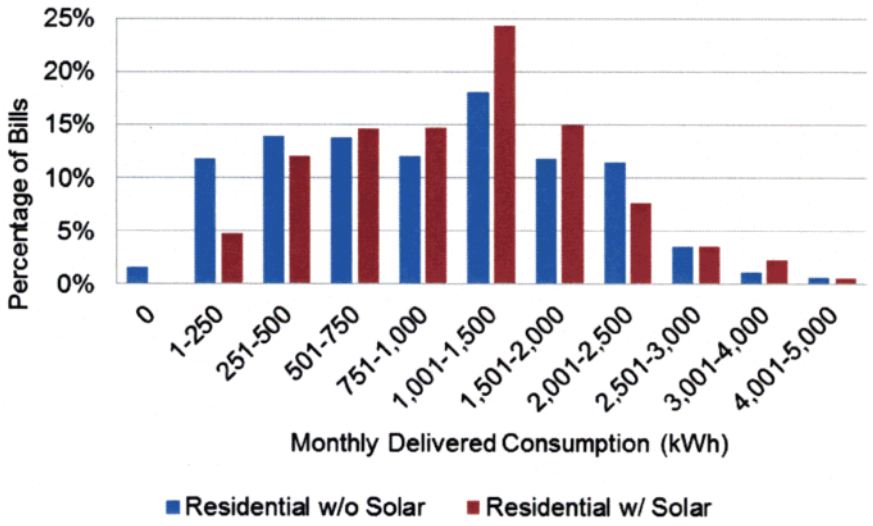
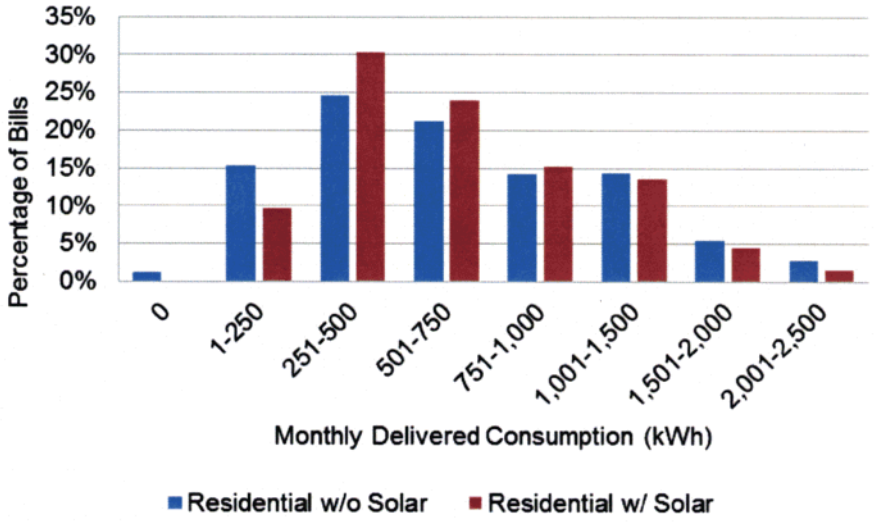


Figure 2 Residential Solar and non-Solar Customer Winter Delivered Consumption



Q. If a customer purchases less electricity from the utility after installing rooftop solar is that a justification for moving the customer to a separate rate class?

A. No, customers can reduce their electricity purchases for a number of reasons including fuel switching, energy efficiency, part-time occupancy, and changes in number of people in the household. However, those customers are not moved to a different rate class. As Figure *1* and Figure *2* demonstrate, there are large variations in consumption among residential customers.

Q. What types of residential customers are low volume users?

A. APS does not appear to have any specific information on the demographics of the low volume users. In my experience, low volume residential service points are a diverse group, including small residential units (often apartments), seasonal use units, smaller (often single person) households, and households with residents that are at the older end of the age demographic.

APS notes that there are approximately 115,000 apartment dwellers, or about 11% of the residential customers, but does not have an indication of the number of winter visitors beyond approximately 5,000 self-reporting winter visitors.[8] A review of 2010 census data for Arizona shows that approximately 6% of all dwellings are for seasonal, recreational, or occasional use. Approximately 6% of the dwellings in the counties that APS serves are also for seasonal, recreational, or occasional use.[9]

Low volume users are not limited to seasonal dwellings and apartments. There are no specific industry criteria for defining what a low volume user is, however, a large number of residential customers pays less than the average fixed cost of serving the residential class.

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[8] Attachment JAH-10
[9] Attachment JAH-12

Q. What proportion of residential customers do not pay their full share of fixed costs?

A. APS in their calculation of fixed cost recovery appears to treat all costs as fixed except the fuel costs. In the long-run all costs are variable.[10] However, using the APS definition I calculate the average annual fixed cost per residential customer to be $1,306. While APS allocates over 85% of the fixed costs on demand not all those costs directly vary with capacity. For example, the cost of digging a trench, laying conduit, setting a pole, service centers, etc. have little if any relationship to whether a residential customer has a peak demand of 3 kW or 5 kW. Therefore the use of $1,306 per residential customer, while not a 100% accurate allocation of cost to each residential customer, is a reasonable proxy for evaluating residential customer contribution to fixed cost recovery. Based upon my analysis roughly 75% of the E-12 customers do not pay their full share of fixed costs and over half the ET-2 customers do not pay their full share. This analysis is summarized in Table *1*.

Table 1 Contribution to Fixed Cost Recovery

	E-12	ET-2
% of All Residential Customers	46%	29%
Average Residential Revenue ($/ kWH)	0.1414	0.1289
Average Fuel cost ($/kWH)	0.0320	0.0320
Average Fixed Cost Recovery ($/kWH)	0.1094	0.0969
Annual Fixed Cost / Residential Customer	1,306	1,306
Average Monthly Consumption Required to Recover Fixed Costs	994	1,123
% of Summer Bills < Average Required Monthly Consumption	76%	38%
% of Winter Bills < Average Required Monthly Consumption	89%	76%

Q. How do the load factors of rooftop solar customers differ from their non-solar counterparts?

A. I analyzed the load factors of rooftop solar customers and compared those against the load factors of the residential class. I have summarized two summer months and two winter

[10] APS response to RUCO 6.11

months in Table *2*.[11] Even though there are differences in the class level load factors, it is also important to recognize that customers within the non-solar residential class have a large variation in load factors, as shown in Table *3*.[12] However, all the non-solar residential customers are treated similarly with regard to not being separated into a different class and not being put on different rates. While there are differences in load factors, the solar customers peak later in the day after the system peak so they *reduce* system costs by reducing peak hour loads despite having a lower load factor.

Table 2: Load Factor Comparison for Solar vs. Non-Solar Residential Customers

Month	Res No Solar	Res Solar Delivered
12	63.0%	53.1%
1	55.8%	45.0%
7	62.8%	47.3%
8	57.2%	44.1%

Table 3 Distribution of non-Solar Residential Load Factors

Load Factor	Monthly Bills	% Bills	Average Load Factor
1-10%	431,034	3.6%	7%
11-20%	2,483,954	20.8%	16%
21-30%	3,520,035	29.5%	25%
31-40%	2,792,840	23.4%	35%
41-50%	1,631,576	13.7%	44%
51-60%	641,940	5.4%	54%
61-70%	224,023	1.9%	64%
71-80%	101,101	0.8%	74%
81-90%	57,485	0.5%	85%
91-100%	35,978	0.3%	95%
Total Bills	11,919,966		31%

[11] Attachment JAH-13
[12] Attachment JAH-14

Q. Do the timing of peak loads for solar customers justify establishing a separate rate class so that cost allocation follows cost causation?

A. No. Rooftop solar customers use less grid energy than non-rooftop customers during the proposed 3 pm to 8 pm TOU peak period and this actually reduces total system costs. Reductions in total load on the APS system during peak hours is creating benefits by reducing the need for energy that is typically more expensive on peak, reducing system peak demands, and reducing loading on transformers. Even though the residential rooftop customers' total solar production diminishes after 5:00 pm in the summer, the systems still produce energy through 7:00 pm, resulting in reductions to APS' peak demand up until 7:00 PM.

An analysis of residential solar system production by month and hour is shown in *Table 4*. *Table 4* shows the ratio of the average hourly residential solar customers' system production to the maximum solar production for the hour shown at the top of each column and the month shown in each row of the table.

Table 4 Ratio of Average Hourly Solar Production to Maximum Hourly Production

Month	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM
Jan	75%	73%	63%	44%	20%	3%	0%	0%
Feb	86%	84%	74%	57%	34%	10%	0%	0%
March	87%	84%	77%	62%	41%	18%	2%	0%
April	92%	88%	81%	66%	44%	22%	4%	0%
May	90%	88%	80%	66%	47%	26%	8%	0%
June	89%	86%	79%	66%	48%	28%	10%	1%
July	89%	86%	79%	66%	49%	28%	10%	1%
August	92%	91%	83%	68%	47%	25%	7%	0%
Sept	88%	83%	74%	59%	37%	14%	1%	0%
Oct	79%	75%	64%	46%	24%	5%	0%	0%
Nov	88%	81%	67%	45%	18%	1%	0%	0%
Dec	80%	74%	61%	41%	16%	1%	0%	0%

Q. Does the delivered load of the rooftop solar customers accurately represent the demand of this group of customers?

A. Yes, the delivered load is the actual load that the customers place on the utility's system.

Just as there are variations in the time of peak demands of individual non-solar residential customers, there are variations among solar residential customers but collectively what is actually delivered to the customer is the aggregate demand on the utility and what the utility should plan and design for.

Q. Is there a difference between the "partial requirements" rooftop solar customers and customers relying on self-generation virtually full time and taking stand-by service from the utility?

A. Yes, there are two major distinctions. Customers with standby service purchase electricity from the utility on a random, intermittent basis. The standby class of customers is typically diverse in both the loads they rely upon from the utility and the timing of when they rely upon the utility. The periods when they need to purchase electricity due to outages of their self-generation facilities are difficult to predict, and typically infrequent. In contrast, rooftop solar customers represent a large number of customers that have regular and predictable utility electricity requirements that fall within the requirements of others in the residential class. While the output of an individual customer's rooftop solar system may be difficult to predict due to micro climates and individual equipment outages, there are currently over 55,000 customers who have installed rooftop solar systems. Collectively the output is much more predictable and can be forecast in the same way that utilities already predict and forecast output from utility-scale solar and other variable generation sources. These rooftop solar customers as a group purchase electricity from the utility 24 hours per day and every day of the year.

Q. Does the APS ECOSS study correctly reflect the costs and revenues of rooftop solar customers that will not take service under a NEM arrangement?

A. No, the parity ratio does not reflect revenues associated with delivered load. The Company's ECOSS study shows the revenues based upon the current NEM arrangement where delivered electricity is reduced by the export of electricity. The Company did not develop any estimate of pro forma revenues based upon compensation for all excess energy produced. In addition, the customers who take service from the utility in the future may have a different

pattern for excess energy as a result of different system configurations in response to the newly proposed compensation structure.

Q. Based upon your analysis should a separate rate class be developed for the rooftop solar customers?

A. No. The residential customer class incorporates a wide range of customers that all take service at secondary voltage levels and includes customers with a range of consumption and load factors. This class is represented by a diverse group of customers living in urban vs. rural environments and single family vs. multi-family homes that may have vastly different consumption patterns. While the Commission has defined residential rooftop solar customers as partial requirements customers – by this definition – those are only one type of partial requirements customers currently included in the residential rate class. There are many other customers that meet part of their household energy requirements through the use of other energy resources, such as natural gas and propane, and varying degrees of reliance on energy efficiency. Unless the Commission intends to classify all of these customers as partial requirements customers as well, it is inappropriate to use this definition to create a classification that results in discriminatory pricing for rooftop solar customers.

IV. APPROPRIATE TREATMENT OF A ROOFTOP SOLAR CUSTOMERS IF A SEPARATE RATE CLASS IS CREATED

Q. If the Commission concludes that rooftop solar customers should be evaluated as a separate class in the ECOSS study, what are the key issues that need to be addressed?

A. The key issues are the treatment of exported energy, total electricity consumed on site, and the electricity actually purchased from the utility. I discuss each of these concepts separately but it is important to understand that they need to be considered in the context of the theory, methodology, and objectives associated with the cost allocation model.

Q. What is the theory behind an electric utility cost allocation model?

A. The guiding principle is that cost allocation should follow cost causation. In the context of utility cost of service studies, an embedded revenue requirement is typically divided up, or "allocated" to the different classes of customers. If the costs to serve different groups of customers are significantly different, then conceptually different classes should be created to achieve the objective of cost allocation following cost causation. Ideally, costs would be allocated by direct assignment; each class pays for the facilities that are used to serve them. In practice, direct assignment can only be used for a fraction of the utility's costs since most facilities are jointly used and facilities are rarely dedicated to a specific customer or group of customers. For example, the central generating station serves all the customers who purchase electricity and the distribution feeder serves all the customers connected to that feeder.

Q. Can the ECOSS study be used to determine if the costs of serving rooftop solar customers are significantly different than similarly situated customers without rooftop solar?

A. Not entirely. The results of an ECOSS are completely subject to limitations of the assumptions and methodology used to allocate the costs amongst the different customer classes. Dramatically different answers can result from the methodology and assumptions used to allocate what are predominately joint costs to the different rate classes. In addition, the embedded cost methodology allocates all overhead and indirect costs to a limited number of utility activities (production, transmission, distribution, customer service) and then to the rate classes. The utility has a large amount of overhead and joint costs and the allocation decisions about those and other costs can make certain classes of customers appear more or less costly than they actually are.

Q. How should exported energy be treated in an embedded cost of service study?

A. Non-energy cost components should only be included to the extent that: dedicated facilities are associated with exported energy, specific incremental costs are created by the

customer class that exports that energy, and there are specific services provided by the utility to serve that class of customers. At this point the only specific facilities for solar customers that APS has identified is the incremental cost of the bi-directional meter. Payments made for exported energy should be treated as power costs and in the case of avoided capacity costs, those costs should be allocated in the same way as avoided capacity costs are treated for energy efficiency.

Q. Are there dedicated facilities required to accommodate exported energy from rooftop solar customers?

A. Rooftop solar customers require a different metering configuration so that both outflows and inflows of electricity are metered – which is why APS rooftop solar customers need to have dual register meters installed. The other dedicated facilities for secondary voltage service, the service line and transformer, could hypothetically need to be sized differently to accommodate exported energy in limited instances. These are small, quantifiable costs that are mostly upfront. In addition, based upon the exported electricity data provided by APS, there does not appear to be a need to upsize these customer dedicated facilities and APS has not provided any evidence that they are upsizing the dedicated facilities.

Q. Is there a cost associated with exported energy flowing on the primary voltage distribution system?

A. Only in limited and largely hypothetical circumstances. There could conceivably be a cost to the primary distribution system from exported energy but this cost is allocated on the basis of load. Unless the electricity exported exceeds the usage of electricity by all the other customers on the feeder the exported electricity displaces electricity that would otherwise flow from other generators and through the distribution substation. Just as those generators do not pay for use of the distribution system, the rooftop solar customers who deliver electricity to the distribution system should not pay for that "use" of the distribution system.

Q. Does the exported electricity from distributed solar create an additional demand on the distribution system, or just displace other electricity flowing from APS generators and purchased power?

A. APS data has not shown that peak demands on feeders have resulted from rooftop solar customers exporting energy. While there may be limited instances of reverse power flows on the distribution system, APS has not identified costs associated with these instances. It is possible that if there was a significantly high degree of saturation of NEM customers on a feeder, reverse flows could become material enough to require incremental investment in upgraded distribution facilities to handle incremental energy flows. Therefore, it is reasonable for APS to continue to monitor penetration at the feeder level.

Q. Do you agree with the APS proposal to allocate costs based upon the customer's site use of electricity as opposed to the electricity actually delivered from the Company?

A. No. The delivered use reflects the energy and capacity requirements that the class collectively uses. The Company's allocation based on site use is equivalent to charging customers for phantom load. It is phantom load since it is not electricity or capacity that the Company currently provides. Furthermore, the utility does not allocate costs to other customer groups based upon what it potentially might provide in the future.

Q. If other customer groups reduce their energy purchases from the utility does the utility allocate costs to those customers based upon what electricity they would have used but for their actions to reduce electricity purchases?

A. No. The clearest inconsistency is that customers who reduce electricity usage and peak demands due to programmatic and non-programmatic energy efficiency and demand response measures are not allocated costs for their electric load reductions. Likewise, customers who switch from an electric HVAC or household appliance to natural gas fired appliances are not allocated costs related to their electric load reductions. Additionally, customers who may choose to turn on all of their appliances during the peak period are allocated costs according to their

actual electricity consumption. Likewise, customers who only occupy their household part-time are not allocated costs based upon what electricity they would have consumed had they been a full-time occupant.

Q. What about the argument that demand costs should be allocated on site use because the solar systems may not produce electricity or may substantially reduce production at any moment?

A. Again, rooftop solar is no more intermittent than other resources, such as utility-scale solar, that utilities already forecast and manage without issue. In fact, rooftop solar is less intermittent and more reliable because it is geographically distributed. Unlike a utility-scale installation, there is a little risk of a single event taking out all or the majority of production unexpectedly.

While there are hours of the day when the solar systems are not producing electricity, these hours are during the night time and in that case the delivered use and the site use are the same, creating no issue with using delivered consumption. However, the assumption that there are times that the rooftop solar class may not produce electricity during day time peak demand hours is a fallacious argument.

While APS allocates transmission on four coincident peaks and allocates distribution on the class' four non-coincident peak hours of the year, I examined the top 100 hours of system loads for 2015. During the top system four peak hours the residential solar systems in aggregate were always producing electricity. At the top 50 and 100 hours of system load there were a few hours after 7:00 and when the solar systems were not offsetting retail demand. A summary of this analysis is shown in Table 5.[13] As shown in *Figure* 3, rooftop solar is producing electricity in almost all of the top 100 retail load hours and offsetting the need for capacity resources. Simply stated, as a class, solar production never goes to zero during the daylight hours so use of "site"

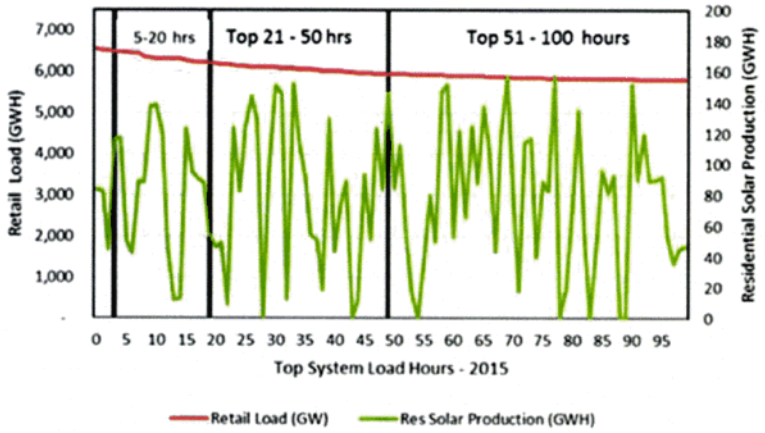
[13]Attachment JAH-16

load allocates costs on a non-existent demand, therefore violating the fundamental tenet that cost allocation should follow cost causation.

Table 5 Residential Solar Production during Peak Retail Demand Hours

Top	Average System Demand	Average Coincident Residential Solar Production (MWH)	Min Solar Production (MWH)	Max Solar Production (MWH)	Hours with Solar Production < 5 MW
4 Hours	6,517	82.2	45.3	117.0	0
20 Hours	6,361	81.9	12.2	139.2	0
50 Hours	6,175	81.8	0.2	152.6	2
100 Hours	6,024	79.6	0.0	157.6	7

Figure 3 Residential Solar Production during Top System Hours



Q. If a group of customers reduce their electric consumption does that shift costs to other customers?

A. There is not a simple answer since it depends on both the allocation of costs and the relationship between embedded costs and both short and long-run marginal costs. If embedded distribution and transmission costs are greater than short run marginal costs, which is generally the case, then reduced consumptions will reduce revenues and that can shift costs. If long-run marginal costs are greater than the embedded costs then the short-term cost shift is offset by a

lower long-term revenue requirement. It is important to recognize that a shifting of costs is not the same as a subsidy. Cost shifts regularly occur as a result of utility administered energy efficiency, environmental protection initiatives, economic development programs, inaccurate cost allocations or other business or regulatory decisions. There are established mechanisms, like decoupling, that account for revenues that might be unrecovered in the short term, and that simultaneously align utilities' incentives with those of consumers and society.

V. CRITIQUE OF THE APS ECOSS STUDY

Q. What are your primary concerns with the ECOSS study prepared by APS?

A. My primary concerns are with the allocation factors and the calculation of the parity ratio. These concerns are:

1) The allocation of primary distribution, substation, and transmission, and generation costs using site loads versus delivered loads for the rooftop solar classes,

2) Use of the NCP demand for primary distribution and distribution substation costs,

3) The calculation of metering costs for the rooftop solar classes,

4) The calculation of the basic charge for all residential customers, and

5) APS's evaluation of parity for rooftop solar customers is flawed because it i) fails to make a pro-forma revenue adjustment considering delivered load in order to understand the parity of non-grandfathered rooftop solar customers and ii) for grandfathered customers it fails to account for the system benefits provided by those customers.

The first concern is critical since allocation of energy and capacity costs on services not used by the class is a clear violation of the tenet that cost allocation should follow cost causation. The second, third, and fourth items are concerns that are valid reasons for rejecting the APS methodology. The fifth concern is critical since the incorrect calculation of parity can impact the distribution of the rate increase and the policy decisions of this Commission.

My conclusion is that the APS has systematically overestimated the cost of serving the solar customers and has failed to match cost allocation with cost causation. This in turn led to the

incorrect conclusion by APS that rooftop solar customers are being heavily subsidized by other customer classes.

Q. **Does the Company use site versus delivered loads to allocate all generation, transmission, and primary distribution costs to the rooftop solar customers?**

A. Yes, the Company has used total customer electricity use including electricity from the rooftop solar systems in the ENERGY (energy), DEMPROD (production demand), DEMTRAN (transmission demand), and DEMDIST (distribution demand) allocation factors. The result of this is the over-allocation of costs to the solar customers and discriminating against rooftop solar customers by penalizing them for reducing their purchases from the utility. Conversely, the Company and Commission do not penalize customers for reducing purchases due to energy efficiency or fuel switching.

Q. Is there a valid argument that the solar customers should be allocated costs for the utility standing by to serve a customer whose solar system might not be working?

A. No, the allocation of the joint costs to rate classes is based upon the collective characteristics of the rate class as opposed to individual customers. Historically utilities have evaluated demand costs to large rate classes based upon a statistical sample intended to reflect the collective behavior of the rate class. In the case of the rooftop solar customers the utility has used a census and so the sum of the delivered load reflects the actual aggregate demand and the collective variation of energy use and energy production within the class. Use of the census versus a sample provides a high degree of accuracy with respect to understanding when rooftop solar customers purchase and generate electricity. The Company's approach is incorrect in that it also uses an energy allocation factor based upon energy that is not consumed by the class.

Solar systems are significant capital investments that are not portable. These solar systems are not on the roof one day and gone the next. In addition, consumers have a strong financial incentive to maintain their systems in order to recoup the capital investment. While solar production can vary from hour to hour and day to day, the APS data shows that during the

daylight hours the rooftop solar systems produce energy and when the utility system peaks during daylight hours the systems are not only producing energy but cumulatively exporting energy to the grid. *Table* 6 shows that during the total residential solar system production and export as a percentage of the system retail load for the top 4, 10, 50, and 100 system hours. The table also shows that in aggregate the residential systems were producing electricity in all the top 100 system hours for 2015 and 99 hours in 2016. The one hour when residential rooftop solar was not producing was the 81st highest load hour in 2016, June 20 at the hour ending 9:00 PM.

Table 6 Residential Solar Production during System Peak Hours[14]

	2015			2016[1]	
System Hours	Production	Export	# Hours of Production	Production	# Hours of Production
Top 4 Hours	1.03%	0.14%	4	0.99%	4
Top 10 Hours	1.08%	0.17%	10	1.50%	10
Top 50 Hours	1.08%	0.22%	50	1.55%	50
Top 100 Hours	1.08%	0.24%	100	1.60%	99

1. Export data for residential solar systems for 2016 were not located

Q. How should the allocation factor for rooftop solar customer classes be calculated for the secondary lines and line transformers?

A. The Company has incorrectly calculated the allocation factor based on site use, as that does not reflect the actual load on the facilities. In the future it might be appropriate to consider the maximum load on these facilities as the higher of the delivered peak load and the exported load – but only if the exported load requires increasing the size of the secondary lines and transformers. However, the Company has not identified instances of having to increase the size of these facilities due to exported electricity to reflect the actual demand on the secondary distribution facilities.

[14] Attachment JAH-17

Q. What is your concern with using a NCP cost allocation factor for the primary distribution system and distribution substations?

A. These facilities are designed to meet the aggregate peak load of all the customers connected to these facilities regardless of the rate class. If distribution feeders and distribution substations were dedicated to a single class of customers, then use of the class NCP would be an appropriate allocation factor. However, based upon my analysis of data provided by APS, the NCP is not an accurate allocator. This conclusion is based upon:

- Customer counts or residential and non-residential counts at substations,
- Comparison of the class peaks of solar customers versus residential customers and distribution service non-residential classes.
- Analysis of substation peak data versus the rooftop solar peaks and system peaks.

Q. Are distribution substations dedicated to residential customer classes or solar customer classes?

A. No, an analysis of the data provided by APS shows that the majority of substations have at least 10% non-residential customers, and certainly no existing substation serves 100% solar customers. While on a customer basis most substations have more residential customers than commercial customers, commercial customers on average have higher loads. On a simple average basis the small and medium sized commercial customers on the distribution system have peak demands 8 and 33 time greater than the average residential customer. Therefore, the 10% of the customers may be responsible for a significant portion of the peak load on the substation.[15]

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[15] Attachment JAH-13

Q. Do the residential rooftop solar NCP class peak demands occur at the same time as other residential customers?

A. No. *Table* 7 shows the date and time of the NCPs of the solar and non-solar residential customers. The residential solar customers peak later than system in 19 of the top 20 system peak hours and the residential solar customer group never peaks at the same hour as the system in the top twenty hours. The proposed solar residential customer class also peaks later than the residential class and the solar residential customers' peak later than the system peak. Therefore, the solar customers collectively are actually contributing to an overall reduction of system and substation peaks and costs are being over allocated to these customers.

Table 7 Coincidence of Rooftop Solar Peaks with Residential and System Peaks

	System			Residential Non-Solar			Residential Solar		
2015 NCP	Peak (MW)	Date	Hour Ending	Peak (MW)	Date	Hour Ending	Peak (MW)	Date	Hour Ending
1	6,557	08/15/15	17:00	4,088	08/15/15	17:00	172	08/16/15	20:00
2	6,514	08/14/15	17:00	4,061	08/16/15	18:00	171	08/15/15	19:00
3	6,509	08/15/15	18:00	4,054	08/16/15	17:00	169	08/16/15	19:00
4	6,487	08/15/15	16:00	4,043	08/15/15	18:00	168	08/15/15	20:00
5	6,476	08/14/15	16:00	4,037	08/15/15	16:00	163	08/14/15	19:00
6	6,465	08/16/15	18:00	3,963	08/16/15	16:00	161	08/14/15	20:00
7	6,433	08/14/15	18:00	3,909	08/16/15	19:00	161	08/16/15	21:00
8	6,432	08/16/15	17:00	3,906	08/15/15	15:00	157	08/13/15	20:00
9	6,348	08/13/15	17:00	3,852	08/15/15	19:00	156	08/05/15	20:00
10	6,334	08/15/15	15:00	3,802	08/16/15	15:00	155	08/13/15	19:00
11	6,317	08/14/15	15:00	3,780	08/14/15	18:00	155	08/15/15	21:00
12	6,309	08/16/15	16:00	3,776	08/14/15	17:00	154	08/17/15	20:00
13	6,305	08/13/15	18:00	3,715	08/16/15	20:00	151	08/29/15	19:00
14	6,301	08/15/15	19:00	3,703	08/15/15	14:00	151	08/14/15	21:00
15	6,298	08/16/15	19:00	3,683	08/14/15	16:00	151	08/15/15	18:00
16	6,253	08/13/15	16:00	3,670	08/13/15	18:00	150	08/17/15	19:00
17	6,231	08/05/15	17:00	3,660	08/29/15	17:00	149	08/04/15	20:00
18	6,223	06/18/15	17:00	3,649	06/28/15	17:00	149	08/30/15	19:00
19	6,222	08/17/15	17:00	3,636	08/14/15	19:00	149	08/05/15	19:00
20	6,210	08/05/15	18:00	3,632	08/29/15	16:00	148	08/16/15	22:00

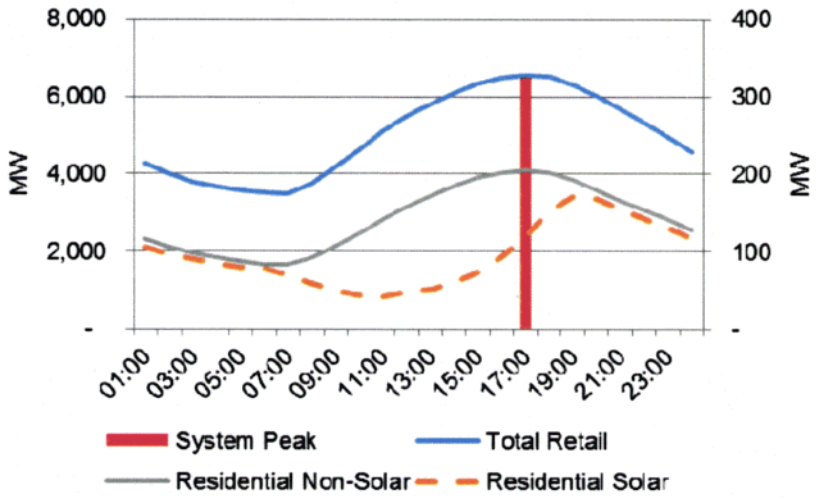
Q. How do the distribution substation peaks compare to the rooftop solar class peaks and system peaks?

A. I analyzed the 4 peak hours of the 388 distribution substations and 35% of the substations peak before 6:00 PM and 76% of the substations peak before 7:00 PM.[16] Two of the top four NCPs for the residential solar customers occur after 7:00 PM so they are not coincident with the peaks of the majority of distribution substations.

Q. Do the residential solar rooftop solar customers contribute to the system and substation peaks or reduce the peak loads?

A. They reduce the peak loads by offsetting capacity requirements during the APS system peak. This is demonstrated graphically in Figure *4* that illustrates how residential customers without solar peak with the system but rooftop solar customers are peaking after the system peak. As a result, on the peak day in 2015, it is clear that it was a benefit to the grid that solar customers' peak occurred at a time other than the system peak.

Figure 4 APS System Peak Day - August 25, 2015



[16] Attachment JAH-19

Q. Based upon your analysis what is your recommendation for the allocation factor for distribution substations?

A. I recommend that the coincident peak allocation factor be used because: 1) the substations serve residential and commercial loads, and 2) the rooftop solar customers in general contribute to reducing the coincident peak for all customers.

Q. Based upon your analysis what is your recommendation for the allocation factor for distribution feeders?

A. My recommendation is that distribution feeders be allocated on coincident peaks similar to substations.

Q. What is the impact of correcting APS's errors in calculating the allocation factors?

A. The correction adjusts the parity ratios (the percentage of actual costs a given customer class pays under the proposed rates) upward approximately 7.4% for the residential solar energy group (from 37.6% to 45.0%).

Q. What are your concerns with the development of meter costs?

A. The Company's calculation of meter costs for solar and non-solar customers has significant problems. My concern is that the meter costs for all customers are over-stated since the Company has allocated significant non operations expenses and A&G costs to meter costs. In addition the costs are over-stated for rooftop solar customers because of the allocation of the production meter cost to those customers as well as the allocation factor used for meter expense.

Q. Why are the meter costs allocated to rooftop solar customers over-stated?

A. There are at least two issues with the meter cost allocation. The first issue is the allocation factor for meter investments assigns responsibility for the production meter to the

solar customer when the production meter is not needed by the customer. It is used by the utility to measure distributed renewable energy produced to comply with the state renewable energy standard and reporting on the amount of renewable energy derived from distributed solar systems and also for reporting under the Lost Fixed Cost Recovery Mechanism (LFCR) which allows the Company to recoup a portion of revenues lost to energy efficiency and distributed generation adoption. Regulatory compliance costs should be borne by all of the APS customers and not by the customers who are helping the utility comply with state regulations. I also note that in the ALJ's recommended decision in the Tucson Electric Power (TEP) rate case, the judge agreed with my perspective and recommends that the production meter costs should be removed from the meter cost for distributed solar customers.[17] The second issue is that meter expense is allocated based upon the cost of the meter when it should be allocated based upon customers. For example, the cost of the meter shop and associated equipment recorded in meter expense has not been demonstrated to be a function of the cost of the meter.

Q. What adjustments do you recommend to the allocation of meter costs?

A. In addition to any other reductions, the meter capital cost for residential solar costs must at least be reduced from$566.97 to $431.44 to remove the R2S – Commercial Production Meter[18] from the meter cost allocation factor CUST370. The CUST370 allocation factor should also be substituted with the CUSTNUM allocation factor for the meter expense accounts (FERC 586 and 597). I have one additional concern with the incremental meter cost; I noted that the TEP recommended order indicates that the incremental capital and labor cost to install the bi-directional meter in TEP service territory is $142.95.[19] This is significantly less than the $296.91 cost that APS states.[20] To the extent that the Commission investigates assigning an increased meter cost responsibility to customers with solar, I encourage the Commission to look carefully

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[17] Attachment JAH-20
[18] Attachment JAH-21
[19] Attachment JAH-20
[20] Attachment JAH-21

at the cause of this apparent disparity and to make sure that solar customers are not paying two times as much for a meter in APS service territory as they would in the territory of TEP.

Q. How have non-meter costs been allocated to the cost of meters?

A. APS has separately split distribution operation and maintenance expenses into two categories; direct and indirect maintenance expense (a category referred to as "Misc" in the ECOSS study). The "Misc" expense is then reallocated to the "Non-Misc" expenses using an allocation factor which is the ratio of the "Misc" / "Non-Miss" expenses.[21] The categorization and calculation is shown in Table *8*. The reallocation factor for distribution operations cost is 3.2387. This means that the $5.6M of meter expense in FERC account 586 is adjusted upward to $23.8M before being allocated as meter expense to the different rate classes and incorporated into the basic charge calculation. In the case of the residential classes there is over $21M allocated as meter expense where the residential share of FERC account 586 is under $5M. In addition, APS has allocated an almost additional $18M of A&G expense to the meter costs. To the extent that the A&G and "Misc" costs were prudently incurred, they should be recovered from customers. However, those costs are not appropriately classified as meter costs.

Table 8: APS Reallocation of Distribution Expenses

FERC Account	2015 Expense	Category	FERC Account	2015 Expense	Category
OPERATIONS			AB:Maintenance		
H:580 Supervision and Engineering	4,803,283	Misc			
I:581 Load Dispatching	2,200,293	Misc	AC:590 Supervision & Engineering(Misc.)	2,739,119	Misc
Q:582 Station Expense(Substation)	1,576,261	Non-Misc	AG:591 Structures(Substation)	252,338	Non-Misc
R:583 Overhead Lines Expense(Pri./Sec./Serv.)	2,630,964	Non-Misc	AH:592 Station Equipment(Substation)	3,383,396	Non-Misc
S:584 Underground Line Expense(Pri./Sec./Serv.)	1,797,421	Non-Misc	AI:593 Overhead Lines(Pri./Sec./Serv.)	20,411,819	Non-Misc
T:585 Street Lighting & Signal System	2,337	Non-Misc	AJ:594 Underground Lines(Pri./Sec./Serv.)	9,902,185	Non-Misc
U:586 Meter Expense	5,616,656	Non-Misc	AK:595 OH/UG Line Transformers	2,724,211	Non-Misc
V:587 Dusk to Dawn	19,614	Non-Misc	AL:596 Street Lighting & Signal Systems	539,741	Non-Misc
J:587 Customer Installation Expense(Misc.)	660,567	Misc	AM:597 Meter Expense		
K:588 Miscellaneous Distribution	32,083,855	Misc	AN:598 Dusk To Dawn	396,813	Non-Misc
X:589 Rent	629,407	Non-Misc	AD:598 Miscellaneous Distribution	3,098,330	Misc
Total Operations Expense	52,020,658		Total Maintenance Expense	43,447,952	
O:Total Operation-Misc	39,747,998		AE:Total Maintenance-Misc	5,837,449	
Z:Total Operation Non-Misc	12,272,660		AO:Total Maintenance-Non-Misc	37,610,503	
Gross-Up Factor	**3.2387**		Gross-Up	**0.1552**	

[21] Allocation in Workbook C – 2015TY COSS Working Model.xlsx in tab O-M_D_W_Misc_Allocation.

Q. What is the impact of these adjustments?

A. The two adjustments lower the meter costs by over 35%.

Q. Do you have other concerns with APS's calculation of the components of the basic charge?

A. Yes. The issue of over-allocation of costs to meter expenses applies to the other components of the basic charge as well. In addition, the calculation of the basic charge should exclude non-dedicated facilities. At a minimum, secondary distribution lines should be removed from the basic charge. I also recommend removing line transformers from the basic charge since many transformers are also shared system facilities. Additionally, the ECOSS model makes it challenging to understand the actual costs of these transformers versus the allocated cost that is adjusted by the gross-up factors shown in Table *8* as well as the assignment of A&G costs. In sum, I think the Company's calculations related to the basic service charge and the meter fee component of that charge should all be looked at with a degree of skepticism and, at the very least, the adjustments I identified must be made.

Q. Why should pro forma revenues be calculated for the rooftop solar customers?

A. In order to establish appropriate rates for non-grandfathered rooftop solar customers it is important to have an accurate understanding of the relationship between the cost of serving these customers and their revenues. One of the challenges is that while there are currently rooftop solar customers there are no non-grandfathered rooftop solar customers. Therefore there are neither costs, nor revenues for this non-existent group of customers. In order to understand the cost of serving these prospective rooftop solar customers I recommend analyzing the solar customers as if they were not on net metering. This entails both allocating costs on delivered load in order to reflect their actual usage of the APS system and calculating the associated revenues assuming those customers were not on net energy metering. I refer to this calculation of revenues assuming no net metering as the "pro forma revenues". The solar customers not on net metering will pay for electricity based upon delivered load. Since this group of customers

does not exist, I assume that they will have solar systems and energy use patterns similar to the customers on NEM. My calculation does not take into consideration the potential impacts from the new compensation scheme which may lead to changes in delivered and exported load due to customers optimizing their solar system size and installation to maximize the economic return under the new rate terms.

Q. What is the difference between the billing determinants used by APS in their test year calculation versus the actual delivered load?

A. I have estimated that difference at approximately 47%; or approximately 392 GWH for residential rooftop solar delivered kWH versus the Company's 207 GWH number used in the billing determinants for the test year revenue. In other words, in the absence of net metering on average the solar customers will be purchasing 47% more electricity from the utility. (There will also be an increase in the amount of exported electricity that the utility will pay the customers for.)

Q. Why is it appropriate to exclude the contribution of NEM to these pro forma revenues?

A. The ending of retail rate NEM creates a different billing arrangement for future rooftop solar customers. The pro forma calculation shows what the existing customers revenue would be if they were not on NEM rates. The energy purchases from APS would be no longer be limited to just the any amounts of delivered energy less all exported energy, but instead they would purchase a greater amount of energy than under NEM since none of the delivered energy would be offset by production from the solar systems. A non-grandfathered rooftop solar customer will pay for all delivered energy. Any exported energy will be paid for under rider EPR-6S based upon the value of that energy.

Q. Have you estimated the impact of the pro forma adjustment of using the delivered 392 GWH?

A. Yes. It changes the APS calculated historical revenues from approximately $25M for the residential rooftop customers to almost $45M after the adjustments that APS incorporated into its proof of revenue work papers. The results of the pro forma revenue analysis, before adjustments for weather normalization and other adjustments in the APS proof of revenue work papers is shown in Table *9*.

Table 9 Pro Forma Adjustments to Reflect Delivered kW and kWH

Solar Schedule	APS TY MWH	Pro Forma MWH	APS TY Revenue Before Adjustments	Pro Forma Revenue Before Adjustments
E-12	33,613.13	98,875.22	5,037,220	12,432,322
ET-1 / ET-2	155,186.32	268,428.15	16,291,139	29,595,495
ECT-1R / ECT-2	18,141.22	24,667.93	2,178,848.00	3,051,947.42
	206,941	391,971	23,507,207	45,079,764

Q. Would you please describe how you calculated the pro forma revenue adjustment for the residential rooftop solar customers?

A. I estimated the monthly bills of the E-12, ET-1, ET-2, ECT-1, and ECT-2 customers based upon the 2015 hourly delivered data provided by APS.[22] My calculation of the monthly bill assumed that all the delivered energy was billed at the corresponding rate schedule that the customer is currently on. For example, the monthly bill of an E-12 solar customer was calculated using the delivered consumption for each month and the corresponding seasonal blocked energy rate. The same process was used for the ET-1, ET-2, ECT-1R, and ECT-2 customers. For the demand customers, I calculated the maximum on-peak weekday demand based upon the delivered load.

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[22] Attachment JAH-22

Q. Is it critical that you estimated the pro-forma revenue rather than having an exact calculation?

A. No, the grandfathered NEM customers will be billed under their historical rate schedules. The purpose of the calculation is to illustrate that on a forward looking basis the revenue from non-grandfathered solar customers will reflect the delivered electricity and accounting for how the electricity actually will be sold dramatically changes the relationship between the allocated costs and revenues from the delivered electricity for the prospective rooftop solar customers.

Q. What is the parity ratio impact of the pro forma revenue adjustment for the solar customers?

A. The cumulative impact of my proposed changes to the cost allocation and incorporation of the pro forma revenues is that customers on the energy rates are presently at 88.9% of parity and at 100% under the proposed allocation of the rate increase, and the customers on demand rates are currently at 110.7% of parity and at 123% of parity under the proposed for rate increase. This means that the non-grandfathered customers will be paying 100% or more of their fully allocated embedded costs.

Q. What is the parity ratio impact of the pro forma revenue adjustment for the non-solar residential customers?

The cumulative impact presently for the E-12, ET-1 & ET-2, and ECT-1 & ECT-2 are 92.2%, 85.9%, and 82.9% respectively. Under the proposed rate increase these values increase to 99%, 92%, and 89%. This result shows that both the non-solar residential customers and non-grandfathered rooftop solar customers will be paying an equitable share of the utility's cost to serve based upon the embedded cost methodology. It also demonstrates that it is not necessary to have separate rate classes and rates for new rooftop solar customers since the parity ratios for both groups of residential customers were calculated with the same rate schedules.

VI. VALUING EXCESS ENERGY EXPORTED TO THE GRID

Q. Are you familiar with the ACC order on the value of distributed generation in Docket No. E-00000J-14-023?

A. Yes. While I was not involved in that Docket, I have read the order and understand that the Commission directed that the Resource Comparison Proxy (RCP) methodology should be used in pending rate cases for valuing the exported electricity of non-grandfathered customers.

Q. Is it your opinion that the RCP methodology correctly values exported electricity from customers' rooftop solar energy systems?

A. It is my understanding that the value of solar will be addressed in supplemental testimony due in March 2017 and in my supplemental testimony I will be addressing issues related to the proper methodology for valuing exported energy and generation capacity including, but not limited to, the RCP. However, while the RCP methodology will also include long-term transmission and distribution system benefits, it is my opinion that environmental benefits should also be included.

Q. Will the determination of RCP impact your analysis in this testimony?

A. Yes. In this testimony, I address whether the APS proposed treatment of non-grandfathered rooftop solar customers will effectively end the competitive rooftop solar business in APS' service territory. I reserve the right to modify this conclusion based upon what the Company proposes and the Commission determines the RCP payment should be.

VII. ROOFTOP SOLAR CUSTOMERS ARE NOT BEING SUBSIDIZED

Q. Do you agree with the APS conclusion that rooftop solar customers are being subsidized?

A. No, APS' conclusion is based upon an incorrect analysis of the cost to serve rooftop customers. Their analysis excludes consideration of the value of the excess energy produced by rooftop solar customers and delivered to the grid, as well as the avoided costs associated with reduced costs for system energy production and delivery. When these two issues are corrected, as I discuss previously in my testimony, the rooftop solar customers are paying over 90% of parity while the non-solar residential customers are paying 87%. In addition, the pro forma adjustment that shows the revenues on a going forward basis where non-grandfathered rooftop solar customers pay for all delivered electricity show that the residential rooftop solar customers under the APS proposed allocation of the rate increase would be paying parity.

Q. How did you value the benefits provided by the grandfathered rooftop solar customers?

A. APS identified that the residential rooftop solar customers resulted in reduced sales of 338,340 MWH during the 2011 – 2015 period. The APS analysis of the subsidy calculates a reduction of revenues of almost $28M based upon lost margin excluding fuel costs.[23] The reduction in energy and capacity is not valued for these customers, in contrast to energy efficiency. For example, if one uses the value of solar of over $0.11 / kWh identified in EPR-6S, these customers are providing a benefit in excess of the lost distribution margins, excluding the avoided capacity benefits associated with the transmission and distribution system.

Q. Should an associated benefit be calculated for reductions in energy use associated with programmatic energy efficiency?

A. The Company does assign a benefit in developing the cost benefit analysis of each energy efficiency / demand management program. With regard to the cost of service study and attribution of the benefits, the difference is that customers who participate in APS energy efficiency programs have the reduced consumption and demand paid for, at least in-part, through

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[23] Attachment JAH-7

APS provided funds. Therefore, all customers are both paying for the reductions and receiving the associated benefits. In contrast, rooftop solar customers are financing the investment in reducing the sales without any utility incentive payments, but the company and other customers receive the energy and load reduction benefits.

Q. Is shifting costs from one class to another a subsidy?

A. No, as customers and customer classes change their patterns and levels of electricity usage it is likely that the allocation of joint cost facilities will change between the rate classes. This shift in cost is not a subsidy but an artifact of applying a reasonable methodology for allocating joint cost facilities. The determination of whether there is a subsidy or not depends on the results of the cost allocation. While it is common to try to move classes to cost of service parity, it is my opinion that the term "subsidy" needs to be used carefully. The issue is that there is not a single correct approach to the allocation of utility joint costs, different commissions use different approaches, and these approaches evolve over time.

Q. Have you reviewed Ms. Lockwood's claim on page 6, lines 11 – 12 of her direct testimony that "Assuming grandfathering, the 20 year rooftop solar subsidy continues to grow rapidly at the rate of $740,000 per day"?

A. Yes, while it may make a nice sound bite, my conclusion is that it lacks perspective compared to the utility's residential revenue requirement, the cost shift compared to energy efficiency, and fails to account for the benefits that the solar customers provide to the utility which the utility does not pay for. I also think the sentence could be subject to misinterpretation since the calculation, as framed by the utility, is *utility's lost margin over twenty years* and it is not the daily cost.

Q. How does the $740,000 per day compare to the residential revenue requirement?

A. The $740,000 per day is the total lost margin over twenty years. The residential annual revenue requirement is over $1.9B; when the annual residential revenue requirement is

multiplied by twenty years and converted to a daily number, the $740,000 is 0.7% of the residential revenue requirement.[24]

Q. How does Ms. Lockwood's alleged cost shift for residential energy efficiency compare with the cost shift for residential solar?

A. The energy efficiency cost shift is almost 300% larger.[25]

Q. Why does Ms. Lockwood's calculation fail to account for the benefits provided by DG and not paid for by the utility?

A. Customers investing in rooftop solar reduce the long term need for new energy resources, transmission facilities and distribution facilities, just like energy efficiency and demand side management investments. These reductions provide long-term benefits to all utility customers beyond the avoided energy cost of $0.032071 per kWh used in the calculations by Mr. Ewen.[26] While the value of these reductions have yet to be established, the Company uses the value of long-term energy and capacity reductions to justify expenditures in energy efficiency. Unlike energy efficiency the programs are paid for by the rate payers, the new residential solar installations, excluding Solar Partners, are not paid for by the rate payers. In the case of energy efficiency the customers have paid over $200M since 2005 to get the savings benefits.[27]

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[24] The parallel calculation to Ms. Lockwood is to $1.9B annual residential revenue requirement and multiply it by twenty years and divide by 365 days / year: 1.9B * 20 / 365 = $104M per day.
[25] Attachment JAH-7
[26] Attachment JAH-7
[27] Attachment JAH-23

VIII. NEGATIVE IMPACTS AND CUSTOMER OPINIONS ASSOCIATED WITH A CHANGE TO A THREE PART RATE DESIGN

Q. What are your concerns with the residential rate designs proposed by APS?

A. My primary concern is that mandatory demand charges are not an appropriate way to incent efficient use of energy and to send price signals to customers. Given APS' investment in advanced metering and the increased penetration of tools for customers to actively manage their energy use, the company should be encouraging customers to transition to time of use rates and dynamic pricing. I also believe that increasing the basic charge is not appropriate and it is my conclusion that APS is discriminating against rooftop solar customers by only offering them only one rate option while the majority of residential customers without solar have three rate options. It is also worth noting that, similar to energy efficiency and lifestyle decisions that reduce consumption but are not part of an efficiency program administered by the utility, rooftop solar customers make a choice about their own investments, property, and consumption patterns. Just as a personal investment in energy efficiency that reduces consumption is not characterized as causing a "subsidy," a consumer's decision to generate a portion of their own electricity should not be discouraged by taking the savings away from the consumer.

Q. Why is time-of-use and critical peak pricing better than the seasonal on-peak demand charges APS has proposed?

A. Time-of-use is more equitable, predictable, and sends a much more actionable signal than a charge based upon a single peak hour. Even though APS has defined summer and winter demand charges as only weekdays between 3:00 PM – 8:00 pm, the customer may peak at a time different than the system, substation, and feeder peak and yet still being charged the full demand charge. Spreading the capacity costs over the peak hours is more equitable and provides customers with more flexibility for managing their energy use. Creating a critical peak pricing mechanism creates a focused ability to manage capacity costs and can be used to modify the TOU rates to provide customers with a clear price signal.

Q. Should TOU / CPP pricing be mandatory for residential and small commercial customers?

A. No, not at this time. Customers need time to be educated and while APS points out that most customers have access to technology in the residential sector, the penetration is not 100% and it still may be new to some customers.[28] Furthermore, at this time APS has not performed any customer sentiment analysis regarding a more widespread institution of time based rates[29].

Q. Is instituting demand rates an appropriate transition to TOU/CPP pricing?

A. No, shifting rate schedules for customers is a significant undertaking with regards to educating customers and it is also important to have rate stability so that customers can reasonably make long-term investments with regards to managing their electricity usage.

Q. Does APS's experience with demand charges indicate that customers understand demand charges?

********** **CONFIDENTIAL DATA – STARTS** **********

A. [redacted]

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[28] Attachment JAH-24
[29] Attachment JAH-25
[30] Attachment JAH-26

[redacted]

********** **CONFIDENTIAL DATA – ENDS** **********

Q. Does the data indicate that customer interest and acceptance of demand charges has increased significantly over the last ten years of offering this rate option?

A. No, I reviewed the historical data on the selection of demand charges over the last ten years and the percent of residential customers on demand rates only increased from 7.3% in 2006 to 11.5% in 2015. In the last three years the percent of residential demand rates only increased from 10.9% to 11.5% of the residential customers.[33] Furthermore, while the total number of customers on demand rates has increased slightly, the underlying numbers indicated that individual customers are not satisfied with the demand rates. There is an extremely high opt-out rate for the ECT-2 demand rate. In 2015, an average of 1,411 customer per month canceled their service on this rate – summing to a total of 16,934 customers for the year.[34] When factoring in the 19,353 customers that enrolled in that year, this translates into an 81% customer retention rate[35]. Described another way, 19% of customers on a demand rate opted to switch off that rate last year. This trend is presented in Figure *5* and is an indication of the negative customer reactions towards this rate option.

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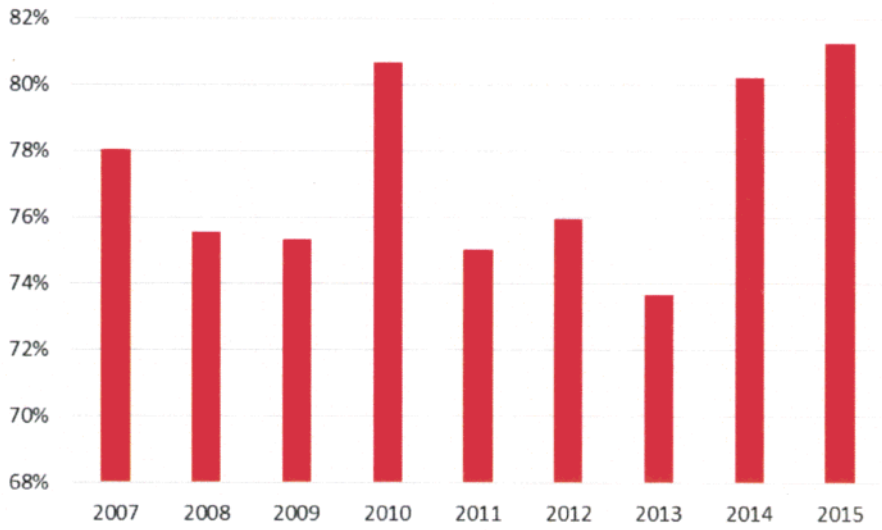
[31] Attachment JAH-24
[32] Attachment JAH-26
[33] Attachment JAH-24
[34] Attachment JAH-27
[35] Attachment JAH-28

Figure 5 Annual Retention Rate for Schedule ECT-2



Q. Does the data suggest that the residential customers prefer demand charges to the other rate options?

A. The data does not provide any indication of why customers choose demand charges. As previously noted only a minority of customers on demand charges know that they were on demand charges. However, the data show that on average the customers on the demand rate use more than three time times the electricity of customers on E-12. I have summarized average energy use per customer on the seasonal rate versus the TOU and demand rates in *Table* 10.[36] In addition, as with any case where there is an option, informed customers will select the lowest cost option when the service is the same regardless of the schedule. In the case of customers on ECT-2, the average annual bill savings compared to the ET-2 and E-12 rates is 5.5% and 23.2% respectively.[37] The high summer usage of the typical ECT-2 customer means that they will move from the E-12 rate to avoid paying the high third and fourth block energy rate.

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[36] Attachment JAH-30
[37] Attachment JAH-31

Table 10 Average Annual User per Customer (kWH)

Schedule / Year	2013	2014	2015
E-12	8,181	7,703	7,891
ET-1 / ET-2	15,639	14,859	15,046
ECT-1R / ECT-2	24,593	23,418	23,558

Q. What is the significance of customers self-selecting demand rates versus requiring customers to be on demand rates?

A. As previously noted, the customers who are on demand rates are the larger electricity users. I am not aware of any survey data that identifies why these customers are large users or what tools they have to manage their energy use. APS in response to Staff 5.37 provides an analysis of 97 customers in the Phoenix Metro area that switched from TOU to demand rates.[38] While 60% of the customers decreased their annual electricity consumption, that still leaves 40% of the customers who increased their energy consumption. Without supporting survey data of the customer it is not clear whether the APS study demonstrates that customers shifted their behaviors in response to demand charges or simply that some customers increased their energy use while others decreased their energy use. However, the customers with high load factors and high electricity usage have an economic incentive to switch to the demand rate since in 2015 the average cost per kWH for residential customers on the seasonal rates, TOU rates, and demand rates was $0.14144 / kWH, $0.12857/kWH, and $0.11604/kWH respectively. Furthermore, 93% of the summer bills for these residential customers had consumption over 800 kWH / month. Had these customers been on the seasonal energy rate they would have paid $0.16167/ kWH or more, significantly higher than the energy charges associated with the demand rates.[39]

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[38] Attachment JAH-32
[39] Attachment JAH-9

Q. Do you have any other concerns with the mandatory demand charges for all residential customers?

A. I understand that in APS response to Staff 5.36 the company did not anticipate that residential customers "will receive shockingly high bills under our proposed new rate design".[40] However, it is not clear whether APS identified whether any segments of the residential class would be impacted with increases significantly different than the average increase. It is my understanding that in the UNSE rate case, Docket No. E-4204A-15-0142, the Commission expressed a concern about the impact of three part rates on low income customers. As shown in *Table 11*, there is also a significant number of low income customers in the APS service territory.[41] In fact there are more low income customers in APS service territory than there are total electric customers in UniSource Energy Services' territory.[42]

Table 11 APS Customers by Family Income Level

Ownership Type by Family Income	Income Bracket	# of AZ Families in Income Bracket	% of AZ Families in Income Bracket
< $24,036	Poverty	19,967	1.88%
$24,036 - $48,072	Lower Income	210,409	19.76%
$48,072 - $75,000	Middle Class	511,431	48.04%
$75,000 - $100,000	Middle Class	182,714	17.16%
>= $100,000	Upper Class	140,076	13.16%
Total		1,064,597	100.00%

Q. Are demand charges necessary for providing the utility with a reasonable opportunity of collecting the target revenues?

A. No, the Commission has already approved a Lost Fixed Cost Recovery Mechanism (LFCR) for the utility to recover shortfalls of margin associated with energy efficiency and

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[40] Attachment JAH-53 APS response to Staff 5.36 a.
[41] Attachment JAH-33
[42] Attachment JAH-45 Unisource Energy Services "electric service reaches more than 93,000 customers in Mohave and Santa Cruz counties" from https://www.uesaz.com/about/

rooftop solar. In addition the utility is provided a rate of return in excess of the risk free rate and that risk premium reflects that the utility is not guaranteed a rate of return. The utility is not guaranteed a rate of return and can experience electricity sales that are either higher, or lower than forecast. In addition, there are other mechanisms, such as decoupling, that are designed to remove the utilities incentive to sell electricity while providing more certainty in recovering fixed costs that could be a better approach than mandatory demand charges for all customers.

IX. PROPOSED RESIDENTIAL RATE DESIGN

Q. Would you please summarize your recommendations for the residential rate design?

A. My recommendation is that no residential consumer be forced into a particular type of plan; all non-grandfathered residential customers should retain a choice among a seasonal blocked energy rate, a seasonal TOU rate, and a seasonal TOU / demand rate. Any new residential solar customers that are not grandfathered should have access to the same residential rates as non-solar residential customers. The one exception is that the new solar customers could be subject to an additional meter charge to cover the incremental cost of the bidirectional meter. (This approach is consistent with the proposed order in the TEP case[43] and the Commission's prior determination in the UNS rate case[44]). I propose that the Commission exercise gradualism in modifying the TOU period, which should be changed from 12:00 – 7:00 PM to 2:00 to 7:00 PM, while lowering the basic service charge for this rate. I have not proposed changes to the rates that grandfathered residential customers are on (ET-1, ECT-1R, and the legacy rooftop solar NEM rates).

Additionally, I explicitly reject the institution of mandatory demand charges for residential customers.

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[43] Attachment JAH-20

[44] Recommendations of the Administrative Law Judge UNS Electric, Inc. (Rates), Docket No. E- E-04204A-15-0142, p 66.

Q. What are your concerns with the APS' proposal to increase the basic charge for residential and rooftop solar customers?

A. Fixed charges discourage investment in energy efficiency and consumer behaviors to reduce electricity consumption. In addition, basic service charges should not vary across the different rate schedules unless there are actual cost differences such as a residential customer with three phase service or requiring a different metering configuration to accommodate rooftop solar.

Q. What is the rationale for excluding the line transformer from the basic charge?

A. The basic charge should cover the minimum cost of facilities dedicated to the customer. Residential customers frequently share secondary transformers. For example over 85% of the residential customers are on secondary transformers with four or more customers based upon APS data on the average number of residential customers on line transformers by feeder. A summary of this analysis is shown in Table *12*.[45]

Table 12 Average Number of Residential Customers on a Transformer

Average # of Res Customers	Number of Feeders	% of Feeders	# Res Customers	% of Customers
1	4	0.5%	1,417	0.1%
2	57	6.5%	51,759	4.6%
3	78	8.8%	90,592	8.1%
4	108	12.2%	130,644	11.7%
5	173	19.6%	229,222	20.5%
6 - 10	386	43.7%	535,807	47.9%
11 - 15	55	6.2%	60,352	5.4%
16 - 20	14	1.6%	14,307	1.3%
> 20	8	0.9%	4,960	0.4%

[45] Attachment JAH-34

Q. Do you agree with Mr. Miessner's definition of the components of what should be in the basic charge?

A. No, Mr. Miessner concludes that grid operations, communications and cyber security equipment should be included in "basic services". However, he notes that not all those costs were included in the Company's proposed basic charge. Utility operating and overhead costs, including cyber security equipment, should not be included in the basic charge. Secondary distribution costs should not be included in the customer costs. In addition, the APS proposed fully allocated cost of service model allocates significant amounts of costs unrelated to billing, meter reading, meters, service lines, and line transformers through the allocation of miscellaneous distribution costs as outlined in *Table* 8.

Q. Is the APS proposal to increase basic charges for residential customers by as much as 176% appropriate?

A. No, it is not appropriate since it includes the allocation of costs not directly related to customer service, billing, meter reading, meters, and the service line. Even if the cost allocation were correct it would not be appropriate since it ignores a key principle that the Commission should consider: gradualism. The current monthly basic service charge of $8.67 /month for E-12 and $16.91/month for ET-2 and ECT-2 would go to $24/month under R-1 which is in addition to having to pay demand charges. This in turn removes the levers that can be applied by the Commission to promote energy conservation and emerging technologies (e.g. energy storage) as this, unlike time or consumption threshold based rates, creates barriers to innovations to manage customer electricity and demand.

Q. What is your proposal for the basic charge?

A. My proposal is to increase the E-12 basic charge by 7.96%, the average residential rate increase, after netting out the amount that is being transferred to base rates. All the residential customers should pay this same basic charge so that customers are not given a disincentive to

transfer to either TOU rates or TOU / demand rates. Solar customers could pay a slightly higher fee for the incremental cost of a bi-directional meter.

Q. What do you recommend for the incremental meter charge for the non-grandfathered residential solar customers?

A. If the Commission is going to impose this charge, I recommend a charge of $2.05 / month (0.0674 / day) which reflects the incremental cost of the bi-directional meter identified in the recommended order for TEP.[46] The TEP costs should be used until APS can demonstrate why its incremental meter costs for residential solar customers is more than twice the TEP's meter costs. This cost excludes the cost of the production meter since, as discussed previously, this is not required to serve the customer and is for the benefit of the Company and ratepayers as a whole.

Q. Should residential solar customers have the option of opting out of the incremental meter charge by paying the up-front incremental cost of the bi-directional meter?

A. Yes, the APS incremental cost of the bi-directional meter including installation costs is $296.91, while the TEP incremental cost is $142.95. Once the correct cost is established, customers should have the option to make a one-time payment to cover the incremental cost.

Q. Why is APS being discriminatory in offering more rate design options to residential customers than the residential rooftop solar customers?

A. Residential rooftop solar customers monthly use of APS provided electricity is similar to the non-solar residential customers, they have similar peak demands, and use the distribution system less than the non-solar residential during the distribution, transmission, and generation peak hours. However, they are not provided with the same rate options. As previously stated,

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45 Attachment JAH-20

my recommendation is that APS not adopt demand charges but continue transitioning customers to TOU rates and then TOU rates with critical peak pricing. As part of this transition, customers should retain the option to be on non-TOU rates, TOU rates, and TOU rates with CPP.

Q. Why should all non-grandfathered residential customers have the same rate options?

A. As previously discussed, the residential solar and non-solar customers have similar characteristics in terms of their service and energy use. As demonstrated in the cost of service analysis the new solar customers will also be paying a similar share of their allocated cost of service when they are on the same rates as non-solar residential customers.

Q. Why are you recommending changing the TOU periods to 2:00 – 7:00 PM?

A. I reviewed the Company's proposal to shift the peak demand period from 12:00 – 7:00 PM to 3:00 – 8:00 PM and I reviewed the historical hours of peak demand and determined that it was appropriate to remove 12:00 – 2:00 PM since the system does not peak during those hours for the top twenty annual peak demand hours over the last two years. The distribution of retail system peaks by hour of the day is shown *in Table 13 - Table 15*. In the last three years the system has only peaked between 7:00 and 8:00 PM in the summer once in 2014. While the top 50 – 200 hours do have some peak hours from 7:00 – 8:00 PM, I have a concern with extending the peak period one hour to 8:00 PM. Customers on the time based rates are being incented to reduce consumption for the afternoon thru the evening and it is only reasonable to allow customers some opportunity to use air conditioning and complete their household chores prior to going to sleep. As more technology is incorporated into managing household energy use it should be easier for customers to manage energy use later in the evening should the system peaks shift into the night. Should the system start to peak later in the day, the merits of extending the peak period later in the evening can be re-evaluated.

From a utility system capacity standpoint, in 2015 there are no instances in the top 20 hours where the peak was reached at 8pm and only two within the top 50 hours – which represents only 4%.

Table 13 APS Retail System Peak Hours 2016

		Peak Hour Ending (data through Sept.)							
Top	Hours in Summer	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM
4 Hours	4	0	0	0	1	2	1	0	0
20 Hours	20	0	0	5	7	6	2	0	0
50 Hours	50	0	5	9	14	13	7	2	0
100 Hours	100	4	9	18	23	25	13	7	1
200 Hours	200	11	20	32	40	42	31	15	7

Table 14 APS Retail System Peak Hours in 2015

		Peak Hour Ending							
Top	Hours in Summer	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM
4 Hours	4	0	0	1	2	1	0	0	0
20 Hours	20	0	2	4	7	5	2	0	0
50 Hours	50	2	5	10	14	11	6	2	0
100 Hours	100	4	10	18	29	23	9	6	1
200 Hours	200	9	21	43	46	46	19	10	4

Table 15 APS Retail System Peak Hours in 2014

		Peak Hour Ending								
Top	Hours in Summer	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	2:00 PM
4 Hours	4	0	0	0	1	2	1	0	0	0
20 Hours	20	0	2	2	5	5	4	1	1	0
50 Hours	50	2	3	7	9	11	10	4	3	1
100 Hours	100	3	5	12	17	23	21	11	4	2
200 Hours	200	5	12	22	37	44	39	21	12	4

Q. Do the marginal energy costs change significantly between the 3:00 – 8:00 PM period and the 2:00 – 7:00 PM periods?

A: No, there is very little difference. Based on the 2015 summer average marginal energy cost, there is only a ~$0.05/MWh differential between the two peak periods. In the winter period the difference is larger but still not significant, at $0.31 / MWH. Furthermore, the marginal energy costs between the peak and off-peak periods is also not significant. A summary of the marginal costs is shown in

Table 16.[47]

[47] Attachment JAH-35

Table 16 2015 System Marginal Costs

Season	Weekday Hours	Average Marginal Cost ($/MWH)
Summer	15 – 20	19.52
Summer	15 – 19	19.49
Summer	14 – 19	19.47
Summer	20 – 24	18.53
Winter	15 – 20	17.58
Winter	15 – 19	17.52
Winter	14 – 19	17.27
Winter	9 – 15	16.35
Winter	1 – 9, 19 – 24	16.80

Q. What is your proposed TOU and TOU/Demand rate design for all residential customers?

A. I have developed a seasonal rate option and a seasonal TOU option that modifies APS' recommendation to have the peak period defined as weekdays between 3:00 PM – 8:00PM to a 2:00 PM – 7:00 PM time period to both reflect cost causation and reasonable incentives for customers to manage their electricity use. In developing the rate design I focused on moderating the impacts so I used the current summer / winter price differentials as guidelines, but I did not keep exactly the same differentials. This approach was necessary since the percentage of demand and energy in the on and off-peak periods change as a result of reducing the peak period from seven hours to five hours.[48] A summary of the proposed rates is provided in Attachment JAH-2.

46 Attachment JAH-44

Q. Have you analyzed the customer bill impacts associated with your proposed rate changes?

A. Yes, I used the customer hourly consumption data that APS provided to calculate the monthly bill under the existing rate schedule using the base rates and the proposed rates that includes the transfer of adjusters to base rates. Based upon the testimony provided by Mr. Miessner the increase over base rates for residential customers is 19.30% but the net impact is 7.96%.[49] Since my analysis of annual bill impacts is based on the difference between base rates and the requested increase to base rates, the distribution of individual customer increases reflects the average class increase of 19.30%. An analysis of the distribution of annual bill changes for the non-solar customers on ET-2 is shown in *Table* 17. This analysis is based upon a sample of customers that had twelve monthly bills in 2015. The analysis of non-solar customers on ECT-2 is also shown in *Table* 17. This analysis is based upon all the customers that had twelve monthly bills in 2015. Both tables show that the vast majority of customers will experience annual bill increases within 2% of the average increase. While the Commission may want to consider further rate modifications in the future, it is important to incorporate gradualism so that individual customers do not have significant bill impacts. As shown in *Table* 11, there are a large number of low-income households in the APS service territory.

Table 17 Individual Customer Bill Impacts under Proposed Rate Design

Annual Increase (Customers with 12 bills)	<15% Increase	15%-17% Increase	17%-21% Increase	21%-23% Increase	23%-25% Increase	>25% Increase	Total Customers
Customers on ET-2	23.91%	15.85%	36.61%	11.98%	6.76%	4.90%	147,161
Customers on ETC-2	17.32%	15.63%	48.51%	14.14%	3.76%	0.64%	80,381

Q. Are you proposing rate design changes for the grandfathered rooftop solar customers?

A. No, those customers should continue on the legacy grandfathered rate schedules.

Q. Are you proposing any new optional rates?

A. Yes, in recognition of the Commission's progressive interest in new and emerging technologies, I recommend establishing an optional residential rate that is designed to incentivize the development of behind-the-meter residential storage paired with rooftop solar, the "Smart Storage Rate". This optional rate has both a TOU and a demand component. However, it differs from the current ECT-2 rate in that the demand charge is based on a daily demand rate set on the daily on-peak demand rather than the demand set on the maximum monthly on-peak demand.

Q. Why is a daily demand charge appropriate for incentivizing behind-the-meter storage than a monthly demand charge?

A. A daily demand charge sends a price signal incentivizing customers to reduce their demand each day during the peak hours. This is more favorable for storage adoption than a monthly demand charge, which effectively ratchets a customer's demand such that once a customer's peak demand is set in a given month, there is no incentive to reduce demand below that value for the rest of the month. On a monthly demand rate once a customer's maximum peak demand is set, even if it is not during the system peak, the value provided by the battery is only to reduce the cost of the customer's peak energy rate, and this reduces the value of installing storage.

Q. Are there other benefits to adoption of behind-the-meter energy storage, in addition to system peak demand reduction?

A. Yes, in addition to storage facilitating peak load reduction and peak load shifting, storage can be utilized to alleviate congestion at the distribution and transmission levels,

potentially deferring or avoiding the need to upgrade grid infrastructure. These benefits can be maximized if the utility implements a program to incentivize alternative dispatch of behind-the-meter storage systems. In addition, properly managed behind-the-meter storage, coupled with a smart inverter, can also improve system power quality and provide voltage management. In addition, there are societal benefits including additional jobs associated with the solar and related industries and reduced emissions. I have included an example of how storage paired with rooftop solar can reduce customer demands on utility infrastructure in Attachment JAH-3.

Q. Are incentives to increase adoption of peak load-shifting devices consistent with APS and Commission objectives?

A. Yes, APS has a number of demand response programs to manage peak demand. The adoption of behind the meter storage, facilitated by appropriate rate incentives will reduce both on-peak energy usage and on-peak demand, thus providing a high resource value.

Q. Do you have a specific rate proposal?

A. Yes, I reviewed the current ET-2 and ECT-2 rates as well as the APS proposed R-3 rate. I adopted APS's proposed seasonal peak periods definition for energy demand and then developed a rate to balance incentivizing behind-the-meter residential storage, providing appropriate price signals, and recovering the same target revenues as the proposed R-3 rate. For the reasons previously discussed, the monthly demand charge was converted to a daily demand charge.

Q. What are the component charges of the proposed Smart Storage rate?

A. The details of this rate are as follows:

- The fixed charge is equal to the fixed charge of APS's current Demand / TOU (ECT-2) rate at $0.556/day, or approximately $17/month. The approximately $7/month difference in fixed charges between the Smart Home Rate proposed fixed charge and APS's R-3 $24/month fixed proposed charge will be recovered in the seasonal demand rate.

- The $0.70/kW/month fee currently recovered by APS from solar DG customers will not be assessed on customers on the Smart Home Rate that install storage.
- The TOU seasons and periods are equivalent to the R-3 rate with the on-peak period defined as weekdays from 3:00 pm – 8:00 pm.
- The ratios of the on-peak and off-peak price differentials is equivalent to APS's current ET-2 rate, 4:1 in summer and approximately 3.25:1 in winter. The ratio of the summer and winter on-peak rates is also equivalent to APS's current ET-2 rate of approximately 1.25:1.
- The TOU energy rates were designed to recover equivalent revenues to the R-3 energy rates.
- The ratio of the differential between the summer and winter demand charge is equivalent to the 1.4:1 ratio in the R-3 rate.
- The demand rates are designed to recover equivalent revenues to the R-3 demand rates, in addition to the revenues that would have been recovered under the higher R-3 fixed charge.

A summary of the proposed rate is shown in *Table* 18.*Optional Residential Storage Rate*

Table 18 Optional Residential Storage Rate

Customer Charge ($/day)	$0.556	
	On-peak (weekdays, 3-8pm)	**Off-peak (all other hours)**
Bundled Energy Rate ($/kWh)		
Summer	$0.16268	$0.04067
Winter	$0.13218	$0.04068
Daily demand charge ($/kW-day)		
Summer	$1.336	n/a
Winter	$0.937	n/a

Q. How did you ensure that your rate was revenue neutral (i.e. collected the same revenues) to the proposed R-3 rate?

A. To ensure revenue neutrality between the Smart Storage Rate and APS's R-3 proposed rate, I designed the rate around the parameters previously discussed. I used the energy billing determinants for R-3 and solved for seasonal on and off-peak energy rates so that given the same billing determinants, the energy revenues are unchanged. The development of the daily demand billing determinants was more complex. I developed an estimate of the R-3 daily demand billing determinants by looking at the 2015 relationship between the sum of the daily on-peak demands and the monthly on-peak demand for the ETC-2 non-NEM customers using 2015 hourly customer data. I used the adjusted billing determinants to solve for the demand revenue requirement.

Q. Would you please elaborate on your estimation of the daily demand billing determinants?

A. Yes, I started with the hourly 2015 billing data for over 90,000 ECT-2 non-NEM customers and performed the following calculations.[50]

- I used the hourly data to calculate the maximum monthly on-peak demand for each customer and the sum of the maximum daily on-peak demands for each customer. The on-peak period is 3:00 – 8:00 PM,
- I summed up the individual customer daily on-peak demands by customer by month and by season,
- I summed up the individual customer monthly on-peak demands by customer by month and by season,

[50] Attachment JAH-44

- I calculated the ratio of the seasonal sum of daily on-peak demands to the seasonal sum of the monthly on-peak demands,
- I used the winter and summer seasonal ratios to adjust the R-3 summer and winter demand billing determinants
- I used the estimated daily demand billing determinants, the ratio of summer / winter demand rates and the demand revenue target to solve for the daily rate

A summary of this analysis is shown in *Table* 19.

Table 19 Adjustment of Monthly to Daily Demand Billing Determinants

Season	# of ECT-2 Bills	Sum of Daily On-Peak Demands	Sum of Monthly On-Peak Demands	Ratio
Winter	553,416	3,070,329	34,534,014	11.2477
Summer	554,846	4,559,965	64,875,606	14.2272

Q. Why is the Smart Storage Rate option a more preferable rate design for a customer than the R-3 rate?

A. In addition to providing a customer interested in adopting storage a cost effective rate option to pursue investments in storage, the design of the daily demand charge is inherently far less punitive than a monthly demand charge, should a customer set an uncharacteristically high single peak in a given month. For example, if a customer's maximum 1-hr peak for the month is set at 7 kW in a summer, this would amount to a charge of $114.80 under the R-3 rate, versus $9.35 under the daily demand charges for the other days under the storage rate. For the customer, setting this high demand will be much less financially punitive under a daily demand charge, however the customer is still presented with a strong price signal to incentivize reducing both consumption and demand during the peak hours.

Q. Why is the proposed Smart Storage Rate option an acceptable rate design for the utility?

A. The system benefits of storage accrue to all the utility customers and assuming no changes in usage or pattern of usage the utility is recovering the same revenues while incentivizing peak demand reduction during the peak window each weekday.

In addition, I recommend that the rate be evaluated in a few years to analyze the potential demand savings and compare those savings against the long-run marginal generation, transmission, and distribution capacity savings as well as any other benefits.

Q. Are there any additional potential modifications of this rate that will make it more attractive to residential customers?

A. Yes, the Smart Storage Rate could also serve as a replacement for the ET-EV rate that APS is proposing to sunset at the end of this rate case without a successor. I encourage the Commission to adopt the rate with a super off-peak period from the hours of 11pm to 5am, consistent with APS's current ET-EV rate, to incentivize EV charging during these off-peak hours.

Q. Do you have any additional recommendations for the Commission regarding this rate design?

A. Yes. I encourage the Commission to direct APS to revise its current interconnection requirements to remove any barriers to interconnection of behind-the-meter storage. I would also recommend that the Commission revisit the issue of standardizing storage interconnection rules in Arizona by reactivating the already open docket on storage interconnection rules.

X. ROOFTOP SOLAR WILL NO LONGER BE A VIABLE BUSINESS IN APS' SERVICE TERRITORY UNDER THE COMPANY'S PROPOSAL

Q. What are your concerns related to the viability of further rooftop solar in APS's territory?

A. My primary concern is that APS' proposal dramatically reduces or precludes solar installations and thus eliminates the social and consumer benefits of distributed generation. Furthermore, while the Commission established that the excess energy rate at the time a customer becomes a rooftop solar customer will be set for ten years, the lack of certainty about the rate after a ten year period will reduce the economics and accessibility of rooftop solar.

Q. Are you aware of any examples from this or other jurisdictions where solar rate design changes have had a negative impact on solar customers and the broader industry?

A. Yes, there have been multiple recent instances where changes to rates and rate structures have had significant economic impacts on solar customers and the industry as a whole. In late 2015, the Nevada PUC's decision to end net metering and disallow grandfathering for existing customers caused widespread concern amongst solar customers and lead to the three largest solar companies in the state to cease their operations and eliminate hundreds of jobs in the state of Nevada. Within this jurisdiction, in December 2014 Salt River Project (SRP) began requiring solar customers to take service under a new E-27 tariff – which subjected these customer to higher monthly fixed charges, mandatory demand charges, and a lower rate of compensation for energy exported back onto the grid. This resulted in the number of applications for solar system in 2015 being 94% lower than those received in 2014.[51]

[51] Attachment JAH-36

Q. Is your conclusion consistent with APS's analysis of the impact of demand charges on the penetration of residential rooftop solar?

********** **CONFIDENTIAL DATA – STARTS** **********

A. [redacted]

********** **CONFIDENTIAL DATA – ENDS** **********

Q. How does setting the excess energy rate for only ten years reduce the accessibility and economics of rooftop solar?

A. The ten year grandfathering creates additional risk for an entity offering a twenty year (or longer) lease and therefore the lease payments will have to be higher making the system less affordable. A customer who chooses to own their rooftop solar system will also factor in the additional risk in evaluating the economics of purchasing a solar system including how it could impact purchase financing. This is an example of asymmetric risk where the value of the exported solar energy for distributed energy customers is based upon long-term utility scale PPAs and the large scale solar customer is given price certainty while the distributed solar customer is not given that same certainty.

Q. Should Rate Rider EPR-6S be limited to solar systems of 100 kW-AC or less?

A. No, APS is proposing that new non-residential customers with solar be compensated at the non-firm avoided cost rate under EPR-2.[52] The value of the solar energy produced by the systems larger than 100 kW is just as valuable as systems below 100 kW.

Q. Should rooftop solar non-residential with solar systems over 100 kW by required to take service under Schedule E-56R?

A. No, similar to the arguments that I made for rooftop solar residential customers, customers should have the option to reduce their electricity purchases from APS by a range of options including fuel switching, energy efficiency, and installing solar panels on their premises.

Q. Will lowering the compensation for export of solar energy from systems over 100 kW impact the economics of rooftop solar?

A. Yes, APS notes that the existing commercial customers are compensated for exported solar production in the $0.05 - $0.08 / kWh range. While APS claims that these customers "do not export a significant amount of energy", lowering the rate adversely impacts the economics.[53]

XI. OTHER ISSUES REGARDING ROOFTOP SOLAR

Q. Will continuation of rooftop solar create a cross subsidization where low income customers are subsidizing high income customers?

A. No, as I previously explain, new rooftop solar customers will be paying 100% or more of their cost of service so these customers, regardless of their income, are not being subsidized.

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[52] Attachment JAH-16
[53] Attachment JAH-55 APS response to EFCA 24.33 (g).

Q. Will continuation of rooftop solar only benefit high income customers?

A. No, my research shows that use of residential rooftop solar spans a variety of household income levels and is not limited to just upper-income households. The analysis shows that in Arizona approximately 11% of the installations are in zip codes that have a median family income defined as low income.[54] In addition, 71% of the installations are in zip codes where the median family income is defined as middle class.[55] I developed this analysis using both median household income and median family income. A household can be a single person or multiple people or unrelated individuals. Families are defined two or more related people in the household. I included the family definition since it is a closer match to the definitions of the income brackets. This is the natural result of lower solar prices and increased financial options as the industry has grown and matured. My analysis is summarized in *Table* 20.

Table 200 APS Residential Solar Installations by Family Income

2015 Median Family Income	Income Bracket	Installations	Installed kW	Pcnt of Installations	% of AZ Families in Income Bracket
< $24,036	Poverty	420	2,663	1%	17%
$24,036 - $48,072	Lower Income	6,930	46,392	11%	24%
$48,072 - $75,000	Middle Class	26,938	195,264	47%	20%
$75,000 - $100,000	Middle Class	13,615	106,186	26%	14%
>= $100,000	Upper Class	7,258	62,188	15%	25%
Total		55,161	412,693	100%	100%

Q. Would you please describe how you prepared the analysis summarized in Error! Reference source not found.**Table *20***

A. I used the dataset of residential installations by zip code for APS from the ArizonaGoesSolar web site.[56] I obtained 2015 estimates of household income and median

[54] Attachment JAH-37
[55] Attachment JAH-38
[56] Attachment JAH-39

household income from the US Census Bureau.[57] I merged the two datasets and created the summary tables.

Q. Does the APS Solar Partners program help make rooftop solar more accessible?

A. No, it does not in that the customers do not own the systems - the program allows the utility to expand rate base investments thereby increasing their profits. The customers are receiving a $30/month payment for the use of their roof and the utility owns the system. If the public policy is for the utility to be the conduit for making distributed solar more accessible to a wider cross-section of residential customers, then there are alternatives to utility ownership such as expanding a competitive community solar program, long-term PPA's for community solar projects, PACE financing programs and potentially creating loan guarantee programs. Further, despite selling the program as one that would bring solar to low income Arizonans, only 8% of those that became customers under this rate were actually low income customers.

Q. Do you have concerns about APS continuing or expanding its Solar Partners program?

A. Yes. I have a number of concerns. My fundamental concern is that the Commission will give APS a further unfair competitive advantage where there is clearly a well-functioning and evolving competitive market. The Commission's granting authority for APS to install rooftop solar is not correcting any market failures, rooftop solar is not a natural monopoly. Continuation of the program in conjunction with the APS proposed rate treatment for new residential rooftop solar customers creates unfair competition and not only reduces customer choice, but also effectively eliminates the option for customers to choose to own their own solar systems as an economic alternative.

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[57] Attachment JAH-40

Another issue is that the program does not create any direct economic interest in the rooftop solar project and the customers' bill is independent of the output of the system. The customer's bill is unchanged by participation except for a $30/month rental payment. The customer is indifferent between the utility signing a PPA for a large utility scale project and receiving a monthly check for $30 versus the Solar Partners program.

Q. Is the rooftop solar business a competitive business in Arizona?

A. Yes, at least as of 2015. *Table* 21 shows that a large number of companies are serving the APS residential solar market. However, the impact of policies hostile to distributed solar have already impacted solar jobs in the state. The Arizona solar jobs census reported that there were 6,922 workers employed in the solar industry in Arizona in 2015 and this was a decrease of 24.5% following the reduction of installations associated with Salt River Project (SRP) implementing a high demand charge for non-grandfathered solar systems.[58] Despite the reduction of solar jobs, there were still 37 companies that installed 50 or more solar systems in APS's service territory in 2015 and 2016.

Table 21 Residential Solar Installations in APS Territory by Installer

Companies	Percent of total installations	Percent of total capacity
Top ten Companies	67.8%	69.4%
Companies with 251 - 1115 installations	15.1%	15.0%
Companies with 51 - 250 installations	11.7%	10.9%
Companies with < 50 installations	5.3%	4.8%
Total	168%	169%

Q. Why does Solar Partners create unfair competition?

A. The Commission, while not providing a guaranteed rate of return on the investment, creates a low risk investment for the utility through providing rate base treatment. Therefore the

[58] Attachment JAH-44

utility's shareholders earn a 10% or more rate of return and are not exposed to the risks that competitive solar providers have. Further, since the Company has an easy and direct line of communication with consumers and controls a variety of aspects of the solar application process (such as, for example, the time within which it processes solar applications), Solar Partners creates incentives for the Company to pressure consumers to favor Solar Partners over independent offerings.

Q. How do shareholders have little risk associated with rooftop solar compared to competitive providers?

A. The shareholders will get a return of and on their investment regardless of the performance of the system and the shareholders bear no price risk related to the value of electricity produced by the system. Alternatively, the private sector bears the performance risk and new installations under the current rules have price certainty on the output for only ten years and no certainty about the savings from avoided electricity purchases.

Q. Is the value of rooftop solar different if the system is owned by the utility versus the customer or third party business?

A. No, the electricity delivered to the grid, or flowing into the household to offset site use is the same regardless of the ownership. However, the policies of the Commission in conjunction with the rate proposal proposed by APS make it uneconomic for new rooftop solar installations yet the Company is advocating that it is economical if they own the systems.

Q. Is it more economical for the utility to own the systems than to continue with customer / non-utility third party ownership?

A. No, the average cost of the APS residential installations under the Solar Partners program is approximately $3.00/watt excluding the ongoing payments to customers, O&M costs,

and administrative costs.[59] The present value of the payments to customers is approximately $0.59/watt.[60] The annual O&M costs are estimated by APS at $17/kW-year and the company says it does not track the program administrative expenses.[61] In addition, the $3.00/watt of capital costs is not the cost to rate payers since customers must pay for the utility's after tax cost of capital and the associated taxes on earnings. In addition, virtually all risk associated with the investment is transferred to the rate payers once the Commission approves the inclusion of the investment in rate base.

Q. Does this conclude your testimony?

A. Yes.

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[59] Attachment JAH-42
[60] Attachment JAH-42
[61] Attachment JAH-43

BEFORE THE ARIZONA CORPORATE COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036 & E-01345A-16-0123

PREFILED DIRECT TESTIMONY OF

JAMES A. HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-1 – C.V

February 3, 2017

Jim Heidell

Jim Heidell specializes in electric and gas utility regulation, utility finance, wholesale electricity markets, evaluation of renewable energy technologies and financial analysis of complex investments. Mr Heidell assists clients with due diligence associated with acquisition of natural gas and electric utilities and wholesale energy market transactions. Mr Heidell has prepared and submitted testimony in both regulatory proceedings and civil contract damages cases. Mr Heidell also specializes in strategic analysis and evaluation of opportunities associated with renewable / alternative energy technologies. .

Primary expertise

- Electric and natural gas utility regulation and finance
- Analysis of wholesale electric markets
- Renewable Energy Technologies
- Asset valuation / M&A Advisor
- Damages estimation for civil litigation

Related experience

- Strategic planning
- Financial modelling of complex investments
- Financial planning

Qualifications

- 30-years' experience with electric & gas utilities and electricity markets
- MBA University of Washington
- MSE Engineering Economics, Stanford University
- BSE, Civil Engineering, Tufts University
- CFA

Primary expertise

Utility Regulatory Support - Prepare expert testimony in regulatory hearings related to resource acquisition, QF issues, rate impacts, marginal and embedded cost of service, and rate design. Developing marginal and embedded cost studies for regulated utilities.

Renewable Energy Technologies - Develop business plans, market positioning strategies, and financial analysis of renewable technologies including PV cell manufacturing, flywheels, and fuel cells along with renewable generation technologies including solar thermal, geothermal, wind, battery storage, and IGCC projects.

Analysis of Electric Markets - Develop energy and capacity forecasts for U.S. power markets to support: strategic investments by utilities and major energy companies, development of utility risk management strategies, and corporate strategies for generation asset acquisition and disposition.

Asset Valuation / M&A Advisor - Provide valuation advice for acquisition of electric generation portfolios, single power plants, transmission projects, electric utilities, and gas distribution companies. Work also included review of wholesale and retail regulatory pricing mechanisms and analysis of associated risk.

Damages Estimation for Civil Litigation Testimony - Prepare expert witness testimony to support power contract litigation, property tax cases, power plant development agreements, and quantification of economic damages.

Financial Analysis - Long-term modelling of utility finance. Analysis of major capital investments using a variety of tools to incorporate uncertainty and risk.

Key client achievements

UTILITY REGULATORY SUPPORT

Analysis and testimony on behalf of Norther Nevada Utility Customers related to cost of service and rate treatment of rooftop solar customers in the Sierra Pacific Power Company 2016 general rate case.

Analysis and testimony on behalf of Constellation Energy Group related to typical merger and acquisition conditions required by regulators in utility and non-utility transactions. Testimony related to the EDF / Constellation joint venture.

Testimony related the use and design of ratchet rates on behalf of Northern Indiana Public Service Company. Testimony related to the application of ratchets to the client's unique position and appropriate recovery of costs.

Analysis of the economics of an electric utility's interruptible rates including the value of interruptions versus the payments received by customers. Developed recommendations for pricing interruptible rate programs that were consistent with the utility's avoided costs and ISO markets.

Developed electric cost-of-service studies, rate design, and testimony to support Puget Sound Energy in multiple general rate cases in Washington. The engagements included addressing issues such as special rates for strategic customers with competitive options, line extension policies, and rates to address revenue attrition.

Developed natural gas cost-of-service studies, rate design, and testimony to support Puget Sound Energy in a general rate case in Washington.

Prepared marginal cost of service studies and testimony to support Montana-Dakota utilities in multiple Montana rate cases.

Assist Montana-Dakota Utilities in development of its integrated resource plan through analysis of options using the Strategist planning model.

Supported Montana-Dakota Utilities in answering a complaint in front of the South Dakota Public Utilities Commission regarding a wind generator requesting a contract under the provisions of PURPA.

Expert testimony related to Montana Dakota's proposed participation in the Big Stone II power plant. Prepared and delivered testimony provided in multiple hearings in North Dakota and Minnesota.

Prepared testimony on behalf of Hydro One Networks regarding rate shock and how to address necessary rate changes associated with the restructuring of the electric utility business in Ontario.

Developed an analysis or weather risk associated with the retail power sales of IPALCO. Effort was conducted as part of a comprehensive risk assessment conducted by AES. Models of the weather / load relationship were developed and then integrated with the rate structures and cost adjustment mechanisms to assess the utility's overall exposure to weather risk.

Advised Old Dominion Electric Cooperative on options for acquiring new generation in a depressed power market and incorporation of the analysis in their long-term resource planning.

MEXICO ENERGY MARKET REFORM

Developed rate proposals for PEMEX SDC tariffs for transportation, conditioning and storage of oil and natural gas. The rate proposals were the final stage of a project that started with benchmarking tariff structures in key markets worldwide, development of business considerations, development of appropriate cost of service and rate design principles, preparation of a revenue requirement, development of a cost of service model and study, and development of proposed rates for the PEMEX services.

Developed long-run electricity price forecasts multi-national energy companies reflecting the rules of the reformed market. Price forecast based upon an hourly chronological dispatch model.

Delivery of a workshop for rate design for CFE transmission. Review of distribution and transmission revenue requirements for CFE and analysis of financial implications of energy reform on CFE.

ELECTRIC MARKETS RISK MODELING

Advised major European trading company on entering the U.S. electricity trading business. Project included selection of target markets, characterization of types of trading opportunities, characterization of market volumes, identification of target customers, review of key licensing requirements, and development of a high level business strategy.

Provided support to a bond insurance company to prepare an assessment of the distribution of income from a fleet of peaking power plants in the South-East. Analysis used to review the provision for loss reserves.

Supported a bond insurance agency in determining the probability that a fleet of Mid-West generation assets would generate insufficient cash to meet debt payments and reserve requirements.

Developed an Excel based model for a mid-west public utility to assist in developing annual targets for the amount of surplus generation capacity to be sold as merchant and in contracts of varying tenor. The model was integrated into the corporate financial model to assist in identifying the appropriate risk profile to support building the reserve fund and to delay future rate increases.

M&A and BANKRUPTCY ADVISOR

Advised creditors of the Puerto Rico Power Authority (PREPA) with regards to restructuring over eight billion dollars of debt. Multiple analyses were developed to support the restructuring negotiations including the development of a financial model to forecast the revenue requirement under different scenarios of fuel costs, types of generation resources, and cost savings initiatives.

Prepared an analysis of New Mexico Gas Company to support a prospective buyer. We assisted multiple clients with due diligence related to the acquisition of gas LDCs. Assisted the client with a review of the deal model including: assumptions about rate cases, assumptions regarding ROE, sales growth by rate class, and revenue by rate class. The engagement also included an assessment of the regulatory climate and potential conditions and costs associated with obtaining regulatory approval of the transaction.

Prepared a valuation of the Mountaineer Gas Company including the analysis of regulatory issues to support the debt financing associated with the purchase of the energy company.

Assisted an infrastructure fund in valuing power contracts and reviewed the regulatory model used in conjunction with establishing the price to bid for the acquisition of Northwestern Utility.

Prepared an analysis of Duquense Light to support an infrastructure fund's bid for the utility. The analysis included projections of growth opportunities through distribution & transmission investment, analysis of the POLR load obligation, and a review of key regulatory issues.

Developed a valuation model of Mirant including analysis of debt carrying capacity to assist a strategic player in the U.S. Power Industry determine whether to make an unsolicited offer to purchase Mirant.

Assisted an international oil company in development of modelling processes and assumptions to support a corporate effort to acquire a fleet of U.S. merchant generating assets.

Support a strategic player in valuing the Lake Road Generation Plant as part of their bid to acquire the asset in a competitive auction. Effort involved projection of future gross margins of the plant, analysis of the ISO-NE Forward Capacity Market, and analysis of transmission constraints.

Directed the valuation of the entire NRG portfolio on behalf of the bank creditors in the NRG bankruptcy hearings. The valuation work included advising on a range of types of generation assets in the U.S. as well as in Europe, South America, and the Asia-Pacific region. Mr Advised on the fairness of offers for assets being disposed of by NRG.

Assisted creditors in the valuation of assets in the NEG bankruptcy including the options for completing unfinished gas-fired generation assets. Served as the interim finance manager for the Lake Road Generation facility.

Member of team that advised Calpine as part of the company's restructuring and plan of reorganization. Assignment included analysis of the Canadian portfolio, advising on the sale of generation assets, modelling of long-term turbine maintenance costs, and the valuation of complex power contract.

Assisted the lenders on valuation and strategy related to AES' turn-back of the Granite Ridge Power Plant to the lender group.

Advised the bank and lender group on valuation and strategy related to the bankruptcy of the Kendall Power Plant.

ELECTRIC GENERATION FINANCE SUPPORT:

Market expert report for the Landfill Energy Systems, a national 66 MW portfolio of fourteen landfill gas power plants. The market expert report included a discussion of the key attributes of each of the power markets that the portfolio encompasses, long-term forecasts of wholesale electricity prices, and forecasts of gross margins.

Independent Market Expert Report to support the financing of the repowering and development of a fleet of combined cycle and simple cycle power plants in the ERCOT market. The independent market expert report was used to support the syndication of loans and obtaining debt ratings associated with investing over $1 billion in the Barney Davis, Nueces Bay, and Laredo Energy Center facilities.

Independent Market Expert Report to support the financing of Sequent Power's purchase of the Wolf Hollow 730 MW combined cycle power plant located in ERCOT. The report was used to support the syndication and rating of over $400M of primary and mezzanine debt. The report incorporated forecast of gross margins for both the contracted and non-contracted portions of the facility as well as providing a detailed description of the ERCOT market conditions and key assumptions to the financial analysis.

Independent Market Expert Report to support the financing of Invenergy's purchase of the partially completed Grays Harbor 620 MW combined cycle power plant located in the Pacific Northwest. The report was used to support the syndication and rating of over $100M of debt. The analysis included valuing both hedged and unhedged positions for the facility and conducting extensive due diligence regarding how NW power markets are likely to evolve and the role of independent power in a market dominated by vertically integrated public and investor-owned utilities.

Independent Market Report to support the refinancing of the Dynegy corporate revolver. The effort included analysis of multiple U.S. power markets, valuation of the fleet of generation assets and associated contracts, and review of regulatory conditions impacting the Company's ability to realize earnings in markets with competitive auctions to serve load.

Multiple forecasts of California power market prices including support of a bid for a cogeneration facility located in the San Francisco Bay area and sale of La Rosita.

Forecast of the New England power markets to support a bid for the First Light Generation Assets.

Forecast of the California and SPP power markets to support a bid for assets from the EIF portfolio.

Analysis of the ERCOT, PJM and MISO markets for multiple bids for merchant gas fired generation plants.

Development of multiple Confidential Information Memorandums to support the sale of power plants. CIMs included description of the wholesale power markets and summaries of the key attributes of the assets to be sold in auction.

Preparation of sale offering of the Audrain power plant in response to Ameren solicitation to acquire new resources. Effort included evaluation of likely competitors and the development of the bid strategy.

Advise on pricing for offering power contracts as well as the sale of gas-fired combined cycle power plant in the South-East. Pricing and sale price based upon projections of the value of the power plant as a merchant unit, assessment of potential competitors, and the analysis of transmission constraints.

Additional Expertise - Expert Testimony

Before the Public Utilities Commission of Nevada, Direct and Rebuttal Testimony of James A. Heidell, Docket No. 16-06006 In the Matter of the Application of Sierra Pacific Power Company, d/b/a NV Energy. Testimony on behalf of Northern Nevada Utility Customers on cost of service and rate design for rooftop solar customers.

Before the Public Service Commission of Maryland, Rebuttal Testimony of James A. Heidell, Case No. 9173, Phase II In The Matter Of The Current And Future Financial Condition Of Baltimore Gas And Electric Company.

Before the Indiana Utility Regulatory Commission, Rebuttal Testimony in Northern Indiana Public Service Company's request to raise rates in Cause No. 43526. Testimony on behalf of the utility related to ratchets and other mechanisms appropriate to recover costs allocated to large energy using customer classes.

Before Public Service Commission of the State of North Dakota, Direct and Rebuttal Testimony in Montana Dakota Utilities Co., and Otter Tail Corporation; Advance Determination of Prudence, Big Stone II Generating Station Case Nos. PU-06-481 and PU-06-482. On behalf of Montana-Dakota Utilities. 2007 & 2008. On behalf of Montana-Dakota Utilities.

Before the Public Service Commission of the State of Montana, Direct and Rebuttal Testimony in Montana-Dakota's General Rate Case – Marginal Cost of Service Study, Docket No. D2010.8.82. On behalf of Montana-Dakota Utilities.

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Affidavit of James A. Heidell & Mark Repsher, Appropriate Approach to Calculating the Weighted Cost of Capital, Docket No. ER14-2940-0000, U.S. Federal Energy Regulatory Commission, October 15, 2014.

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BEFORE THE ARIZONA CORPORATE COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036 & E-01345A-16-0123

PREFILED DIRECT TESTIMONY OF

JAMES A. HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-2 – Proposed Residential Rates

February 3, 2017

ARIZONA PUBLIC SERVICE COMPANY
Residential Rate ET-2 Present Rate (Excludes EPR-2, EPR-6)
Test Year Ending Dec-15
Proof of Revenue

EFCA Proposed - Peak 2:00 PM - 7:00 PM - Lower Peak / Off-Peak Ratios

EFCA Proposed - Peak 2:00 PM - 7:00 PM - Billing Units from Class Hourly Profile

Present Charge	Present Billing Determinants	Present Rate ($/unit)	Present Revenue ($)	Proposed Units Normalized	Proposed Rate ($)	Proposed Revenue ($)	Notes		Billing Units
ET-2				-					
Summer - Days	54,059,066	0.556	30,056,841	54,059,066	0.308	16,633,218	average rate increase to E-12		54,059,066
On-peak kWh	700,286,350	0.24477	171,409,090	527,023,392	0.32121	169,285,184	Limit to 10% more than ET-2 Legacy Proposed	0.32121	520,295,491
Off-peak kWh	2,056,371,542	0.06118	125,808,811	2,229,634,500	0.09193	204,970,300	maintain winter / summer off-peak the same	3.49	2,201,171,325
Billed kWh, Revenue	2,756,657,892		327,274,742	2,756,657,892		390,888,702			2,721,466,816
Winter - Days	53,672,350	0.556	29,841,827	53,672,350	0.308	16,514,231			53,672,350
On-peak kWh	289,841,818	0.19847	57,524,906	218,717,259	0.26045	56,964,910	Limit to 10% more than ET-2 Legacy Proposed	0.26045	212,221,139
Off-peak kWh	1,252,848,931	0.06116	76,624,241	1,323,973,490	0.09193	121,712,883	requirement	2.83	1,284,650,164
Billed kWh, Revenue	1,542,690,749		163,990,974	1,542,690,749		195,192,024			1,496,871,303
Annual Total	4,299,348,641		491,265,716	4,299,348,641		586,080,726			4,218,338,119
						586,079,999	19.3% target increase		

ARIZONA PUBLIC SERVICE COMPANY
Residential Rate ECT-2 Solar Legacy (EPR-2, EPR-6)
Test Year Ending Dec-15
Proof of Revenue

Present Charge	Present Billing Determinants	Present Rate ($/unit)	Present Revenue ($)	Proposed Units Normalized	Proposed Rate ($)	Proposed Revenue ($)	EFCA Proposed - Peak 2:00 PM - 7:00 PM - Lower Peak / Off-Peak Ratios Notes		EFCA Proposed - Peak 2:0(Billing Units from Class Ho Billing Units
ECT-2				-					
Summer - Days	16,976,486	0.556	9,438,926	16,976,486	0.308	5,223,427	average rate increase to E-12		16,976,486
On-peak kW	4,462,949	13.50	60,249,812	4,402,969	16.11	70,931,827	Limit to 0% more than ECT-2 Legacy Proposed		4,424,878
On-peak kWh	331,607,268	0.08867	29,403,616	248,357,850	0.11636	28,898,919	Limit to 10% more than ECT-2 Legacy Proposed	0.11636	247,368,998
Off-peak kWh	1,026,914,142	0.04417	45,358,798	1,110,163,560	0.06007	66,687,525	maintain winter / summer off-peak the same	1.94	1,105,743,378
Billed kWh, Revenue	1,358,521,410		144,451,152	1,358,521,410		171,741,698			1,353,112,376
Winter - Days	16,911,127	0.556	9,402,587	16,911,127	0.308	5,203,317			16,911,127
On-peak kW	2,963,458	9.30	27,560,159	2,888,245	11.10	32,059,515	Limit to 0% more than ECT-2 Legacy Proposed		2,902,616
On-peak kWh	138,610,066	0.05747	7,965,920	104,218,186	0.07542	7,860,136	Limit to 10% more than ET-2 Legacy Proposed	0.07542	101,425,465
Off-peak kWh	632,975,248	0.04107	25,996,293	667,367,128	0.06006	40,082,070	use solver to ajust winter off-peak rate to get revenue	1.26	649,483,778
Billed kWh, Revenue	771,585,314		70,924,959	771,585,314		85,205,038			750,909,242
Annual Total	2,130,106,724		215,376,111	2,130,106,724		256,946,736			2,104,021,618
Annual Total Demand	7,426,407					256,943,700	19.3% target increase		7,463,361

ARIZONA PUBLIC SERVICE COMPANY
Residential Storage Proposed Rate
Test Year Ending Dec-15
Proof of Revenue

Proposed Charge	Proposed Billing Determinants	Rate ($/unit)	Proposed Revenue ($)
Rate R-3			
Summer - Days	47,630,809	0.556	26,482,730
On-peak daily kW	165,393,505	1.336	220,965,723
On-peak kWh	671,525,410	0.16268	109,243,754
Off-peak kWh	2,972,965,896	0.04067	120,910,523
Billed kWh, Revenue	3,644,491,306		477,602,730
Winter - Days	47,807,269	0.556	26,580,842
On-peak daily kW	94,158,079	0.937	88,226,120
On-peak kWh	311,199,174	0.13218	41,133,529
Off-peak kWh	1,898,482,501	0.04068	77,230,268
Billed kWh, Revenue	2,209,681,675		233,170,759
Annual Total	5,854,172,981		710,773,489

Analysis of ECT-2 Non-NEM customers

Season	# of ECT-2 Bills	Sum of Daily On-Peak Demands	Sum of Monthly On-Peak Demands	Ratio
Winter	553,416	3,070,329	34,534,014	11.2477
Summer	554,846	4,559,965	64,875,606	14.2272

Approximate # of Customers 92,355

BEFORE THE ARIZONA CORPORATE COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036 & E-01345A-16-0123

PREFILED DIRECT TESTIMONY OF

JAMES A. HEIDELL

On Behalf of Energy Freedom Coalition of America

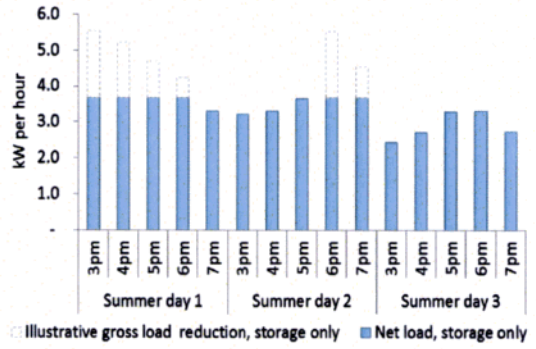
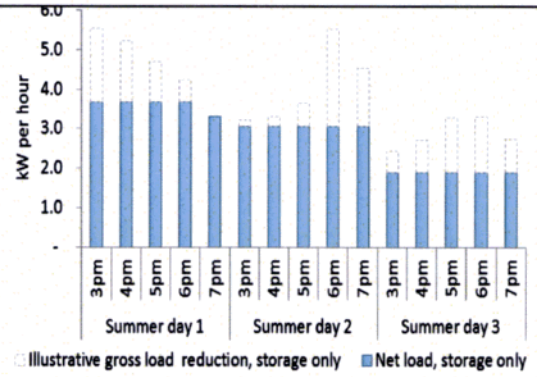
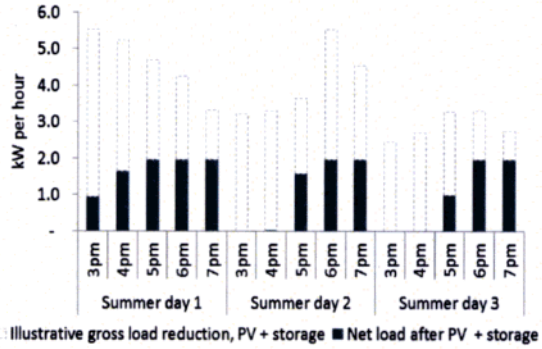
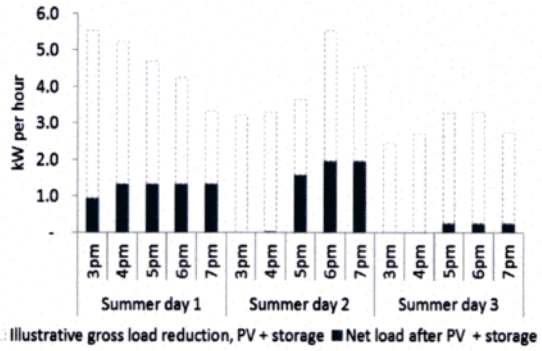
Attachment JAH-3 – Example of Energy Storage

February 3, 2017

Illustrative Billing Under the Residential Storage Optional Rate

In the illustrative three day billing period example below, the "monthly" demand is set on day one to about 3.7 kW for storage only and about 2 kW with PV + storage. In the monthly demand charge example, the storage resource is not large enough to reduce the net demand in days 2 and 3 below the threshold set on the first day, hence will reserve capacity for the subsequent day. The battery is underutilized and the net demand on the system from this home is not reduced below the day one demand. In the daily demand charge example, the storage resource is more fully dispatched each day because bill savings are possible for decreasing net load as much as possible. This results in more significant savings for the customer, encouraging more investment in storage, and a greater net load reduction on the system from this customer, due to decreased overall net peak demand. In the event a system wide peak occurs on a day that does not coincide with an individual customer's peak, a customer on a monthly demand charge would not be incentivized to provide any relief to the system whereas a customer on a daily demand charge would be encouraged to do so.

Figure 1: Illustrative Peak Reduction Benefit of Storage and Storage + Solar on Monthly and Daily Demand Charge

Dispatch for Monthly Demand Charge Reduction	Dispatch for Daily Demand Charge Reduction
	
	

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-4: Arizona Corporation Commission - In the Matter of the Commission's Investigation of Value and Cost of Distributed Generation, Decision No. 75859, January 3, 2017

0000176114

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Corporation Commission
DOCKETED

JAN - 3 2017

DOCKETED BY

COMMISSIONERS

DOUG LITTLE – Chairman
BOB STUMP
BOB BURNS
TOM FORESE
ANDY TOBIN

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COST OF DISTRIBUTED GENERATION.

DOCKET NO. E-00000J-14-0023

DECISION NO. 75859

OPINION AND ORDER

DATE OF HEARING: November 4, 2015, (Procedural Conference), April 15, 2016, (Pre-Hearing Conference), April 19-22, 25, 27, 29, May 5-6, 10-11, June 8-9, and 13, 2016

PLACE OF HEARING: Phoenix, Arizona

ADMINISTRATIVE LAW JUDGE: Teena Jibilian

APPEARANCES:

Mr. Thomas A. Loquvam, PINNACLE WEST CAPITAL CORPORATION Law Department, and Mr. Raymond S. Heyman, SNELL & WILMER, LLP, on behalf of Arizona Public Service Company;

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Ms. Jennifer Cranston, GALLAGHER & KENNEDY, PA, on behalf of Grand Canyon State Electric Cooperative Association, Inc.;

Mr. Nicholas J. Enoch and Ms. Emily Tornabene, LUBIN & ENOCH, PC, on behalf of IBEW Locals 387, 1116 and 769;

Mr. Greg Patterson, Of Counsel, MUNGER CHADWICK, on behalf of Arizona Competitive Power Alliance;

Mr. Tom Harris, on behalf of Arizona Solar Energy Industries Association;

Ms. Patricia C. Ferré, pro se;

Mr. Craig A. Marks, CRAIG A. MARKS, PLC, on behalf of Arizona Utility Ratepayer Alliance;

Mr. Daniel Pozefsky and Mr. Jordy Fuentes, Chief Counsel, on behalf of the Residential Utility Consumer Office; and

Ms. Maureen Scott, Senior Staff Counsel, and Mr. Matthew Laudone, Staff Attorney, Legal Division, on behalf of the Utilities Division of the Arizona Corporation Commission.

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BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-5: Staff 5.23_Unit Cost for Basic Services_APSRC0124.xls

	General Service/E-		General Service		E-20 (Church Rate)	
December Customer Count	139,289		128,443		405	
MW	41,475		39,595		236	
MWh	15,667,021		15,157,141		38,746	
		$/cust/mo		$/cust/mo		$/cust/mo
Distribution (Transformers, Secondary & Services)	55,412,124	33.15	38,163,419	24.76	293,782	60.45
Distribution Costs for BSC	**55,412,124**	**33.15**	**38,163,419**	**24.76**	**293,782**	**60.45**
Distribution (Customer Accounts, Cust. Service, Sales)	13,950,060	8.35	12,882,572	8.36	45,032	9.27
Metering	18,687,504	11.18	18,063,632	11.72	174,255	35.86
Billing	1,510,211	0.90	1,392,469	0.90	4,397	0.90
Meter Reading	414,826	0.25	410,187	0.27	1,296	0.27
Revenue Cycle Costs for	**34,562,600**	**20.68**	**32,748,861**	**21.25**	**224,982**	**46.29**
Total BSC	**89,974,725**	**53.83**	**70,912,280**	**46.01**	**518,764**	**106.74**

	Total Residential		RESIDENTIAL E-12		RESIDENTIAL ET-1 & ET-2	
December Customer Count	1,059,292		473,340		429,763	
MW	73,645		24,640		34,271	
MWh	13,518,425		3,689,073		6,464,264	
		$/cust/mo		$/cust/mo		$/cust/mo
Distribution (Transformers, Secondary & Services)	173,409,381	13.64	58,751,263	10.34	80,145,215	15.54
Distribution Costs for BSC	**173,409,381**	**13.64**	**58,751,263**	**10.34**	**80,145,215**	**15.54**
Distribution (Customer Accounts, Cust. Service, Sales)	92,678,529	7.29	41,098,599	7.24	37,761,942	7.32
Metering	81,516,159	6.41	32,709,158	5.76	29,706,953	5.76
Billing	11,500,132	0.90	5,138,634	0.90	4,665,699	0.90
Meter Reading	3,389,741	0.27	1,514,522	0.27	1,375,251	0.27
Revenue Cycle Costs for	**189,084,561**	**14.88**	**80,460,913**	**14.17**	**73,509,845**	**14.25**
Total BSC	**362,493,942**	**28.52**	**139,212,176**	**24.51**	**153,655,061**	**29.79**

	E-32 TOU (0-100 kW)		E-32 TOU (101-400 kW)		E-32 TOU (401+ kW)		School TOU	
December Customer Count	379		73		55		122	
MW	109		169		568		445	
MWh	36,912		72,164		245,946		105,093	
		$/cust/mo		$/cust/mo		$/cust/mo		$/cust/mo
Distribution (Transformers, Secondary & Services)	118,943	26.15	145,370	165.95	355,877	539.21	457,089	312.22
Distribution Costs for BSC	**118,943**	**26.15**	**145,370**	**165.95**	**355,877**	**539.21**	**457,089**	**312.22**
Distribution (Customer Accounts, Cust. Service, Sales)	37,705	8.29	15,494	17.69	36,894	55.90	35,243	24.07
Metering	71,835	15.79	123,832	141.36	68,945	104.46	60,725	41.48
Billing	4,113	0.90	792	0.90	597	0.90	1,324	0.90
Meter Reading	1,211	0.27	233	0.27	176	0.27	390	0.27
Revenue Cycle Costs for	**114,864**	**25.26**	**140,352**	**160.22**	**106,612**	**161.53**	**97,683**	**66.72**
Total BSC	**233,807**	**51.41**	**285,722**	**326.17**	**462,489**	**700.74**	**554,772**	**378.94**

	RESIDENTIAL ECT-1 & ECT-2		RESIDENTIAL SOLAR (ENERGY RATES)		RESIDENTIAL SOLAR (DEMAND RATES)	
December Customer Count	118,890		35,988		1,311	
MW	11,976		2,624		135	
MWh	2,801,983		530,434		32,670	
		$/cust/mo		$/cust/mo		$/cust/mo
Distribution (Transformers, Secondary & Services)	28,194,122	19.76	6,025,110	13.95	293,670	18.67
Distribution Costs for BSC	**28,194,122**	**19.76**	**6,025,110**	**13.95**	**293,670**	**18.67**
Distribution (Customer Accounts, Cust. Service, Sales)	10,587,732	7.42	3,115,186	7.21	115,070	7.31
Metering	8,219,855	5.76	10,498,288	24.31	381,905	24.28
Billing	1,290,740	0.90	390,824	0.90	14,235	0.90
Meter Reading	380,470	0.27	115,301	0.27	4,198	0.27
Revenue Cycle Costs for	**20,478,796**	**14.35**	**14,119,598**	**32.70**	**515,408**	**32.76**
Total BSC	**48,672,918**	**34.12**	**20,144,709**	**46.65**	**809,078**	**51.43**

	E-30, E-32 (0-100 kW)		E-32 (101-400 kW)		E-32 (401+ kW)		E-34	
December Customer Count	122,044		4,259		1,028		32	
MW	15,012		8,641		7,867		1,765	
MWh	4,100,274		3,272,544		3,708,764		937,757	
		$/cust/mo		$/cust/mo		$/cust/mo		$/cust/mo
Distribution (Transformers, Secondary & Services)	22,257,346	15.20	8,163,972	159.74	4,744,214	384.58	375,726	978.45
Distribution Costs for BSC	**22,257,346**	**15.20**	**8,163,972**	**159.74**	**4,744,214**	**384.58**	**375,726**	**978.45**
Distribution (Customer Accounts, Cust. Service, Sales)	11,125,735	7.60	842,547	16.49	495,252	40.15	87,549	227.99
Metering	14,443,876	9.86	1,920,379	37.57	867,664	70.34	136,094	354.41
Billing	1,324,669	0.90	45,926	0.90	9,890	0.80	304	0.79
Meter Reading	390,210	0.27	13,531	0.26	2,914	0.24	90	0.23
Revenue Cycle Costs for	**27,284,490**	**18.63**	**2,822,383**	**55.22**	**1,375,720**	**111.52**	**224,037**	**583.43**
Total BSC	**49,541,837**	**33.83**	**10,986,355**	**214.96**	**6,119,934**	**496.10**	**599,763**	**1,561.88**

December Customer Count
MW
MWh
Distribution (Transformers, Secondary & Services)
Distribution Costs for BSC
Distribution (Customer Accounts, Cust. Service, Sales)
Metering
Billing
Meter Reading
Revenue Cycle Costs for
Total BSC

	E-35		E-221 (Water Pumping)		Street Lighting		Dusk to Dawn	
December Customer Count	46		1,450		1,153		8,243	
MW	4,783		1,398		419		64	
MWh	2,638,942		336,064		150,810		23,006	
		$/cust/mo		$/cust/mo		$/cust/mo		$/cust/mo
Distribution (Transformers, Secondary & Services)	1,251,100	2,266.48	1,434,825	82.46	9,910,810	716.31	5,903,070	59.68
Distribution Costs for BSC	**1,251,100**	**2,266.48**	**1,434,825**	**82.46**	**9,910,810**	**716.31**	**5,903,070**	**59.68**
Distribution (Customer Accounts, Cust. Service, Sales)	161,120	291.88	206,515	11.87	124,164	8.97	736,809	7.45
Metering	196,027	355.12	623,871	35.85	-	-	-	-
Billing	456	0.83	15,741	0.90	12,517	0.90	89,483	0.90
Meter Reading	134	0.24	4,639	0.27	-	-	-	-
Revenue Cycle Costs for	**357,737**	**648.07**	**850,767**	**48.89**	**136,681**	**9.88**	**826,292**	**8.35**
Total BSC	**1,608,837**	**2,914.56**	**2,285,592**	**131.36**	**10,047,491**	**726.18**	**6,729,362**	**68.03**

December Customer Count
MW
MWh

Distribution (Transformers, Secondary & Services)
Distribution Costs for BSC

Distribution (Customer Accounts, Cust. Service, Sales)
Metering
Billing
Meter Reading
Revenue Cycle Costs for

Total BSC

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-6: Arizona Solar Jobs Census 2015, The Solar Foundation, www.TSFcensus.org

2015

ARIZONA SOLAR JOBS CENSUS

The SOLAR FOUNDATION™

RESEARCH & EDUCATION TO ADVANCE SOLAR ENERGY

[bw] RESEARCH PARTNERSHIP

ASU ENERGY POLICY INNOVATION COUNCIL

ABOUT THE SOLAR FOUNDATION®

The Solar Foundation® (TSF) is an independent 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transforms markets. TSF is considered the premier research organization on the solar labor workforce, employer trends, and the economic impacts of solar. It has provided expert advice to leading organizations such as the National Academies, the Inter-American Development Bank, the U.S. Department of Energy, and others during a time of dynamic industry growth and policy and economic uncertainty.

While TSF recognizes that solar energy is a key part of our energy future, it is committed to excellence in its aim to help people fairly and objectively gauge the value and importance of solar technologies.

ABOUT BW RESEARCH PARTNERSHIP

BW Research is widely regarded as the national leader in labor market research for emerging industries and clean energy technologies. In addition to the *Census* series, BW Research has conducted rigorous solar installation and wind industry labor market analysis for the National Renewable Energy Laboratory, wind energy and energy retrofit studies for the Natural Resources Defense Council, a series of comprehensive clean energy workforce studies for the Commonwealth of Massachusetts, Illinois, Vermont, Florida, Pennsylvania, Iowa, and California, as well as numerous skills and gap analyses for community colleges, workforce investment boards, state agencies, and nonprofit organizations.

ABOUT THE ARIZONA STATE UNIVERSITY ENERGY POLICY INNOVATION COUNCIL

The Energy Policy Innovation Council (EPIC) at Arizona State University informs and educates policymakers and key stakeholders on current, complex issues in energy policy that impact Arizona and beyond. In addition to creating policy brief sheets, videos, and reports, EPIC staff and student researchers strive to make policy more accessible in innovative ways, such as live-tweeting public hearings. EPIC is currently engaged in the transformative regulatory proceedings underway in Hawai'i and in Clean Power Plan activities in Arizona. EPIC is housed within the School for the Future of Innovation in Society at Arizona State University in Tempe, Arizona.

COVER IMAGE COURTESY OF THE NATIONAL RENEWABLE ENERGY LABORATORY

ACKNOWLEDGEMENTS

The Solar Foundation® (TSF) is a national 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transform markets. In 2010, TSF conducted its first *National Solar Jobs Census* report, establishing the first credible solar jobs baseline and verifying that the solar industry is having a positive impact on the U.S. economy. Using the same rigorous, peer-reviewed methodology, TSF has conducted an annual Census in each of the last six years to track changes and analyze trends.

This *Arizona Solar Jobs Census 2015* report is an offshoot of TSF's *National Solar Jobs Census 2015* effort. Research partners for the *Census 2015* effort include the Arizona State University Energy Policy Innovation Council for providing editorial guidance and peer review, the George Washington University Solar Institute for providing assistance and support in reviewing and validating report results and analysis; the Solar Energy Industries Association (SEIA) for use of its National Solar Database and peer review; and GTM Research/SEIA for providing survey respondents with the U.S. Solar Market Insight: 2014 YIR report.

Sponsors of this year's *Census* effort include: Energy Foundation, William and Flora Hewlett Foundation, Tilia Fund, George Washington University Solar Institute, SEIA, Recurrent, SolarCity, First Solar, Sol Systems, E.ON, Trina Solar, State of Minnesota Department of Commerce, State of New Mexico Energy Minerals and Natural Resources Department, Utah Governor's Office of Energy Development, sPower, Standard Solar, CALSEIA, All Earth Renewables, and groSolar.

Finally, we want to thank all the Arizona employers that participated in the survey. Your responses were critical in providing us with accurate and timely data.

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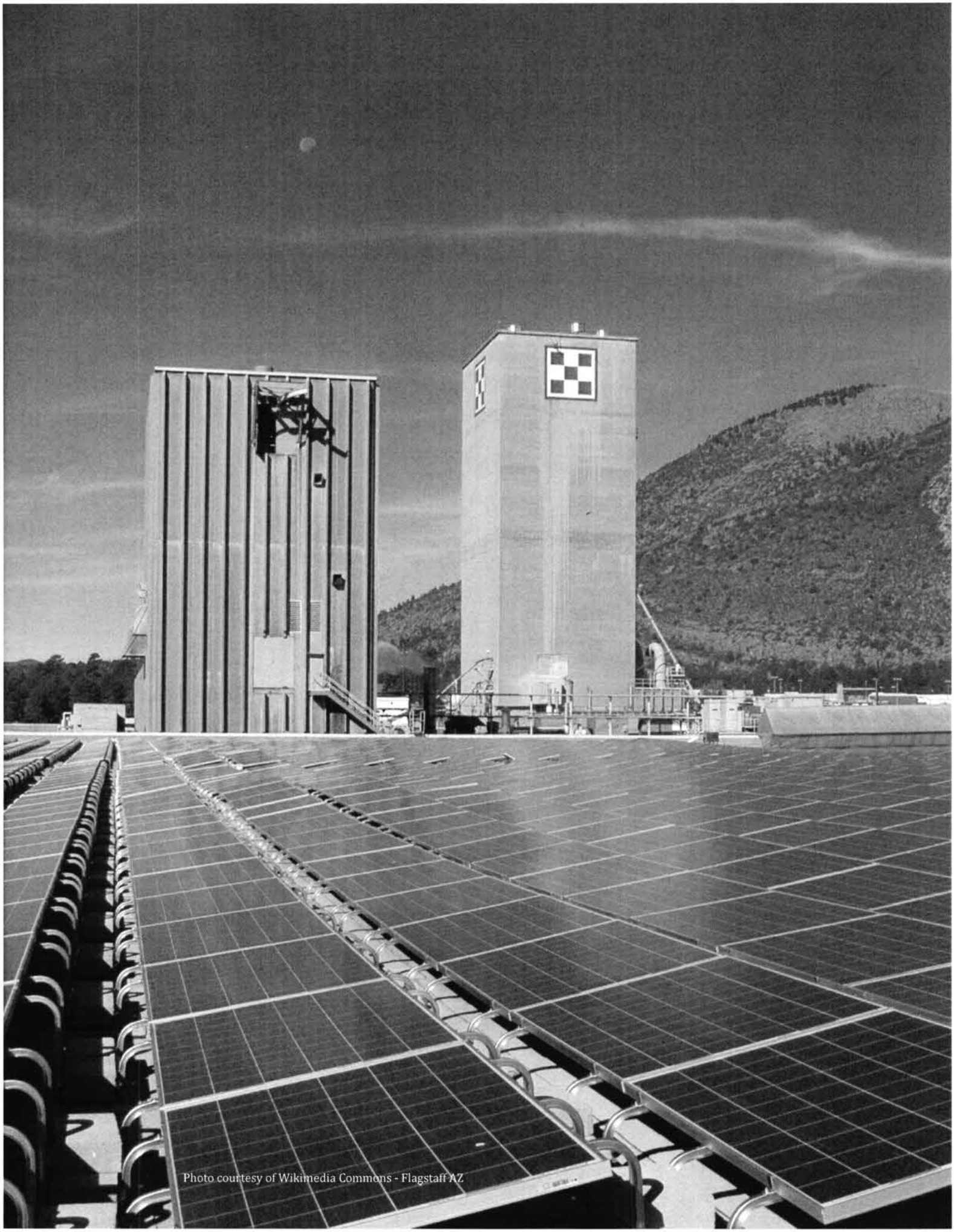
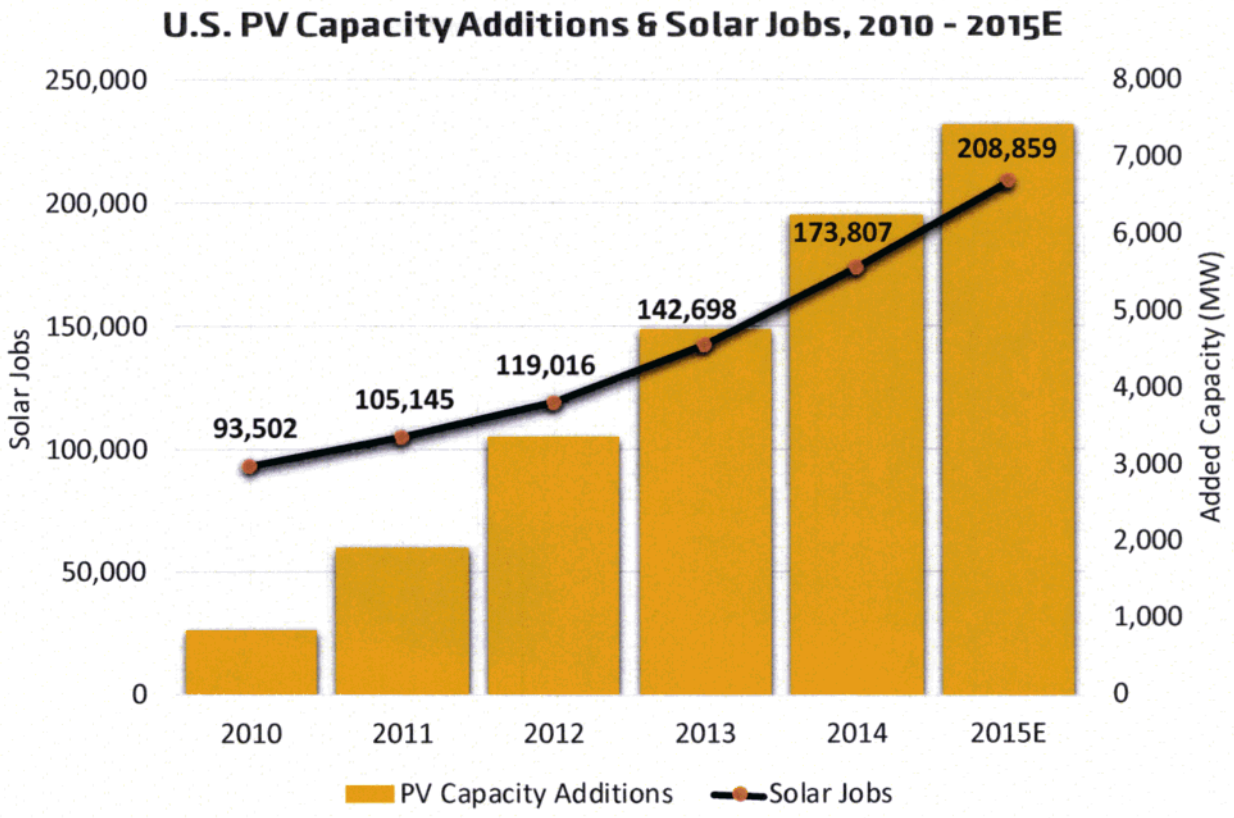


Photo courtesy of Wikimedia Commons - Flagstaff AZ

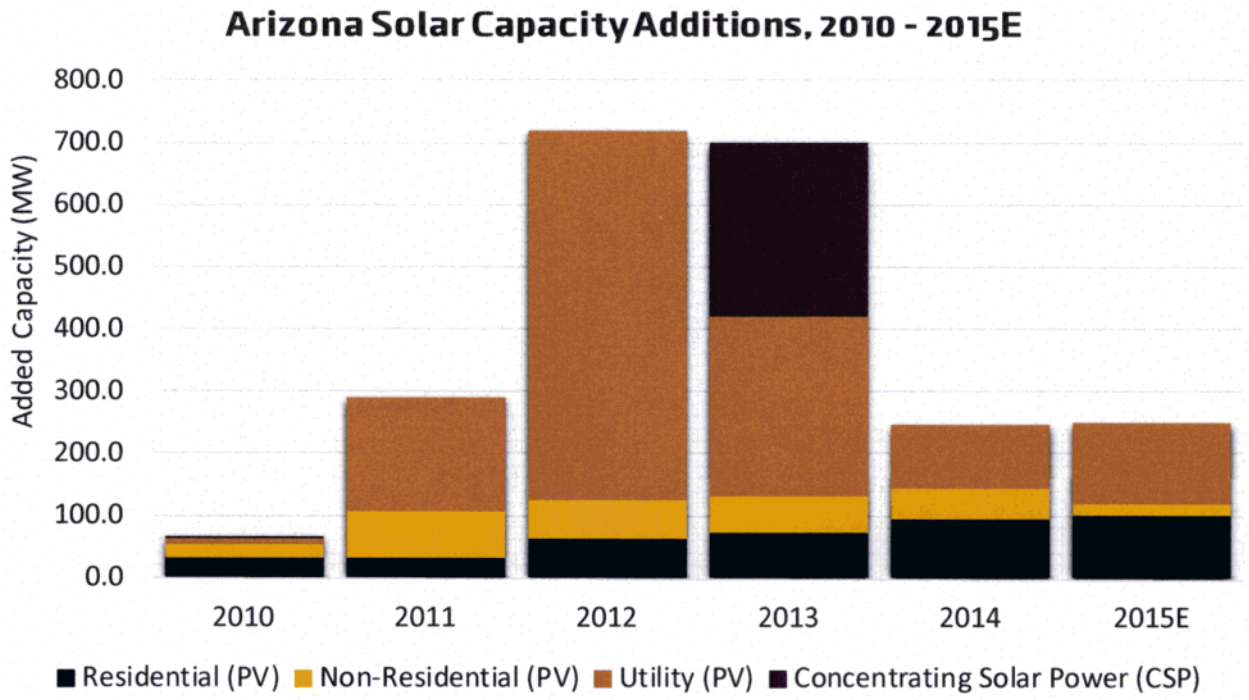
INTRODUCTION

The U.S. solar industry experienced yet another record-breaking year in 2015, with more than 7,400 megawatts (MW) of domestic photovoltaic (PV) capacity expected to have been installed – an 18.5% increase over that of 2014 – bringing total U.S. solar capacity to nearly 27.5 gigawatts (GW).[1]

As the rate of capacity installation has accelerated, employers across the country have continued to expand the size of their payrolls. **This year's sixth annual *National Solar Jobs Census* found that the U.S. solar industry employed 208,859 workers as of November 2015, representing the addition of 35,052 jobs, and a 20.2% increase in employment over November 2014.** Since The Solar Foundation began tracking these numbers in 2010, employment in the industry has more than doubled, growing by 123% and adding over 115,000 jobs. Employers nationwide expect this growth trend to continue through 2016, projecting to add nearly 31,000 jobs to the solar workforce over the course of the year.



Capacity Data Source: SEIA/GTM Research *Solar Market Insight Q3 2015*



Source: SEIA/GTM Research *Solar Market Insight Q3 2015*

Contrary to the positive trends currently enjoyed by the solar industry at the national level, the Arizona solar industry has stagnated in recent years, with annual capacity additions peaking in 2012 before leveling off in 2013 and dropping precipitously in 2014.[2] Despite this, 2014 witnessed a slight rebound in the size of the state's solar workforce, but the contraction of the local market and other headwinds seemed to catch up with payrolls in 2015. **As of November, only 6,922 workers were employed by the solar industry in the state, representing a 24.5% reduction in the size of the workforce since 2014**, and a massive underperformance compared to employer projections of 21% growth from the previous year.[3]

As of September, just under 141 MW of solar capacity had been installed in Arizona during 2015, substantially less than the similarly sunny neighboring state of Nevada, with nearly 218 MW installed during the same period. Although the local industry's past success earned Arizona the distinction of becoming only the second state to cross over the 2 GW threshold in 2014, it is currently projected to be surpassed by North Carolina in total installed capacity over the course of 2016, as the sluggishness of the local market is expected to continue.[4]

Utility-scale development made up the bulk of Arizona's 2015 capacity additions, and has done so each year since 2011,[5] but rather than symbolizing a healthy market for large projects, this is actually emblematic of the struggles faced by the smaller-scale residential and non-residential markets in the state.[6] At multiple times over the course of the year, these struggles were thrust into the national spotlight, establishing Arizona as a flashpoint in the contentious debates over the evolution of rooftop solar policy and electric utility rate design.

In February, Salt River Project (SRP), one of the nation's largest municipal electric utilities, serving large swaths of the Phoenix metropolitan area, approved a new fee of roughly $50 per month on all leased or owned solar systems connected to the electric grid in their territory.[7] The utility explained the new fees, structured to vary based on a solar customer's electricity usage during times of peak demand, as a

mechanism to ensure that all of their customers, both solar and non-solar, were paying their share to maintain the grid as a resource that benefits everyone. The utilities maintain that under the old rate structure, net metering could effectively zero out solar customers' monthly electric bills while the customers still benefitted from their connection to the grid.

Residential solar companies and advocates challenged the utility's claims, pointing to other benefits of distributed solar that were excluded from the analysis, such as mitigating pollution, reducing the need for new investments in transmission infrastructure and conventional power plants, reducing electricity lost during transmission over long power lines, and saving the utility money by helping them meet their obligations under the state's renewable energy standard.[8]

Regardless of the new fee's merits, its implementation significantly impacted the economics of distributed solar installations in SRP's territory. While customers who filed paperwork for approval of their projects before December 8th, 2014 were grandfathered in under the previously existing rate structure, all others were subjected to the new fee, in many cases eliminating their expected monthly savings from solar.

Subsequently, applications for rooftop installations in SRP's territory have fallen by an estimated 75 - 95%.[9] Arizona Public Service (APS), the state's largest investor-owned utility, followed suit at the beginning of April, requesting a fee increase of their own, but pulled the request in September after months of public pressure from both activists and the solar industry.[10] These ongoing debates have prompted action by the state's utility regulator, the Arizona Corporation Commission, and a proceeding has been scheduled for 2016 to set a standard for how Arizona utilities should credit customers with solar systems for the energy they send back to the grid based on a comprehensive analysis of the true value of distributed solar generation.[11]

As of November, only 6,922 workers were employed by the solar industry in Arizona, representing a 24.5% reduction in the size of the workforce since 2014.

With uncertainty casting a shadow over Arizona's smaller-scale residential and non-residential markets, and many of the state's utilities having largely achieved their goals for solar deployment under the state's renewable energy standard, capacity installation is expected to slow even further in 2016.[12] Even so, Arizona employers expect to recoup a portion of this year's job losses over the course of the coming year, expanding their payrolls by more than 580 workers, an increase of approximately 8.4%.[13]

ABOUT THE *ARIZONA SOLAR JOBS CENSUS 2015*

This report includes information about all types of Arizona companies engaged in the analysis, research and development, production, sales, installation, and use of all solar technologies – ranging from solar photovoltaics (PV), to concentrating solar power (CSP), to solar water heating systems for the residential, commercial, industrial, and utility market segments.

The findings presented herein are based on rigorous survey efforts throughout the months of September, October, and November 2015 that include telephone calls and emails to known and potential solar establishments across Arizona. Unlike economic impact models that generate employment estimates based on economic data or jobs-per-megawatt (or jobs-per-dollar) assumptions, The Solar Foundation's *Solar Jobs Census* series provides statistically valid and current data gathered from actual employers. This analysis also purposefully avoids artificially inflating its results with questionable multiplier effects often found in analyses of other industries.

The number of establishments included in this report include all businesses that conduct any solar activity. This includes many businesses that play a very small part in a solar project, or provide financing, legal services, or other support services to solar firms. Employment, however, is only counted for workers that spend at least 50% of their time on solar.

A full explanation of this methodology can be found on page 15 of this report.

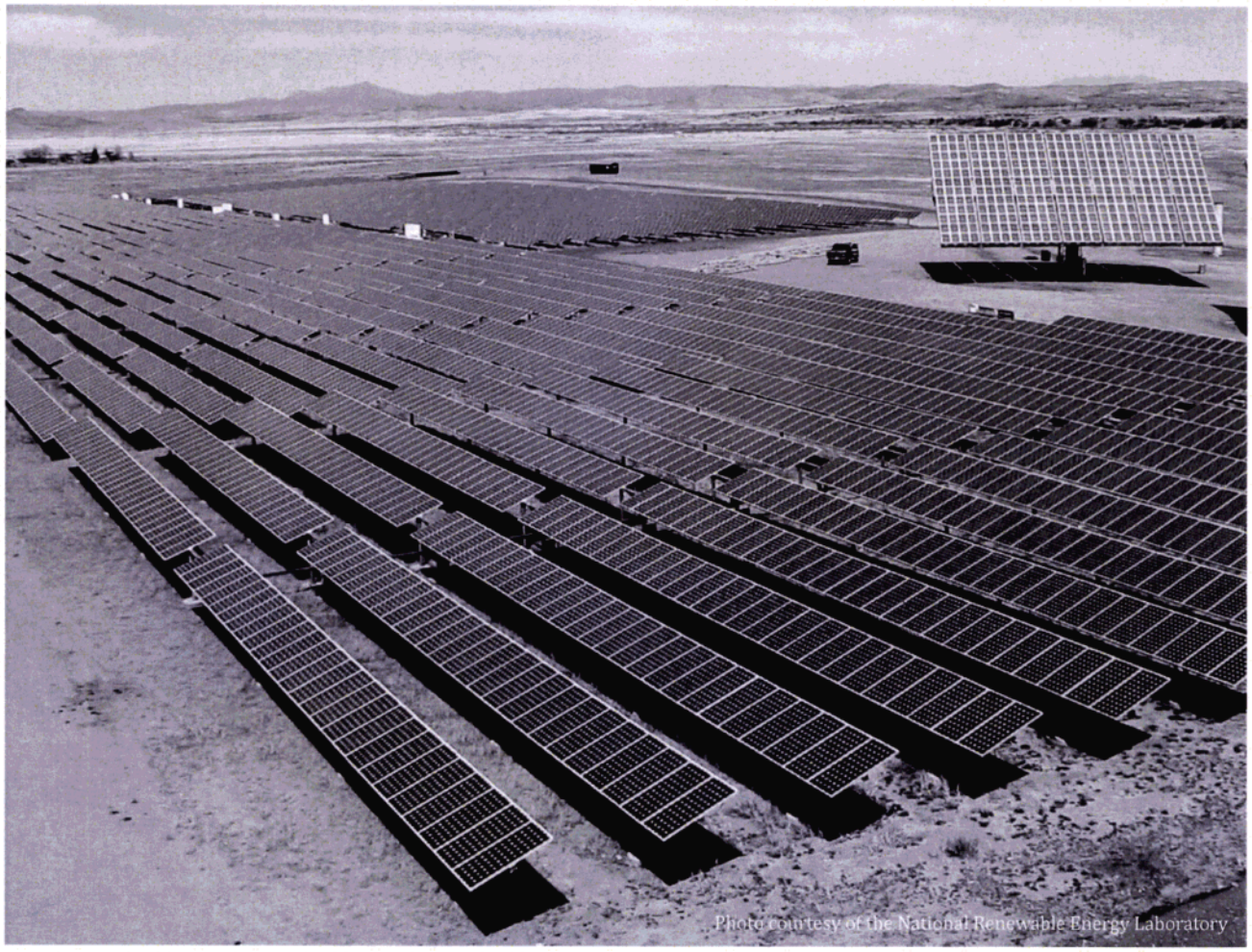
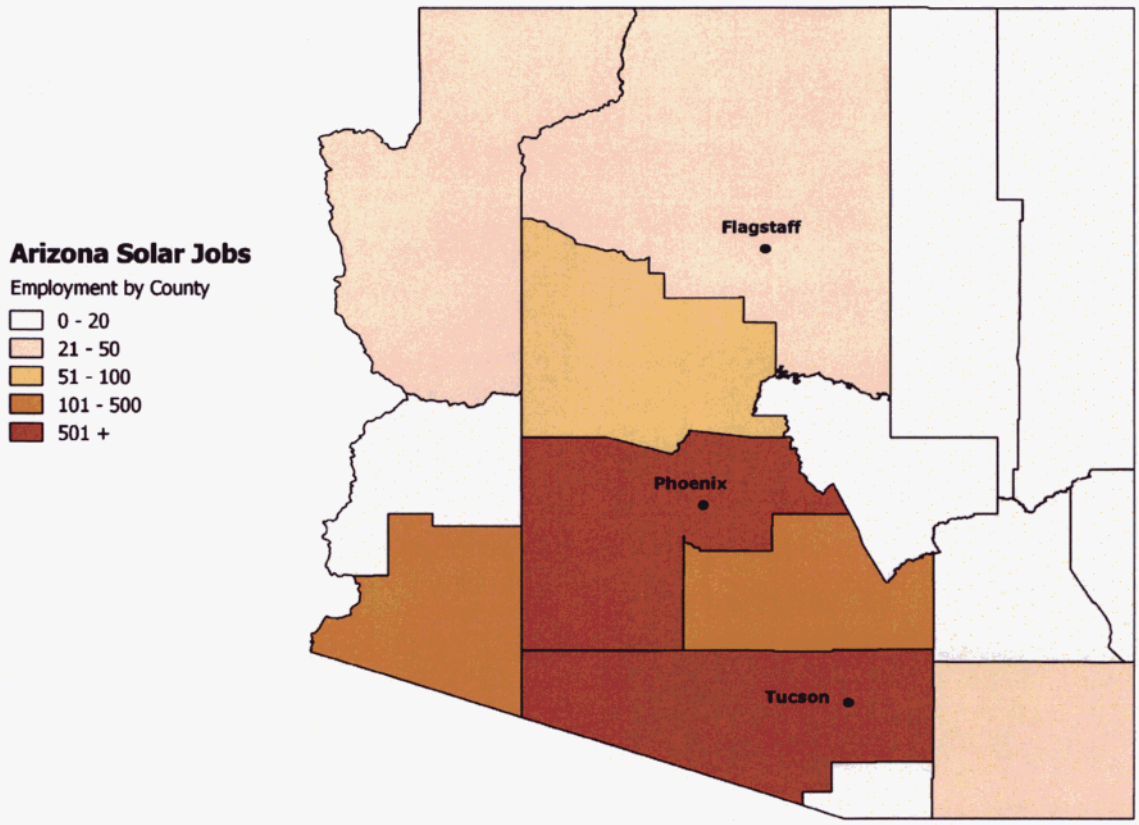


Photo courtesy of the National Renewable Energy Laboratory



ARIZONA SOLAR JOBS

Key Data Points

Total Solar Jobs, 2015

6,922

Projected Solar Jobs Growth, 2016

580

(8.4%)

Cumulative Installed Capacity thru Q3 2015 (MW)[14]

2,209.8

Capacity Installed in 2015 thru Q3 (MW)[15]

140.9

Detailed employment and demographic data for Arizona's legislative districts, counties, and metropolitan statistical areas can be found in the appendix of this report and on The Solar Foundation's interactive jobs map at .

Installation Jobs

2,549

Manufacturing Jobs

2,400

Sales & Distribution Jobs

1,095

Project Development Jobs

584

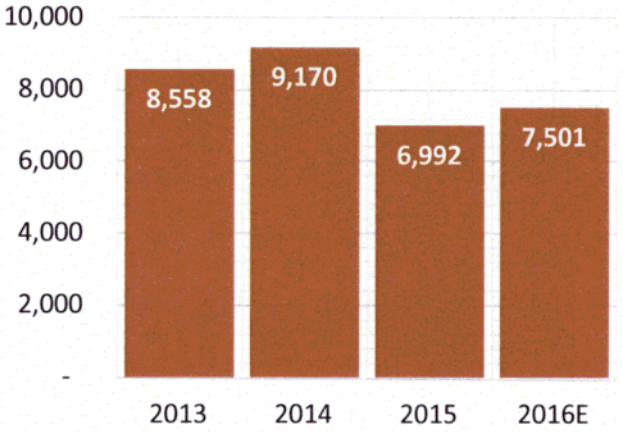
Other Jobs

294

WORKFORCE OVERVIEW

The Arizona solar industry employs 6,922 workers at 2,867 establishments throughout the state, is ranked 7th nationally in solar jobs, and 6th in solar jobs as a share of the state's total employment. The solar workforce in the state contracted by 24.5% since Census 2014, representing a loss of 2,248 jobs; which is fully opposite the roughly 2,000 jobs employers had expected to add during the year. Employers expect a reversal of this trend in 2016, adding approximately 580 new solar workers to payrolls over the next 12 months – a growth rate of 8.4% – while the state's workforce as a whole is projected to grow only 1.3% during the same period.[16]

Arizona Solar Jobs, 2013 - 2016E



An overwhelming majority of Arizona's solar firms (88.8%) report working primarily on utility-scale solar projects, compared to 4.4% for residential and 6.8% for non-residential projects. This is a significant departure from employer responses to Census 2014, when nearly 60% of installation firms, who comprised over half of the state's workforce during the year, worked primarily on residential projects. This shift in market focus is unsurprising given the current level of uncertainty surrounding distributed generation projects in the state.

The Arizona solar workforce is generally less diverse than the state's workforce as a whole, with women (29.5%), African-Americans (3.0%), Asian or Pacific Islanders (1.9%), and Latinos (12.5%) all relatively underrepresented. However, many of these otherwise underserved demographics – women, Latinos, older workers, and veterans – are represented in the state solar workforce at higher rates than their counterparts in the solar industry nationwide.

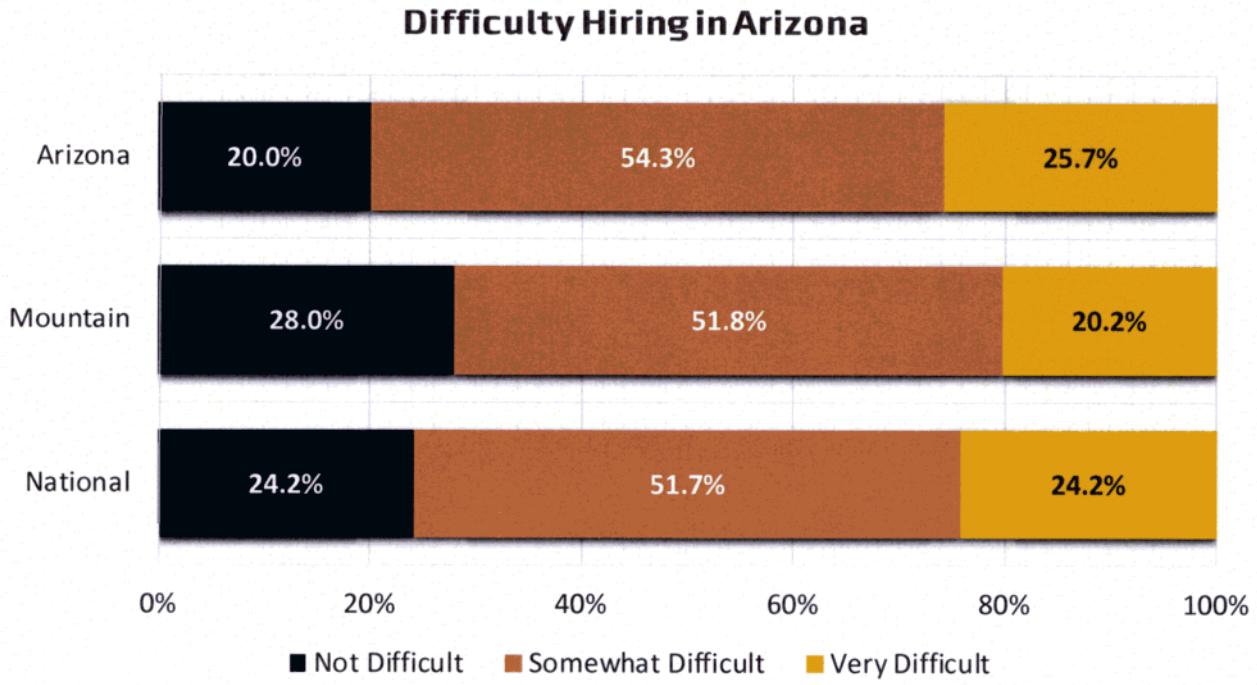
	ARIZONA SOLAR WORKFORCE	ARIZONA OVERALL EMPLOYMENT[17]	U.S. SOLAR WORKFORCE
WOMEN	29.5%	46.1%	23.8%
AFRICAN-AMERICAN	3.0%	4.6%	5.1%
ASIAN OR PACIFIC ISLANDER	1.9%	4.0%	8.6%
LATINO OR HISPANIC	12.5%	33.7%	11.3%
OLDER WORKERS (55+)	28.2%	20.6%	18.6%
UNION MEMBERS	-	-	5.5%
VETERANS OF THE U.S. ARMED FORCES	11.5%	9.3%	8.1%

Veterans of the U.S. Armed Forces represent a uniquely valuable source of human capital for solar employers. With a proven work ethic and practiced discipline, veterans bring a wealth of readily transferable skills and leadership acumen to the industry. Through the Solar Ready Vets program, the U.S. Department of Energy is helping the industry capitalize on this resource by facilitating the transition from military service to employment in the civilian solar workforce.[18] **Arizona solar firms clearly understand this value proposition, with veterans comprising 11.5% of the state's solar workforce, compared to just 9.3% of the state's total workforce and 8.1% of the solar workforce nationally.**

Position	Arizona Median Wage	Mountain Division Median Wage	U.S. Median Wage
Solar Installer	$18.00	$20.00	$21.00
Solar Sales Representative	$36.06	$33.65	$28.85
Solar System Designer	$22.00	$25.50	$26.92
Solar Assembly Worker	-	-	$18.00

Wages paid by firms in the Arizona solar industry differ slightly from those paid by solar employers across the other states in the U.S. Census Bureau's Mountain Division[19] and the industry nationwide. Solar installers in the state are among the lowest paid in the country, at $18.00 per hour, but solar sales representatives are better paid than their counterparts nationally.

Solar employers in Arizona experience a slightly higher level of difficulty on average finding qualified candidates to fill openings on their payrolls than other solar firms across the country. Solar employers in Arizona and the Mountain Division require greater work experience and less education than reported by firms nationally. Arizona firms required related work experience for nearly 86% of positions hired. In contrast, they required a bachelor's degree or more for only 12.1% of positions.

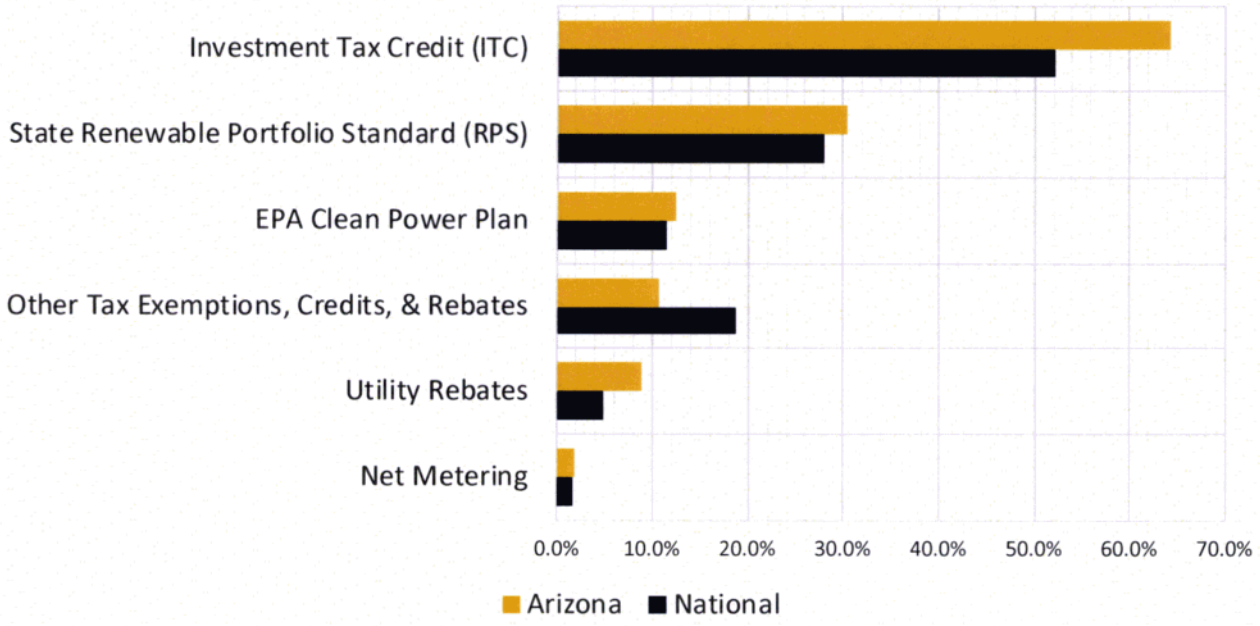


Just over 44% of Arizona solar firms reported that they receive all of their revenues from solar activities, which is lower than the national average of 48.2%, while 31.5% reported that they receive less than half of their revenues from solar activities, compared to 28.5% nationally. A significantly smaller portion of the state's solar firms (54.5%) work primarily with in-state customers than solar firms nationally (65.6%), though a larger portion (18.2%) work primarily with customers in a bordering state than solar firms nationally (5.0%). This latter difference makes a great deal of sense, given the large solar markets of Arizona's neighboring states in the sunny Southwest.

As part of the 2015 Census effort, employers were asked about the impacts of specific existing, pending and proposed policies on their business prospects. **Arizona employers overwhelmingly cite the federal investment tax credit (ITC) as substantially contributing to their firms' success, with 64.3% of respondents referring to it directly**, more than doubling the second most commonly cited policy, the state's renewable energy standard, at 30.4%.

The following pages include detailed breakdowns of workforce data by sector. While there are a number of Arizona solar firms focusing on manufacturing, sales and distribution, and other activities, an insufficient number of these firms responded to the survey to provide statistically significant data for each individual sector.

Businesses Citing Policies Contributing to Success



Sector Jobs

2,549

Change Since 2014

-2,282

Rate of Change Since 2014

-47.2%

Establishments

1,594

Solar Installer Median Wage

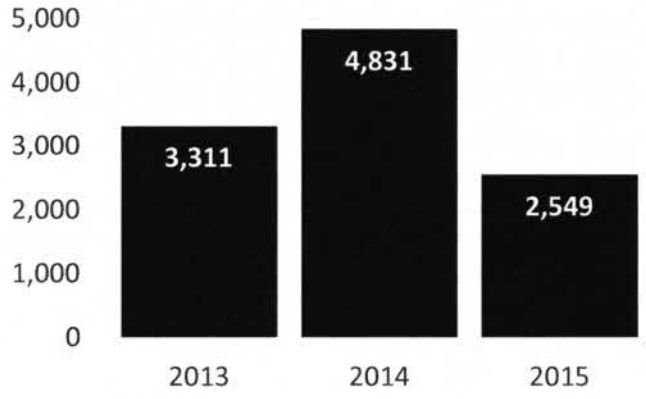
$18/hr

INSTALLATION

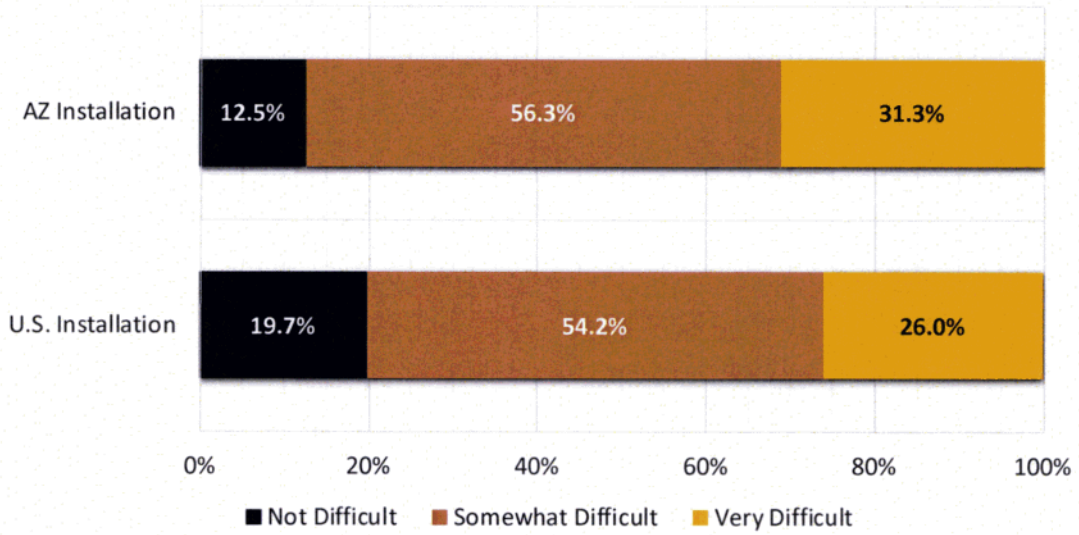
The installation sector is the largest sector of the U.S. solar industry and is composed of companies that primarily install PV, solar water heating, and other solar energy technologies.

The installation sector is responsible for 36.8% of all solar employment in Arizona, employing 2,549 workers. This represents a dramatic decrease of more than 47% since 2014, when firms in the sector employed 4,831 workers, or 52.6% of the workforce.

AZ Installation Jobs, 2013 - 2015



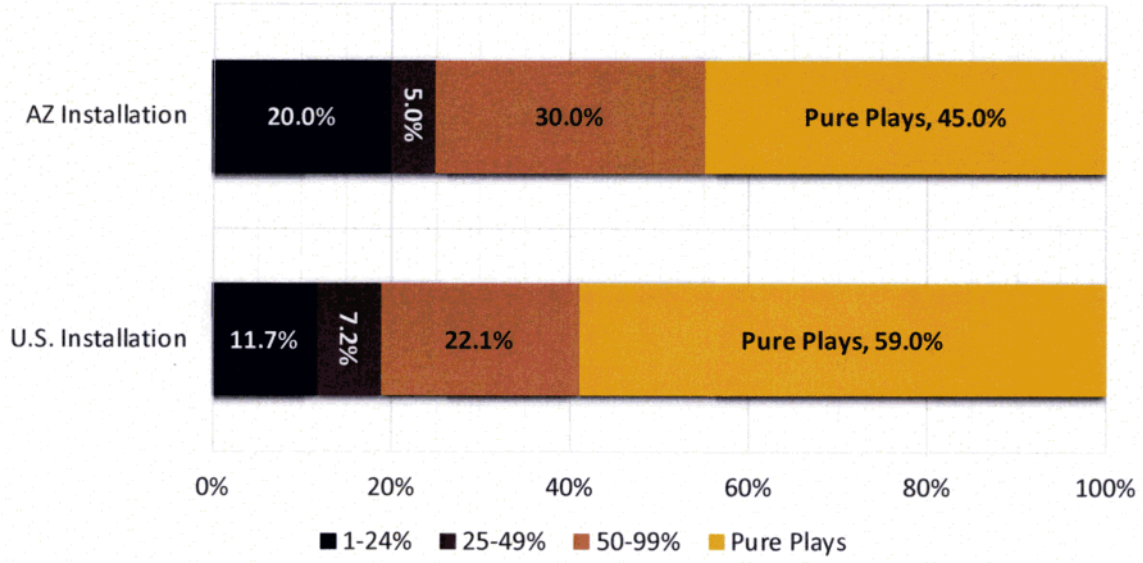
Installation Sector - Difficulty Hiring



Arizona installation firms report greater levels of difficulty finding qualified candidates to fill openings on their payrolls than firms in other sectors of the state's solar industry, as well as other firms in the installation sector nationwide.

A significantly smaller percentage of Arizona installation firms (70.0%) work primarily with in-state customers than their counterparts in the installation sector nationwide (81.5%). Similarly, a smaller percentage of installation firms in the state are pure play solar businesses, receiving 100% of their revenue from solar activities, than installation firms across the country. This diversification, both of business activity and customer base, may in part be a reaction by employers to the recent uncertainty in the local market.

Installation Sector - % Revenues from Solar



Sector Jobs

584

Change Since 2014

+92

Rate of Growth Since 2014

18.7%

Establishments

262

Solar System Designer Median Wage

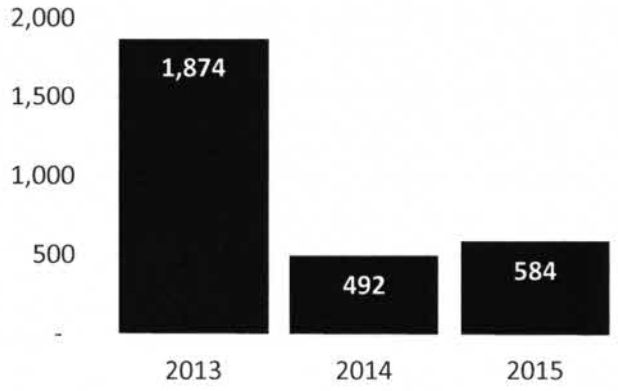
$22/hr

PROJECT DEVELOPMENT

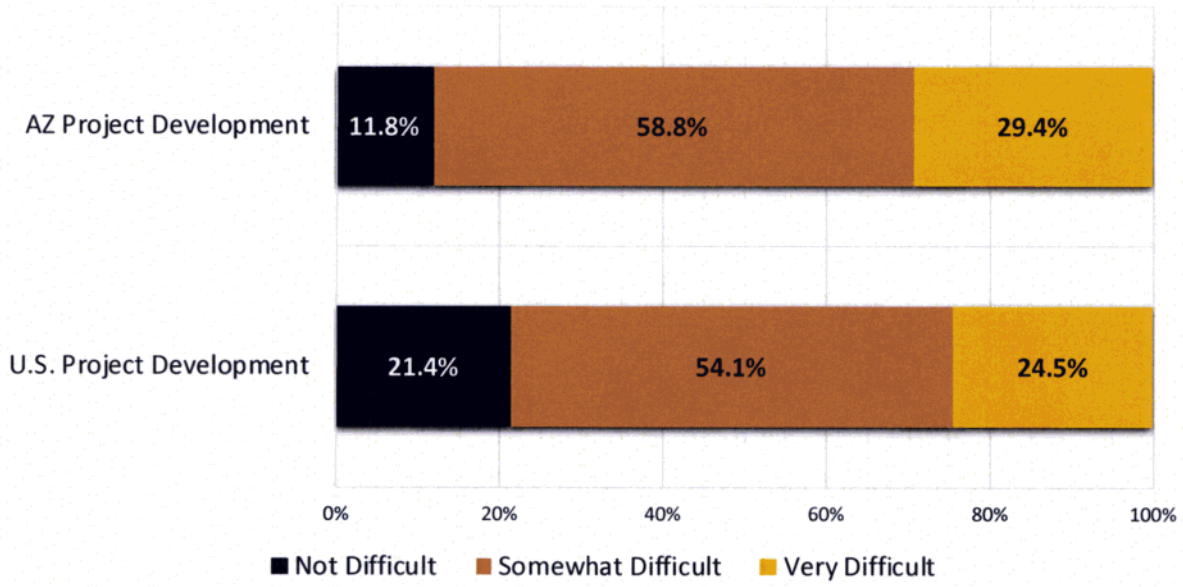
The project development sector includes companies that plan, design and build large commercial- and utility-scale solar projects.

The project development sector is responsible for 8.4% of all solar employment in Arizona, employing 584 workers. This represents a reversal of fortunes and a return to growth for the sector, which had witnessed a nearly 75% reduction in its workforce from 2013 to 2014, although it still comprises a much smaller portion of the state's solar jobs than it did in 2013, when project developers employed nearly 22% of Arizona solar workers.

AZ Project Development Jobs, 2013 - 2015



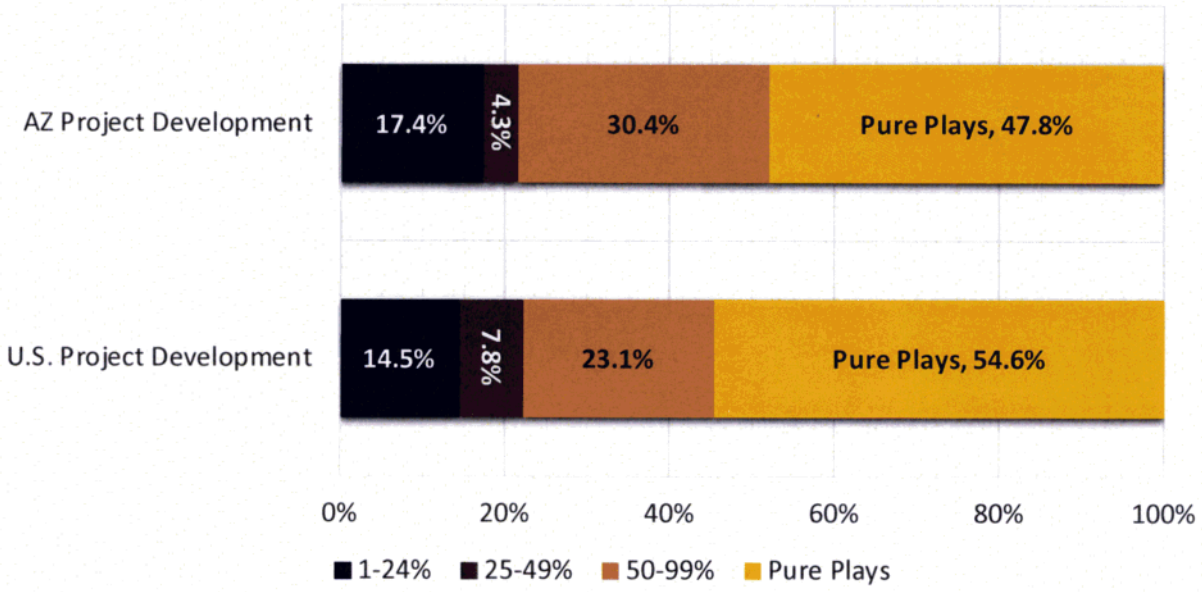
Project Development Sector - Difficulty Hiring



Arizona project developers report greater levels of difficulty finding qualified candidates to fill openings on their payrolls than firms on average across the state's solar industry more broadly, as well as other firms in the project development sector nationwide.

A significantly smaller percentage of Arizona project development firms (60.9%) work primarily with in-state customers than their counterparts in the project development sector nationwide (74.9%). Similarly, a smaller percentage of project development firms in the state are pure play solar businesses, receiving 100% of their revenue from solar activities, than project development firms across the country.

Project Development Sector - % Revenues from Solar



CONCLUSION

While the Arizona solar industry is expected to have installed slightly more solar capacity in 2015 than 2014, the year's additions are a far cry from the industry's peak in 2012, and little is expected to change over the next twelve months. The troubles plaguing the Arizona solar industry are expected to continue in 2016, with regulatory uncertainty casting doubt over individual solar customers' ability to earn a sufficient return on their investment and utilities generally satisfied with a relatively slow pace of utility-scale development. Industry experts project less solar capacity to be added in the state in 2016 than in 2015.

It is important however, to consider the Arizona solar industry's recent doldrums in the context of its historically strong performance and note that, even though the state's solar firms employ fewer people than they did at the end of 2014, the workforce itself is still quite large relative to other states in the country. At 6,922 workers, the state's solar workforce is the 7th largest in the country, well ahead of its eastern neighbor New Mexico (1,899), but well behind Nevada (8,764) to the northwest. Even with the industry's somewhat bleak outlook for the coming year, **employers are expecting to expand their payrolls, adding roughly 580 jobs, representing 8.4% growth in 2016 – more than six times the growth expected for the state's economy,** but only a little more than half the growth expected for the U.S. solar industry at large.

While employment in both the manufacturing and project development sectors grew in 2015, manufacturing was definitely the industry's most successful sector, and though it was outweighed by the contraction of the installation sector, Arizona's solar manufacturing workforce grew by more than 27% over the course of the year. The relative strength of the state's manufacturing sector is also made apparent by the rather low percentage of firms working primarily with in-state customers (54.5%) compared to solar firms across the country (65.6%), reflecting healthy demand for their solar products and equipment in other markets.

It is unclear how the debates between utilities and the solar industry or the Arizona Corporation Commission's proceeding regarding the appropriate value of solar will pan out, but the geographic realities of the desert state and the ever-decreasing costs associated with solar all but ensure the viability of the Arizona solar industry in the long-term. In order to sustain this future growth, it is essential that Arizona employers have ready access to quality talent and skilled labor or enhance their on-the-job training offerings. To achieve this, more focused and comprehensive solar training efforts – in-house, in-state, and across the country – must be sufficiently emphasized. These efforts would reduce the industry's talent acquisition, training, and retention costs, increasing efficiency across the solar value chain, and ultimately reducing costs for Arizona solar customers.

This research shows that the Arizona solar industry is a source of economic opportunity, with the potential to create jobs that pay living wages and are largely available to individuals of different backgrounds from across the state. Only regular reexaminations of the state's solar industry, its workforce, and the employment opportunities presented herein will confirm this potential is realized in years to come.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-7: Cumulative lost sales from residential DG and EE from PME-WP14DR Historical EE and DG 2005-2015

Unrecovered Fixed Costs Re-Allocated to EE and DG Non-Participating Customers

	Gross Costs Shifted to Non-Participants		Cost Shift Recovered Via LFCR-DG Charge ($000)	Net Costs Shifted to Non-Participants		Method of Recovery for Cost Shift			LFCR-Applicable Energy Reductions (MWH)
	All Energy Reductions Since 2005 ($000)	Energy Reductions Since 2010 ($000)		All Energy Reductions Since 2005 ($000)	Energy Reductions Since 2010 ($000)	Recovered in or Prior to 2011 Rate Case * ($000)	Recovered Via LFCR Charge ($000)	To Be Recovered in 2016 Rate Case ($000)	
Costs Shifted in 2015 Due to Cumulative EE Sales Reductions ($000)									
Residential	120,932	81,492	-	120,932	81,492	39,440	22,103	59,388	708,818
C&I Customers < 3 MW	50,193	33,636	-	50,193	33,636	16,557	11,805	21,831	489,711
C&I Customers > 3 MW	7,244	4,854	-	7,244	4,854	2,390	-	4,854	-
Total retail	178,369	86,346	-	178,369	119,982	58,387	33,908	86,074	1,198,529
Costs Shifted in 2015 Due to Cumulative DG Sales Reductions ($000)									
Residential **	31,050	27,839	521	30,529	27,318	3,211	8,818	18,500	282,774
C&I Customers < 3 MW	11,802	11,052	-	11,802	11,052	750	3,262	7,790	135,338
C&I Customers > 3 MW	344	344	-	344	344	-	-	344	-
Total Retail	43,196	39,235	521	42,675	38,714	3,961	12,080	26,634	418,112
Costs Shifted in 2015 Due to Cumulative EE and DG ($000)									
Residential	151,981	109,330	521	151,460	108,809	42,651	30,921	77,888	991,592
C&I Customers < 3 MW	61,995	44,688	-	61,995	44,688	17,307	15,067	29,621	625,049
C&I Customers > 3 MW	7,588	5,199	-	7,588	5,199	2,390	-	5,199	-
Total Retail	221,565	159,217	521	221,044	158,696	62,348	45,988	112,708	1,616,641

* Rates reset per Decision No.73183 or prior.

** Costs shifted due to DG sales reductions are estimated using a class-average price. The actual costs shifted are likely higher than these estimates because the marginal avoided price is higher than the class average.

Historical EE and DG Sales Reductions
2005 - 2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual EE Installed (MWH)											
Residential	9,684	38,519	97,648	119,020	106,480	107,992	181,377	200,444	219,180	190,611	198,805
C&I Customers < 3 MW	6,488	25,808	65,424	79,743	68,656	87,252	117,876	139,308	151,736	135,696	132,626
C&I Customers > 3 MW	3,196	12,711	32,224	39,276	33,815	42,975	58,058	68,614	74,736	66,835	65,323
Total retail	19,368	77,038	195,295	238,039	208,951	238,219	357,312	408,366	445,652	393,142	396,754
Cumulative EE Installed Since 2005 (MWH)											
Residential	9,684	48,203	145,851	264,870	371,350	479,342	660,720	861,163	1,080,344	1,270,954	1,469,760
C&I Customers < 3 MW	6,488	32,296	97,720	177,463	246,118	333,371	451,247	590,555	742,291	877,986	1,010,612
C&I Customers > 3 MW	3,196	15,907	48,131	87,407	121,223	164,197	222,256	290,870	365,606	432,441	497,764
Total retail	19,368	96,406	291,701	529,740	738,691	976,910	1,334,223	1,742,588	2,188,240	2,581,382	2,978,136
Annual DG Installed (MWH)											
Residential UFI	556	836	1,513	2,689	8,183	25,223	29,777	51,318	77,426	46,832	645
Residential Interconnect Only	-	-	-	-	4	20	84	93	652	44,509	87,005
Commercial UFI	124	262	325	589	1,896	1,948	1,620	3,581	2,649	1,255	193
Small Commercial PBI	-	-	29	392	3,009	6,521	46,383	74,810	61,058	30,723	264
Large Commercial PBI	-	-	-	-	-	-	923	5,477	798	2,738	-
Commercial Interconnect Only	-	-	-	-	-	-	3	880	7,893	4,073	871
Total Retail	680	1,098	1,867	3,670	13,092	33,712	78,789	136,158	150,476	130,130	88,978
Cumulative DG Installed Since 2005 (MWH)											
Residential UFI	556	1,392	2,905	5,594	13,777	39,000	68,777	120,094	197,520	244,352	244,998
Residential Interconnect Only	-	-	-	-	4	24	108	201	853	45,361	132,366
Commercial UFI	124	386	711	1,300	3,196	5,144	6,764	10,345	12,994	14,249	14,442
Small Commercial PBI	-	-	29	421	3,430	9,951	56,334	131,144	192,202	222,925	223,189
Large Commercial PBI	-	-	-	-	-	-	923	6,400	7,198	9,936	9,936
Commercial Interconnect Only	-	-	-	-	-	-	3	883	8,776	12,848	13,719
Total Retail	680	1,778	3,645	7,315	20,407	54,119	132,908	269,066	419,542	549,673	638,651
Cumulative EE and DG Installed Since 2005 (MWH)											
Residential	10,240	49,595	148,756	270,464	385,131	518,366	729,605	981,458	1,278,717	1,560,668	1,847,124
C&I Customers < 3 MW	6,612	32,682	98,460	179,184	252,744	348,466	514,345	732,043	947,487	1,115,161	1,248,243
C&I Customers > 3 MW	3,196	15,907	48,131	87,407	121,223	164,197	223,181	298,153	381,579	455,226	521,419
Total Retail	20,048	98,184	295,346	537,055	759,098	1,031,029	1,467,131	2,011,655	2,607,783	3,131,055	3,616,786
Annual Installed EE -- C&I Total	9,684	38,519	97,648	119,020	102,471	130,227	175,935	207,922	226,472	202,531	197,949
Share accounted for by customers > 3 MW	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%
Historical Class Shares of EE Reductions											
Residential	50%	50%	50%	50%							
C&I	50%	50%	50%	50%							

Historical EE and DG Sales Reductions
2011 - 2015

	2011	2012	2013	2014	2015
Annual EE Installed (MWH)					
Residential	181,377	200,444	219,180	190,611	198,805
C&I Customers < 3 MW	117,876	139,308	151,736	135,696	132,626
C&I Customers > 3 MW	58,058	68,614	74,736	66,835	65,323
Total retail	357,312	408,366	445,652	393,142	396,754
Cumulative EE Installed Since 2010 (MWH)					
Residential	181,377	381,821	601,001	791,612	990,417
C&I Customers < 3 MW	117,876	257,184	408,920	544,616	677,241
C&I Customers > 3 MW	58,058	126,673	201,408	268,244	333,567
Total retail	357,312	765,678	1,211,330	1,604,471	2,001,225
Annual DG Installed (MWH)					
Residential UFI	29,777	51,318	77,426	46,832	645
Residential Interconnect Only	84	93	652	44,509	87,005
Commercial UFI	1,620	3,581	2,649	1,255	193
Small Commercial PBI	46,383	74,810	61,058	30,723	264
Large Commercial PBI	923	5,477	798	2,738	-
Commercial Interconnect Only	3	880	7,893	4,073	871
Total Retail	78,789	136,158	150,476	130,130	88,978
Cumulative DG Installed Since 2010 (MWH)					
Residential UFI	29,777	81,094	158,520	205,352	205,998
Residential Interconnect Only	84	177	829	45,337	132,342
Commercial UFI	1,620	5,201	7,850	9,105	9,298
Small Commercial PBI	46,383	121,193	182,251	212,974	213,238
Large Commercial PBI	923	6,400	7,198	9,936	9,936
Commercial Interconnect Only	3	883	8,776	12,848	13,719
Total Retail	78,789	214,947	365,423	495,554	584,532
Cumulative EE and DG Installed Since 2010 (MWH)					
Residential	211,238	463,092	760,350	1,042,302	1,328,757
C&I Customers < 3 MW	165,879	383,578	599,021	766,695	899,778
C&I Customers > 3 MW	58,984	133,955	217,382	291,028	357,222
Total Retail	436,101	980,625	1,576,753	2,100,025	2,585,757

Calculation of Per Unit Revenue Erosion Net of Avoided Fuel Expense
Amounts for Year 2015

	Billed Revenue x/Adjustors ($000)		
1.	Residential		1,502,833
2.	C&I Customers < 3 MW Total	1,194,564	
3.	AG-1 Customers < 3 MW	19,234	
4.	C&I Customers < 3 MW Net of AG-1 Customers (L2 - L3)		1,175,330
5.	C&I Customers > 3 MW Total	194,402	
6.	AG-1 Customers > 3 MW	24,566	
7.	C&I Customers > 3 MW Net of AG-1 Customers (L5 - L6)		169,836
8.			
9.	Billed Demand Charge Revenue Not Avoided ($000)		
10.	Residential		-
11.	C&I Customers < 3 MW Total	292,453	
12.	AG-1 Customers < 3 MW	10,187	
13.	C&I Customers < 3 MW Net of AG-1 Customers (L11 - L12)		282,266
14.	C&I Customers > 3 MW Total	76,183	
15.	AG-1 Customers > 3 MW	5,448	
16.	C&I Customers > 3 MW Net of AG-1 Customers (L14 - L15)		70,735
17.			
18.	Billed Sales (MWH)		
19.	Residential		13,142,277
20.	C&I Customers < 3 MW Total	11,354,261	
21.	AG-1 Customers < 3 MW	428,177	
22.	C&I Customers < 3 MW Net of AG-1 Customers (L20 - L21)		10,926,084
23.	C&I Customers > 3 MW Total	2,738,169	
24.	AG-1 Customers > 3 MW	612,635	
25.	C&I Customers > 3 MW Net of AG-1 Customers (L23 - L24)		2,125,534
26.			
27.	Average Billed Price x/Demand Charges (¢/kWh)		
28.	Residential ((L1 - L10) / L19 *100)		11.44
29.	C&I Customers < 3 MW Net of AG-1 Customers ((L4 - L13) / L22 *100)		8.17
30.	C&I Customers > 3 MW Net of AG-1 Customers ((L7 - L16) / L25 *100)		4.66
31.			
32.	Average Billed Price Less Base Fuel (¢/kWh)		
33.	Residential (L28 - 3.2071)		8.23
34.	C&I Customers < 3 MW Net of AG-1 Customers (L29 - 3.2071)		4.97
35.	C&I Customers > 3 MW Net of AG-1 Customers (L30 - 3.2071)		1.46

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-8: APS ACC Workshop Presentation 7-18-16.pdf P 14

Resource Needs

PRELIMINARY 2017 IRP (Values in MW at Peak)

	2017	2022	2027	2032
PROJECTED LOAD REQUIREMENTS (NEEDS)	8,210	9,748	11,252	12,797
Reserves (included in Load Requirements)	974	1,194	1,370	1,557
EXISTING RESOURCES AS OF JANUARY 2016				
APS-Owned Generation	6,045	5,864	5,475	5,474
Long-Term Contracts	1,489	412	355	342
Total Existing Resources as of January 2016	7,534	6,277	5,830	5,816
RESOURCE GAP	(675)	(3,471)	(5,422)	(6,981)
FUTURE PROJECTED DISTRIBUTED RESOURCES				
Energy Efficiency (1), (2)	225	629	749	857
Distributed Energy (1), (2)	30	98	175	250
Demand Response (3) & Microgrid (4)	32	107	232	357
Total Future Projected Distributed Resources	287	835	1,156	1,464
FUTURE PROJECTED UTILITY RESOURCES				
Natural Gas	363	2,611	4,084	5,229
Renewable Energy & Energy Storage	25	62	182	288
Total Future Projected Utility Resources	388	2,672	4,266	5,517
TOTAL PROJECTED ADDITIONS	675	3,507	5,422	6,981
TOTAL RESOURCES	8,210	9,784	11,252	12,797

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-9: EFCA 20.4_H-5 without solar_APSRC01796.xlsx

ARIZONA PUBLIC SERVICE COMPANY
BILL COUNT
BILLING ACTIVITY BY BLOCK FOR EACH MAJOR RATE - CONSUMPTION
TEST YEAR ENDED DECEMBER 31, 2015 UNADJUSTED

RATE SCHEDULE: **E12 without Solar**
DESCRIPTION: Residential Electric Rate Applicable in All Territory Served by Company

		SUMMER (May through October)						WINTER (November through April)						
				CUMULATIVE						CUMULATIVE				
				BILLS		CONSUMPTION				BILLS		CONSUMPTION		
Line No.	BLOCK (kWh)	NUMBER OF BILLS BY BLOCK	CONSUMPTION kWh BY BLOCK	Number	% of Total	Amount (kWh)	% of Total	NUMBER OF BILLS BY BLOCK	CONSUMPTION kWh BY BLOCK	Number	% of Total	Amount (kWh)	% of Total	Line No.
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	
1	0	73,550	-	73,550	2.65%	-	0.00%	54,215	-	54,215	1.92%	-	0.00%	1
2	1-50	100,957	2,524,465	174,507	6.28%	2,524,465	0.12%	109,095	2,878,774	163,310	5.79%	2,878,774	0.18%	2
3	51-100	103,401	8,264,140	277,908	10.01%	10,788,605	0.51%	121,336	9,573,555	284,646	10.09%	12,452,329	0.79%	3
4	101-150	112,092	14,712,294	390,000	14.04%	25,500,899	1.21%	132,173	17,248,861	416,819	14.77%	29,701,190	1.88%	4
5	151-200	111,347	20,458,897	501,347	18.05%	45,959,796	2.19%	145,741	26,610,521	562,560	19.94%	56,311,711	3.57%	5
6	201-250	113,116	26,706,310	614,463	22.12%	72,666,106	3.46%	162,723	38,147,821	725,283	25.71%	94,459,532	5.98%	6
7	251-300	116,738	33,677,181	731,201	26.33%	106,343,287	5.06%	178,258	51,006,225	903,541	32.03%	145,465,757	9.22%	7
8	301-350	119,800	40,819,166	851,001	30.64%	147,162,453	7.01%	184,100	62,204,683	1,087,641	38.55%	207,670,440	13.16%	8
9	351-400	120,005	47,151,127	971,006	34.96%	194,313,580	9.25%	183,094	71,330,255	1,270,735	45.04%	279,000,695	17.68%	9
10	401-450	119,048	52,992,937	1,090,054	39.25%	247,306,517	11.77%	174,874	77,169,204	1,445,609	51.24%	356,169,899	22.57%	10
11	451-500	116,910	58,159,277	1,206,964	43.46%	305,465,794	14.54%	162,635	80,190,293	1,608,244	57.01%	436,360,192	27.65%	11
12	501-550	112,898	62,055,784	1,319,862	47.52%	367,521,578	17.50%	147,899	80,592,756	1,756,143	62.25%	516,952,948	32.75%	12
13	551-600	108,098	65,067,342	1,427,960	51.41%	432,588,920	20.60%	132,958	79,339,059	1,889,101	66.96%	596,292,007	37.78%	13
14	601-650	102,976	67,378,669	1,530,936	55.12%	499,967,589	23.80%	117,501	76,215,839	2,006,602	71.13%	672,507,846	42.61%	14
15	651-700	97,094	68,610,881	1,628,030	58.62%	568,578,470	27.07%	102,673	71,920,917	2,109,275	74.77%	744,428,763	47.16%	15
16	701-750	91,112	69,148,253	1,719,142	61.90%	637,726,723	30.36%	90,011	67,715,940	2,199,286	77.96%	812,144,703	51.45%	16
17	751-800	85,733	69,549,054	1,804,875	64.98%	707,275,777	33.67%	77,698	62,491,048	2,276,984	80.71%	874,635,751	55.41%	17
18	801-850	79,926	69,020,960	1,884,801	67.86%	776,296,737	36.96%	67,651	57,906,306	2,344,635	83.11%	932,542,057	59.08%	18
19	851-900	74,298	68,048,661	1,959,099	70.53%	844,345,398	40.20%	58,467	53,093,498	2,403,102	85.18%	985,635,555	62.44%	19
20	901-950	68,585	66,400,417	2,027,684	73.00%	910,745,815	43.36%	50,391	48,365,906	2,453,493	86.97%	1,034,001,461	65.51%	20
21	951-1,000	64,074	65,395,965	2,091,758	75.31%	976,141,780	46.48%	43,916	44,430,713	2,497,409	88.52%	1,078,432,174	68.32%	21
22	1,001-1,100	113,746	124,889,357	2,205,504	79.41%	1,101,031,137	52.42%	71,029	77,249,264	2,568,438	91.04%	1,155,681,438	73.22%	22
23	1,101-1,200	95,976	115,416,103	2,301,480	82.86%	1,216,447,240	57.92%	53,956	64,297,174	2,622,394	92.95%	1,219,978,612	77.29%	23
24	1,201-1,300	79,933	104,484,305	2,381,413	85.74%	1,320,931,545	62.89%	40,766	52,796,351	2,663,160	94.40%	1,272,774,963	80.64%	24
25	1,301-1,400	67,268	94,953,078	2,448,681	88.16%	1,415,884,623	67.41%	31,130	43,560,096	2,694,290	95.50%	1,316,335,059	83.40%	25
26	1,401-1,500	56,417	85,542,219	2,505,098	90.19%	1,501,426,842	71.48%	24,104	36,236,762	2,718,394	96.36%	1,352,571,821	85.69%	26
27	1,501-1,600	46,611	75,560,621	2,551,709	91.87%	1,576,987,463	75.08%	18,786	30,192,011	2,737,180	97.02%	1,382,763,832	87.60%	27
28	1,601-1,700	38,701	66,771,497	2,590,410	93.26%	1,643,758,960	78.26%	14,702	25,154,582	2,751,882	97.54%	1,407,918,414	89.20%	28
29	1,701-1,800	31,776	58,147,159	2,622,186	94.41%	1,701,906,119	81.03%	11,920	21,631,801	2,763,802	97.97%	1,429,550,215	90.57%	29
30	1,801-1,900	26,380	51,040,148	2,648,566	95.36%	1,752,946,267	83.46%	9,458	18,146,800	2,773,260	98.30%	1,447,697,015	91.72%	30
31	1,901-2,000	21,630	44,105,703	2,670,196	96.14%	1,797,051,970	85.56%	7,878	15,931,833	2,781,138	98.58%	1,463,628,848	92.73%	31
32	2,001-2,250	62,221	143,913,795	2,732,417	98.38%	1,940,965,765	92.41%	22,157	50,846,600	2,803,295	99.37%	1,514,475,448	95.95%	32
33	2,251-2,500	23,578	66,924,042	2,755,995	99.23%	2,007,889,807	95.60%	8,758	24,690,708	2,812,053	99.68%	1,539,166,156	97.51%	33
34	2,501-3,000	14,496	51,245,678	2,770,491	99.75%	2,059,135,485	98.04%	6,011	21,128,264	2,818,064	99.89%	1,560,294,420	98.85%	34
35	3,001-4,000	3,876	17,871,013	2,774,367	99.89%	2,077,006,498	98.89%	1,739	7,980,068	2,819,803	99.95%	1,568,274,488	99.36%	35
36	4,001-5,000	2,873	18,946,449	2,777,240	99.99%	2,095,952,947	99.79%	1,239	8,059,912	2,821,042	100.00%	1,576,334,400	99.87%	36
37	5,001-10,000	219	2,955,271	2,777,459	100.00%	2,098,908,218	99.93%	87	1,163,134	2,821,129	100.00%	1,577,497,534	99.94%	37
38	10,001-20,000	33	1,437,127	2,777,492	100.00%	2,100,345,345	100.00%	24	914,964	2,821,153	100.00%	1,578,412,498	100.00%	38
39	over 20,000	-	-	2,777,492	100.00%	2,100,345,345	100.00%	-	-	2,821,153	100.00%	1,578,412,498	100.00%	39

Average Number of Customers:	462,915		Average Number of Customers:	470,192	
Average Consumption:	756	kWh per bill	Average Consumption:	559	kWh per bill
Median Consumption:	582	kWh per bill	Median Consumption:	440	kWh per bill

Supporting Schedules:
N/A

Recap Schedules:
N/A

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-10: VS 6.3_monthly NEM data_APSRC01803.xlsx

customer ID with (1) NEM customer delivered load and (2) NEM customer exports that contain the following variables: (KWH, ONKWH38, OFKWH38, ONKW38, ONKWHN7, OFKWHN7, ONKWN7, ONKWH99, OFKWH99, ONKW99).

iii. Please provide an additional dataset that contains all of the data provided in VS 3.2 for non-NEM customers but for NEM customers. Please use the same customer IDs as used in the data provided in response to VS 1.4, 1.5 and 1.6. For each variable requested in VS 3.2(a-f) please provide (1) monthly bills for delivered energy (2) export credits received by NEM customers.

Response:

a) Confirmed. AURA 1.19 does not contain interval data for NEM customers.

b) See response to a.

c) APS objects to this request because the total requested data is not available and it would be burdensome to produce it. The requested data is available for roughly 26,000 solar customers during the Test Year, which was used by APS to assess the solar offset rates for the proposed residential rates.

This information is provided in excel format only and is attached as APSRC01803.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-11: APS response to VS 3.8

VOTE SOLAR'S
THIRD SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 5, 2016

VS 3.8: In Docket No. 14-0023 in support of Mr. Snook's direct testimony, APS filed workpaper "APS15871_Snook Additional Workpapers.xlsx" that included a study of the cost to serve various sub-classes of residential customers.

a) Please provide a copy of APS15871_Snook Additional Workpapers.xlsx.

b) Please describe how APS identified customers that were winter visitors, apartment dwellers, and dual fuel customers for purposes of the analysis.

c) Please indicate whether the roughly 5,000 winter visitors; 115,000 apartment dwellers, and 360 dual fuel customers whose load data is included in the study represent the total number of customers in each of these subclasses. Please explain your answer.

d) Please indicate whether APS has conducted a similar analysis of any other subclasses of residential customers. If so, please provide any such analysis with full supporting documentation and work papers in excel format with formulas and links intact.

e) Please provide an updated version of APS15871_Snook Additional Workpapers.xlsx that uses data from the test year and updated cost of service study.

f) Please provide a dataset that uses the same customer ID as used in Data Request AURA 1.19 and identifies customers that are (1) winter visitors (2) apartment dwellers, and (3) dual fuel customers

Response: a) Please see the copy of APS15871_Snook Additional Workpapers.xlsx filed in Docket No. E-00000J-14-0023.

b) APS identified winter visitors through the Customer Information System who had self-identified as winter visitors. APS identified apartment dwellers through the Customer Information System. APS identified dual fuel customers through APS's Appliance Saturation Survey.

Witness: Leland Snook

VS 3.8 Response Continued:

c) The roughly 5,000 winter visitors is a subset of APS's total winter visitor population because the data was derived from customers that have self-reported this information to APS. The approximate 115,000 apartment dwellers is a reasonable approximation of the number of apartment dwellers in the APS service territory based on APS as the data source. The 360 dual fuel customers are a small sample of the likely dual fuel customers in APS's service territory. The Appliance Saturation Survey is a reliable representative sample for which APS had specific information on the particular dual fuel uses.

d) No.

e) APS has not performed an updated analysis.

f) See APS's response to VS 3.8(e).

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-12: Arizona: 2010 Summary of Population and Housing Characteristics, 2010 Census of Population and Housing, October 2012

Arizona: 2010

Summary Population and Housing Characteristics

2010 Census of Population and Housing

Issued October 2012

CPH-1-4

U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU
census.gov

United States Census 2010

Arizona: 2010

Issued October 2012

Summary Population and Housing Characteristics

CPH-1-4

U.S. Department of Commerce
Rebecca M. Blank,
Acting Secretary

Rebecca M. Blank,
Deputy Secretary

Economics and Statistics Administration
Vacant,
Under Secretary
for Economic Affairs

U.S. CENSUS BUREAU
Thomas L. Mesenbourg,
Acting Director

SUGGESTED CITATION

U.S. Census Bureau,
2010 Census of
Population and Housing,
Summary Population and Housing Characteristics,
CPH-1-4, Arizona
U.S. Government Printing Office,
Washington, DC,
2012

ECONOMICS
AND STATISTICS
ADMINISTRATION

Economics and Statistics Administration

Vacant,
Under Secretary for
Economic Affairs

U.S. CENSUS BUREAU

Thomas L. Mesenbourg,
Acting Director

Nancy A. Potok,
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Enrique J. Lamas,
Associate Director
for Demographic Programs

Enrique J. Lamas,
Acting Chief, Population Division

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*Appendix may be found in the separate volume, CPH-1-A, *Summary Population and Housing Characteristics, Selected Appendixes*, on the Internet at <www.census.gov /prod/cen2010/cph-1-a.pdf>.

Table 12.
Housing Occupancy and Tenure: 2010

[For information on confidentiality protection, nonsampling error, and definitions, see Selected Appendixes at <www.census.gov/prod/cen2010/cph-1-a.pdf>]

State County Place	Total housing units	Occupied housing units						Vacant housing units				
			Owner occupied			Average household size				Vacancy rate		
		Total	Number	Percent of occupied housing units	Renter occupied	Owner-occupied units	Renter-occupied units	Total	For seasonal, recreational, or occasional use	Available housing	Home-owner	Rental
Arizona	2,844,526	2,380,990	1,571,687	66.0	809,303	2.63	2.62	463,536	184,327	7.2	3.9	12.9
COUNTY												
Apache County	32,514	22,771	17,124	75.2	5,647	3.07	3.20	9,743	5,621	3.9	1.3	11.0
Cochise County	59,041	50,865	34,711	68.2	16,154	2.47	2.43	8,176	1,811	5.6	3.2	10.6
Coconino County	63,321	46,711	28,443	60.9	18,268	2.77	2.56	16,610	12,057	4.3	2.9	6.5
Gila County	32,698	22,000	16,759	76.2	5,241	2.35	2.53	10,698	7,449	6.5	4.1	13.4
Graham County	12,980	11,120	8,089	72.7	3,031	3.02	2.98	1,860	315	6.8	3.7	14.1
Greenlee County	4,372	3,188	1,593	50.0	1,595	2.48	2.79	1,184	271	13.3	2.2	22.3
La Paz County	16,049	9,198	7,072	76.9	2,126	2.09	2.51	6,851	5,318	9.3	4.9	21.3
Maricopa County	1,639,279	1,411,583	910,320	64.5	501,263	2.68	2.64	227,696	63,938	7.8	4.1	13.7
Mohave County	110,911	82,539	57,728	69.9	24,811	2.27	2.67	28,372	16,294	7.3	4.9	12.5
Navajo County	56,938	35,658	25,652	71.9	10,006	2.91	3.05	21,280	14,673	6.8	4.3	12.7
Pima County	440,909	388,660	248,970	64.1	139,690	2.52	2.36	52,249	14,862	6.1	2.9	11.2
Pinal County	159,222	125,590	95,629	76.1	29,961	2.67	3.16	33,632	15,499	7.7	5.5	13.9
Santa Cruz County	18,010	15,437	10,428	67.6	5,009	3.11	2.92	2,573	756	6.3	3.5	11.5
Yavapai County	110,432	90,903	64,366	70.8	26,537	2.24	2.39	19,529	9,304	5.9	4.1	10.0
Yuma County	87,850	64,767	44,803	69.2	19,964	2.92	2.95	23,083	16,159	5.5	2.7	11.3
PLACE												
Aguila CDP, Maricopa County	304	234	139	59.4	95	3.09	3.09	70	18	5.2	2.1	9.4
Ajo CDP, Pima County	2,175	1,512	1,053	69.6	459	2.12	2.32	663	312	9.2	4.7	18.1
Ak Chin CDP, Pima County	11	9	9	100.0	0	3.33	0.00	2	1	0.0	0.0	(X)
Ak-Chin Village CDP, Pinal County	256	245	3	1.2	242	9.67	3.41	11	0	0.0	0.0	0.0
Alamo Lake CDP, La Paz County	31	16	9	56.3	7	1.56	1.57	15	15	0.0	0.0	0.0
Ali Chuk CDP, Pima County	60	43	32	74.4	11	3.91	3.27	17	1	0.0	0.0	0.0
Ali Chukson CDP, Pima County	55	38	35	92.1	3	3.51	3.00	17	4	0.0	0.0	0.0
Ali Molina CDP, Pima County	30	24	19	79.2	5	2.95	3.00	6	0	0.0	0.0	0.0
Alpine CDP, Apache County	205	81	46	56.8	35	1.85	1.71	124	108	7.8	5.9	10.3
Amado CDP, Santa Cruz County	207	130	81	62.3	49	2.28	2.24	77	51	4.4	2.4	7.5
Anegam CDP, Pima County	43	38	34	89.5	4	3.82	5.25	5	0	0.0	0.0	0.0
Antares CDP, Mohave County	95	66	49	74.2	17	1.92	1.88	29	6	19.5	21.0	15.0
Anthem CDP, Maricopa County	8,801	7,451	5,725	76.8	1,726	2.83	3.17	1,350	668	5.4	4.5	8.4
Apache Junction city	22,564	15,574	11,737	75.4	3,837	2.21	2.50	6,990	4,946	8.6	4.6	18.7
Maricopa County (part)	293	210	95	45.2	115	1.47	1.34	83	58	8.5	1.0	14.2
Pinal County (part)	22,271	15,364	11,642	75.8	3,722	2.22	2.54	6,907	4,888	8.6	4.6	18.9
Arivaca CDP, Pima County	492	356	279	78.4	77	1.95	1.86	136	34	6.6	4.3	14.3
Arivaca Junction CDP, Pima County	388	337	287	85.2	50	3.18	3.56	51	4	3.1	1.0	13.6
Arizona City CDP, Pinal County	5,064	3,970	2,776	69.9	1,194	2.44	3.09	1,094	325	10.5	5.5	20.2
Arizona Village CDP, Mohave County	531	339	151	44.5	188	2.34	3.15	192	119	7.3	9.9	5.1
Arlington CDP, Maricopa County	99	73	60	82.2	13	2.35	4.08	26	8	11.9	1.6	40.9
Ash Fork CDP, Yavapai County	218	152	113	74.3	39	2.55	2.77	66	5	11.0	3.4	27.8
Avenue B and C CDP, Yuma County	1,968	1,451	757	52.2	694	2.87	2.88	517	226	10.4	0.4	19.1
Avondale city, Maricopa County	27,001	23,386	14,382	61.5	9,004	3.25	3.26	3,615	205	9.8	5.5	16.0
Avra Valley CDP, Pima County	2,487	2,177	1,795	82.5	382	2.77	2.82	310	23	4.7	2.9	12.2
Aztec CDP, Yuma County	24	12	5	41.7	7	1.80	5.43	12	2	7.7	16.7	0.0
Bagdad CDP, Yavapai County	838	682	56	8.2	626	2.07	2.81	156	75	9.7	1.8	10.3
Bear Flat CDP, Gila County	54	9	8	88.9	1	2.00	2.00	45	43	18.2	20.0	0.0
Beaver Dam CDP, Mohave County	1,202	814	650	79.9	164	2.33	2.71	388	292	6.2	5.0	10.7
Beaver Valley CDP, Gila County	225	101	89	88.1	12	2.30	2.17	124	104	14.4	11.9	29.4
Benson city, Cochise County	2,941	2,369	1,646	69.5	723	2.10	2.18	572	196	9.2	5.9	16.0
Beyerville CDP, Santa Cruz County	55	48	31	64.6	17	3.45	4.12	7	1	9.4	6.1	15.0
Bisbee city, Cochise County	3,284	2,620	1,731	66.1	889	2.05	2.00	664	182	7.3	4.8	11.9
Bitter Springs CDP, Coconino County	130	113	110	97.3	3	4.02	3.33	17	11	0.0	0.0	0.0
Black Canyon City CDP, Yavapai County	1,563	1,317	1,001	76.0	316	2.16	2.12	246	57	5.9	3.2	13.6
Blackwater CDP, Pinal County	332	316	250	79.1	66	3.42	3.12	16	2	1.3	0.0	5.7
Bluewater CDP, La Paz County	669	343	264	77.0	79	1.99	2.53	326	292	7.3	5.7	12.2
Bouse CDP, La Paz County	914	547	483	88.3	64	1.81	1.94	367	304	5.3	4.3	12.3
Bowie CDP, Cochise County	256	201	135	67.2	66	2.39	1.91	55	9	4.3	2.9	7.0
Brenda CDP, La Paz County	725	387	359	92.8	28	1.75	1.64	338	229	21.5	0.8	78.6
Bryce CDP, Graham County	60	55	39	70.9	16	3.00	3.63	5	0	5.2	4.9	5.9
Buckeye town, Maricopa County	18,207	14,424	10,905	75.6	3,519	3.05	3.57	3,783	974	10.5	8.5	16.2
Buckshot CDP, Yuma County	75	66	61	92.4	5	2.21	3.60	9	8	1.5	1.6	0.0
Bullhead City city, Mohave County	23,464	16,761	10,198	60.8	6,563	2.22	2.55	6,703	3,695	10.7	6.4	16.7
Burnside CDP, Apache County	174	160	57	35.6	103	3.63	3.20	14	6	0.0	0.0	0.0
Bylas CDP, Graham County	491	445	341	76.6	104	4.23	5.00	46	2	1.3	0.0	5.5
Cactus Flats CDP, Graham County	595	516	431	83.5	85	3.02	2.56	79	14	3.9	1.6	14.1
Cactus Forest CDP, Pinal County	287	245	199	81.2	46	2.37	2.67	42	14	6.1	4.8	11.5
Cameron CDP, Coconino County	285	249	212	85.1	37	3.69	2.76	36	13	0.0	0.0	0.0
Campo Bonito CDP, Pinal County	48	37	33	89.2	4	2.06	1.50	11	1	9.3	7.9	20.0
Camp Verde town, Yavapai County	4,726	4,088	3,124	76.4	964	2.38	2.84	638	171	5.1	3.7	9.3
Cane Beds CDP, Mohave County	168	142	104	73.2	38	3.28	2.82	26	9	3.4	1.9	7.3

Table 12.
Housing Occupancy and Tenure: 2010—Con.

[For information on confidentiality protection, nonsampling error, and definitions, see Selected Appendixes at <www.census.gov/prod/cen2010/cph-1-a.pdf>]

State County Place	Total housing units	Occupied housing units						Vacant housing units				
			Owner occupied			Average household size				Vacancy rate		
		Total	Number	Percent of occupied housing units	Renter occupied	Owner-occupied units	Renter-occupied units	Total	For seasonal, recreational, or occasional use	Available housing	Home-owner	Rental
PLACE—Con.												
Canyon Day CDP, Gila County	310	298	209	70.1	89	3.81	4.63	12	0	0.7	0.0	2.2
Carefree town, Maricopa County	2,251	1,654	1,432	86.6	222	2.07	1.59	597	419	6.8	5.2	15.8
Carrizo CDP, Gila County	40	34	26	76.5	8	3.69	3.88	6	0	0.0	0.0	0.0
Casa Blanca CDP, Pinal County	388	352	262	74.4	90	3.82	4.31	36	1	0.0	0.0	0.0
Casa Grande city, Pinal County	22,400	17,651	11,914	67.5	5,737	2.65	2.92	4,749	2,304	9.4	4.8	17.8
Casas Adobes CDP, Pima County	30,364	28,096	18,669	66.4	9,427	2.44	2.16	2,268	614	4.1	2.1	7.8
Catalina CDP, Pima County	3,290	2,998	2,442	81.5	556	2.44	2.77	292	83	3.7	2.6	8.5
Catalina Foothills CDP, Pima County	27,211	23,493	17,576	74.8	5,917	2.27	1.79	3,718	1,762	5.6	2.7	13.4
Cave Creek town, Maricopa County	2,579	2,150	1,788	83.2	362	2.38	2.12	429	187	5.4	4.8	8.3
Cedar Creek CDP, Gila County	97	78	69	88.5	9	4.14	3.56	19	1	4.9	0.0	30.8
Centennial Park CDP, Mohave County	225	207	147	71.0	60	6.81	4.38	18	3	5.0	0.7	14.1
Central CDP, Graham County	209	189	162	85.7	27	3.41	3.44	20	5	2.6	1.2	10.0
Central Heights-Midland City CDP, Gila County	1,191	1,037	826	79.7	211	2.41	2.58	154	15	2.7	1.9	5.8
Chandler city, Maricopa County	94,404	86,924	57,624	66.3	29,300	2.78	2.58	7,480	1,610	4.7	3.2	7.4
Charco CDP, Pima County	26	17	14	82.4	3	3.07	3.00	9	0	0.0	0.0	0.0
Chiawuli Tak CDP, Pima County	21	19	17	89.5	2	4.12	4.00	2	0	0.0	0.0	0.0
Chilchinbito CDP, Navajo County	228	135	100	74.1	35	3.53	4.37	93	10	31.5	0.0	63.9
Chinle CDP, Apache County	1,483	1,267	498	39.3	769	3.59	3.48	216	76	2.2	0.0	3.5
Chino Valley town, Yavapai County	4,967	4,396	3,282	74.7	1,114	2.41	2.60	571	140	4.9	3.3	9.3
Chloride CDP, Mohave County	245	164	125	76.2	39	1.76	1.31	81	33	12.3	6.0	27.8
Christopher Creek CDP, Gila County	388	91	79	86.8	12	1.73	1.58	297	290	5.2	5.9	0.0
Chuichu CDP, Pinal County	96	71	61	85.9	10	4.00	2.50	25	0	0.0	0.0	0.0
Cibecue CDP, Navajo County	455	419	218	52.0	201	3.89	4.30	36	2	1.6	0.0	3.3
Cibola CDP, La Paz County	307	122	94	77.0	28	2.02	2.14	185	163	6.8	5.0	12.5
Cienega Springs CDP, La Paz County	2,291	913	668	73.2	245	1.94	2.05	1,378	1,146	12.4	9.1	20.2
Citrus Park CDP, Maricopa County	1,385	1,277	1,197	93.7	80	3.15	3.28	108	18	2.6	2.6	2.4
Clacks Canyon CDP, Mohave County	83	69	63	91.3	6	2.51	2.50	14	1	9.2	6.0	33.3
Clarkdale town, Yavapai County	2,059	1,806	1,374	76.1	432	2.22	2.41	253	49	6.7	3.9	14.6
Claypool CDP, Gila County	750	616	482	78.2	134	2.45	2.65	134	11	5.7	3.1	14.1
Clay Springs CDP, Navajo County	164	124	100	80.6	24	3.32	2.88	40	22	6.7	4.7	14.3
Clifton town, Greenlee County	1,580	1,185	410	34.6	775	2.39	2.97	395	63	12.1	2.8	16.7
Colorado City town, Mohave County	599	575	61	10.6	514	8.34	8.39	24	7	0.0	0.0	0.0
Comobabi CDP, Pima County	5	3	3	100.0	0	2.67	0.00	2	1	0.0	0.0	(X)
Concho CDP, Apache County	36	20	14	70.0	6	2.07	1.50	16	7	0.0	0.0	0.0
Congress CDP, Yavapai County	1,226	951	836	87.9	115	2.02	2.46	275	133	5.8	4.9	12.2
Coolidge city, Pinal County	4,796	3,947	2,627	66.6	1,320	2.88	3.23	849	121	8.0	5.3	12.9
Copper Hill CDP, Gila County	63	47	42	89.4	5	2.33	2.00	16	9	2.0	2.3	0.0
Cordes Lakes CDP, Yavapai County	1,463	1,149	910	79.2	239	2.19	2.69	314	101	6.9	6.2	9.4
Cornfields CDP, Apache County	62	59	43	72.9	16	4.07	4.13	3	2	0.0	0.0	0.0
Cornville CDP, Yavapai County	1,695	1,423	1,077	75.7	346	2.26	2.42	272	112	4.7	3.7	7.7
Corona de Tucson CDP, Pima County	2,165	2,016	1,778	88.2	238	2.79	3.01	149	26	3.3	3.3	3.2
Cottonwood CDP, Apache County	66	60	14	23.3	46	3.21	3.93	6	2	0.0	0.0	0.0
Cottonwood city, Yavapai County	5,866	5,179	2,578	49.8	2,601	2.12	2.16	687	137	6.9	4.5	9.2
Cowlic CDP, Pima County	41	30	24	80.0	6	4.42	4.83	11	0	0.0	0.0	0.0
Crozier CDP, Mohave County	11	8	5	62.5	3	1.60	1.33	3	2	0.0	0.0	0.0
Crystal Beach CDP, Mohave County	171	131	100	76.3	31	2.05	2.32	40	18	5.6	3.7	11.4
Cutter CDP, Gila County	21	20	15	75.0	5	3.93	3.00	1	1	0.0	0.0	0.0
Dateland CDP, Yuma County	221	148	103	69.6	45	2.92	2.56	73	41	4.5	3.7	6.3
Deer Creek CDP, Gila County	129	105	94	89.5	11	2.06	2.00	24	13	2.8	3.1	0.0
Del Muerto CDP, Apache County	103	88	80	90.9	8	3.68	4.38	15	4	0.0	0.0	0.0
Dennehotso CDP, Apache County	264	190	160	84.2	30	4.09	3.03	74	31	5.9	0.0	28.6
Desert Hills CDP, Mohave County	1,847	1,084	896	82.7	188	2.00	2.34	763	601	9.2	7.1	17.9
Dewey-Humboldt town, Yavapai County	1,888	1,589	1,277	80.4	312	2.38	2.69	299	95	4.4	3.4	8.2
Dilkon CDP, Navajo County	361	292	120	41.1	172	4.04	4.06	69	3	5.8	0.0	9.4
Dolan Springs CDP, Mohave County	1,556	1,007	856	85.0	151	2.00	2.14	549	228	7.9	7.5	10.1
Doney Park CDP, Coconino County	1,896	1,764	1,524	86.4	240	3.01	3.24	132	55	2.4	2.5	1.6
Donovan Estates CDP, Yuma County	394	374	300	80.2	74	3.91	4.51	20	3	2.3	0.3	9.8
Douglas city, Cochise County	5,652	4,986	2,983	59.8	2,003	3.11	2.78	666	56	5.2	2.8	8.6
Dragoon CDP, Cochise County	115	97	77	79.4	20	2.05	2.55	18	7	2.0	2.5	0.0
Drexel Heights CDP, Pima County	9,684	8,824	6,947	78.7	1,877	3.08	3.35	860	76	4.1	2.8	8.3
Dripping Springs CDP, Gila County	121	93	79	84.9	14	2.57	2.29	28	6	5.1	6.0	0.0
Drysdale CDP, Yuma County	84	74	59	79.7	15	3.68	3.67	10	3	5.1	0.0	21.1
Dudleyville CDP, Pinal County	423	354	303	85.6	51	2.68	2.88	69	14	1.7	0.3	8.9
Duncan town, Greenlee County	398	289	201	69.6	88	2.42	2.39	109	6	18.5	4.3	39.3
Eagar town, Apache County	2,045	1,734	1,303	75.1	431	2.73	3.07	311	147	5.3	2.8	12.1
East Fork CDP, Navajo County	170	149	112	75.2	37	4.36	5.70	21	3	0.0	0.0	0.0
East Globe CDP, Gila County	61	55	50	90.9	5	4.24	2.80	6	1	1.8	0.0	16.7
East Verde Estates CDP, Gila County	165	84	76	90.5	8	1.99	2.38	81	72	2.3	2.6	0.0
Ehrenberg CDP, La Paz County	948	645	405	62.8	240	2.17	2.46	303	215	9.6	5.1	16.3
El Capitan CDP, Gila County	33	18	17	94.4	1	2.12	1.00	15	12	5.3	5.6	0.0
Elephant Head CDP, Pima County	253	233	206	88.4	27	2.60	2.85	20	9	1.7	1.4	3.6

Table 12.
Housing Occupancy and Tenure: 2010—Con.

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State County Place	Total housing units	Occupied housing units						Vacant housing units				
		Total	Owner occupied		Renter occupied	Average household size		Total	For seasonal, recreational, or occasional use	Vacancy rate		
			Number	Percent of occupied housing units		Owner-occupied units	Renter-occupied units			Available housing	Home-owner	Rental
PLACE—Con.												
Elfrida CDP, Cochise County	243	176	127	72.2	49	2.72	2.33	67	5	4.9	4.5	5.8
Elgin CDP, Santa Cruz County	85	69	62	89.9	7	2.40	1.71	16	6	4.2	3.1	12.5
El Mirage city, Maricopa County	11,326	9,416	6,714	71.3	2,702	3.20	3.81	1,910	476	8.1	5.3	14.2
Eloy city, Pinal County	3,691	2,984	1,829	61.3	1,155	3.10	3.17	707	121	9.7	3.4	18.1
El Prado Estates CDP, Yuma County	199	157	122	77.7	35	3.20	3.23	42	26	1.9	1.6	2.8
First Mesa CDP, Navajo County	555	438	351	80.1	87	3.66	3.09	117	76	1.1	0.3	4.4
Flagstaff city, Coconino County	26,254	22,836	10,842	47.5	11,994	2.60	2.47	3,418	1,892	4.8	2.8	6.6
Florence town, Pinal County	5,224	3,330	2,529	75.9	801	2.28	2.58	1,894	1,238	10.7	6.5	21.8
Flowing Springs CDP, Gila County	39	19	19	100.0	0	2.21	0.00	20	17	0.0	0.0	(X)
Flowing Wells CDP, Pima County	7,505	6,643	4,818	72.5	1,825	2.37	2.71	862	227	5.4	2.4	12.4
Fort Apache CDP, Navajo County	53	46	30	65.2	16	3.33	2.69	7	3	0.0	0.0	0.0
Fort Defiance CDP, Apache County	1,250	1,060	628	59.2	432	3.34	3.52	190	41	5.6	0.0	12.7
Fort Mohave CDP, Mohave County	7,179	5,790	4,393	75.9	1,397	2.38	2.78	1,389	674	6.5	5.0	11.0
Fort Thomas CDP, Graham County	206	154	127	82.5	27	2.50	2.07	52	7	6.6	3.0	20.6
Fortuna Foothills CDP, Yuma County	21,642	12,006	10,043	83.6	1,963	2.12	2.51	9,636	7,860	5.8	3.7	14.3
Fort Valley CDP, Coconino County	371	283	238	84.1	45	2.75	2.78	88	67	3.1	3.2	2.1
Fountain Hills town, Maricopa County	13,167	10,339	8,344	80.7	1,995	2.16	2.16	2,828	1,740	7.4	4.8	16.7
Franklin CDP, Greenlee County	51	41	32	78.0	9	2.22	2.33	10	3	10.6	5.9	23.1
Fredonia town, Coconino County	578	488	367	75.2	121	2.77	2.47	90	27	4.9	1.6	13.6
Freedom Acres CDP, Gila County	51	40	35	87.5	5	2.11	2.00	11	7	9.1	10.3	0.0
Gadsden CDP, Yuma County	225	192	128	66.7	64	3.57	3.45	33	6	4.4	1.5	9.6
Ganado CDP, Apache County	445	372	216	58.1	156	3.50	2.92	73	10	8.3	0.0	17.7
Geronimo Estates CDP, Gila County	122	25	23	92.0	2	2.26	4.00	97	79	21.9	23.3	0.0
Gila Bend town, Maricopa County	943	664	386	58.1	278	2.91	2.87	279	18	22.2	3.0	39.1
Gila Crossing CDP, Maricopa County	141	137	110	80.3	27	4.70	3.85	4	0	0.7	0.9	0.0
Gilbert town, Maricopa County	74,907	69,372	52,207	75.3	17,165	3.03	2.91	5,535	1,106	4.3	3.5	6.8
Gisela CDP, Gila County	331	243	204	84.0	39	2.28	2.69	88	55	4.0	2.9	9.3
Glendale city, Maricopa County	90,505	79,114	46,364	58.6	32,750	2.88	2.75	11,391	559	9.5	3.6	16.7
Globe city, Gila County	3,386	2,908	1,992	68.5	916	2.45	2.41	478	55	5.4	3.1	10.0
Gold Canyon CDP, Pinal County	6,874	4,888	4,358	89.2	530	2.02	2.55	1,986	1,487	6.2	4.4	18.3
Golden Shores CDP, Mohave County	1,637	1,011	835	82.6	176	1.97	2.28	626	450	7.8	7.5	9.2
Golden Valley CDP, Mohave County	4,342	3,605	2,964	82.2	641	2.27	2.56	737	207	4.6	3.7	8.4
Goodyear city, Maricopa County	25,027	21,491	16,374	76.2	5,117	2.80	3.04	3,536	1,136	7.1	4.6	14.3
Goodyear Village CDP, Pinal County	121	110	63	57.3	47	4.21	4.09	11	0	4.3	0.0	9.6
Grand Canyon Village CDP, Coconino County	858	761	119	15.6	642	2.08	1.88	97	75	2.1	1.7	2.1
Grand Canyon West CDP, Mohave County	19	2	0	0.0	2	0.00	1.00	17	17	0.0	(X)	0.0
Greasewood CDP, Navajo County	181	142	79	55.6	63	4.15	3.48	39	10	0.7	0.0	1.6
Green Valley CDP, Pima County	17,322	12,741	10,786	84.7	1,955	1.70	1.49	4,581	2,518	8.3	4.9	23.3
Greer CDP, Apache County	167	20	12	60.0	8	2.08	2.00	147	143	16.7	0.0	33.3
Guadalupe town, Maricopa County	1,376	1,292	782	60.5	510	4.49	3.92	84	7	1.7	0.4	3.8
Gu Oidak CDP, Pima County	91	67	62	92.5	5	2.81	2.80	24	1	0.0	0.0	0.0
Hackberry CDP, Mohave County	45	31	29	93.5	2	2.28	1.00	14	5	3.0	3.2	0.0
Haigler Creek CDP, Gila County	46	14	13	92.9	1	1.38	1.00	32	28	12.5	13.3	0.0
Haivana Nakya CDP, Pima County	39	26	19	73.1	7	3.84	3.29	13	0	0.0	0.0	0.0
Hard Rock CDP, Navajo County	41	28	21	75.0	7	3.19	3.86	13	11	0.0	0.0	0.0
Hayden town	301	236	190	80.5	46	2.71	3.22	65	6	1.7	0.5	6.1
Gila County (part)	301	236	190	80.5	46	2.71	3.22	65	6	1.7	0.5	6.1
Pinal County (part)	0	0	0	(X)	0	0.00	0.00	0	0	(X)	(X)	(X)
Heber-Overgaard CDP, Navajo County	3,593	1,236	1,038	84.0	198	2.21	2.66	2,357	2,100	9.8	8.6	15.8
Holbrook city, Navajo County	1,881	1,636	1,035	63.3	601	2.84	2.83	245	36	4.4	1.6	8.7
Hondah CDP, Navajo County	286	211	115	54.5	96	3.60	4.15	75	60	4.1	0.0	8.4
Hotevilla-Bacavi CDP, Navajo County	412	294	249	84.7	45	3.27	3.20	118	91	0.3	0.0	2.2
Houck CDP, Apache County	385	335	291	86.9	44	2.91	4.05	50	10	0.3	0.0	2.2
Huachuca City town, Cochise County	920	782	445	56.9	337	2.39	2.34	138	3	6.5	3.9	9.8
Hunter Creek CDP, Gila County	111	21	21	100.0	0	2.29	0.00	90	89	0.0	0.0	(X)
Icehouse Canyon CDP, Gila County	298	246	193	78.5	53	2.56	3.45	52	5	6.0	1.5	18.8
Indian Wells CDP, Navajo County	75	61	39	63.9	22	4.18	4.18	14	1	4.6	0.0	11.5
Jakes Corner CDP, Gila County	81	53	43	81.1	10	1.35	1.80	28	17	1.9	2.3	0.0
Jeddito CDP, Navajo County	115	88	30	34.1	58	3.13	3.43	27	10	12.0	0.0	17.1
Jerome town, Yavapai County	290	253	144	56.9	109	1.98	1.46	37	11	5.2	2.7	8.3
Joseph City CDP, Navajo County	547	430	311	72.3	119	3.27	3.11	117	52	5.7	0.6	16.8
Kachina Village CDP, Coconino County	1,469	1,039	773	74.4	266	2.45	2.74	430	368	3.5	2.4	6.6
Kaibab CDP, Mohave County	52	44	24	54.5	20	2.67	3.00	8	2	8.3	0.0	16.7
Kaibito CDP, Coconino County	413	351	216	61.5	135	4.56	3.97	62	18	5.6	0.0	13.5
Kaka CDP, Maricopa County	57	37	25	67.6	12	3.52	4.42	20	1	2.6	0.0	7.7
Katherine CDP, Mohave County	158	57	29	50.9	28	1.59	2.04	101	82	12.3	0.0	22.2
Kayenta CDP, Navajo County	1,602	1,375	641	46.6	734	3.81	3.73	227	55	5.9	0.0	10.4
Keams Canyon CDP, Navajo County	142	104	38	36.5	66	3.50	2.59	38	18	7.1	2.6	9.6
Kearny town, Pinal County	878	756	616	81.5	140	2.58	2.58	122	26	5.7	3.6	14.1
Kingman city, Mohave County	12,724	11,217	7,352	65.5	3,865	2.41	2.51	1,507	149	7.1	4.3	12.0
Kino Springs CDP, Santa Cruz County	65	51	35	68.6	16	2.51	3.00	14	2	17.7	10.3	30.4

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		Total	Owner occupied		Renter occupied	Average household size		Total	For seasonal, recreational, or occasional use	Vacancy rate		
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PLACE—Con.												
Klagetoh CDP, Apache County	71	60	36	60.0	24	3.61	4.67	11	4	1.6	0.0	4.0
Kohatk CDP, Pinal County	15	7	7	100.0	0	3.86	0.00	8	0	0.0	0.0	(X)
Kohls Ranch CDP, Gila County	127	23	18	78.3	5	1.94	2.20	104	100	8.0	0.0	28.6
Komatke CDP, Maricopa County	246	207	74	35.7	133	3.73	4.10	39	3	0.5	0.0	0.7
Ko Vaya CDP, Pima County	16	15	14	93.3	1	3.21	1.00	1	0	0.0	0.0	0.0
Kykotsmovi Village CDP, Navajo County	328	252	193	76.6	59	3.16	2.32	76	38	2.7	1.0	7.7
Lake Havasu City city, Mohave County	32,327	23,168	16,403	70.8	6,765	2.19	2.43	9,159	6,862	5.9	3.6	11.2
Lake Montezuma CDP, Yavapai County	2,334	1,930	1,375	71.2	555	2.31	2.75	404	123	7.8	6.3	11.3
Lake of the Woods CDP, Navajo County	2,859	1,607	1,195	74.4	412	2.52	2.62	1,252	804	11.3	4.1	26.5
La Paz Valley CDP, La Paz County	695	370	328	88.6	42	1.86	2.10	325	265	8.4	9.1	2.3
Lazy Y U CDP, Mohave County	194	169	159	94.1	10	2.49	3.20	25	9	4.0	4.2	0.0
LeChee CDP, Coconino County	359	332	284	85.5	48	4.39	4.10	27	17	0.3	0.0	2.0
Leupp CDP, Coconino County	255	232	159	68.5	73	3.99	4.33	23	10	0.8	1.2	0.0
Linden CDP, Navajo County	1,468	1,001	886	88.5	115	2.52	3.13	467	363	5.2	4.5	10.1
Litchfield Park city, Maricopa County	2,716	2,263	1,628	71.9	635	2.41	2.38	453	140	6.8	5.0	10.9
Littlefield CDP, Mohave County	153	109	86	78.9	23	2.86	2.70	44	9	5.2	6.5	0.0
Littletown CDP, Pima County	277	255	218	85.5	37	3.37	3.73	22	0	5.9	5.2	9.8
Lower Santan Village CDP, Pinal County	103	98	82	83.7	16	3.99	2.94	5	1	0.0	0.0	0.0
Low Mountain CDP, Navajo County	260	189	124	65.6	65	4.06	3.91	71	26	1.0	0.0	3.0
Lukachukai CDP, Apache County	674	479	400	83.5	79	3.50	3.81	195	90	1.8	0.0	10.0
Lupton CDP, Apache County	8	6	4	66.7	2	4.25	4.00	2	2	0.0	0.0	0.0
McConnico CDP, Mohave County	56	36	23	63.9	13	1.57	2.15	20	4	23.4	0.0	45.8
McNary CDP	136	124	51	41.1	73	3.78	4.59	12	7	0.0	0.0	0.0
Apache County (part)	127	122	49	40.2	73	3.88	4.59	5	0	0.0	0.0	0.0
Navajo County (part)	9	2	2	100.0	0	1.50	0.00	7	7	0.0	0.0	(X)
McNeal CDP, Cochise County	116	93	50	53.8	43	2.26	2.91	23	6	5.1	5.7	4.4
Maish Vaya CDP, Pima County	59	41	36	87.8	5	3.86	3.80	18	1	0.0	0.0	0.0
Mammoth town, Pinal County	635	487	360	73.9	127	2.94	2.91	148	9	3.5	1.9	7.9
Many Farms CDP, Apache County	491	395	191	48.4	204	3.41	3.41	96	35	10.0	0.0	17.6
Marana town	14,726	13,073	10,566	80.8	2,507	2.60	2.79	1,653	758	4.1	3.2	7.4
Pima County (part)	14,726	13,073	10,566	80.8	2,507	2.60	2.79	1,653	758	4.1	3.2	7.4
Pinal County (part)	0	0	0	(X)	0	0.00	0.00	0	0	(X)	(X)	(X)
Maricopa city, Pinal County	17,240	14,359	11,445	79.7	2,914	2.87	3.66	2,881	698	7.5	7.2	8.5
Maricopa Colony CDP, Maricopa County	201	183	145	79.2	38	3.78	4.24	18	2	1.1	0.7	2.6
Martinez Lake CDP, Yuma County	510	313	178	56.9	135	1.66	3.72	197	185	3.4	0.6	6.9
Mayer CDP, Yavapai County	849	679	482	71.0	197	2.22	2.16	170	57	4.5	3.7	6.6
Mead Ranch CDP, Gila County	108	19	17	89.5	2	2.12	1.00	89	88	0.0	0.0	0.0
Meadview CDP, Mohave County	1,373	656	594	90.5	62	1.85	2.05	717	432	10.7	11.2	6.1
Mesa city, Maricopa County	201,173	165,374	104,559	63.2	60,815	2.63	2.64	35,799	16,926	8.1	3.7	14.9
Mesa del Caballo CDP, Gila County	406	314	258	82.2	56	2.33	2.93	92	44	6.5	2.6	20.8
Mescal CDP, Cochise County	853	767	639	83.3	128	2.28	2.79	86	16	3.0	2.4	5.8
Mesquite Creek CDP, Mohave County	240	196	168	85.7	28	1.96	3.07	44	27	5.8	3.4	17.6
Miami town, Gila County	973	749	534	71.3	215	2.42	2.53	224	24	6.5	2.5	15.4
Miracle Valley CDP, Cochise County	287	232	187	80.6	45	2.71	3.07	55	6	10.4	6.9	22.4
Moccasin CDP, Mohave County	37	30	22	73.3	8	2.73	3.63	7	5	0.0	0.0	0.0
Moenkopi CDP, Coconino County	284	253	201	79.4	52	3.74	4.10	31	19	0.4	0.0	1.9
Mohave Valley CDP, Mohave County	1,300	965	755	78.2	210	2.52	3.39	335	161	8.7	5.5	18.6
Mojave Ranch Estates CDP, Mohave County	21	18	11	61.1	7	3.45	2.00	3	0	0.0	0.0	0.0
Morenci CDP, Greenlee County	792	562	3	0.5	559	3.33	2.64	230	71	19.9	0.0	20.0
Morristown CDP, Maricopa County	139	102	78	76.5	24	2.40	1.67	37	6	7.7	4.8	14.7
Mountainaire CDP, Coconino County	621	486	353	72.6	133	2.27	2.39	135	118	1.4	0.8	2.9
Munds Park CDP, Coconino County	3,019	310	256	82.6	54	1.97	2.33	2,709	2,619	19.6	19.7	19.4
Naco CDP, Cochise County	334	284	222	78.2	62	3.68	3.69	50	6	3.1	0.9	10.1
Nazlini CDP, Apache County	136	112	75	67.0	37	3.93	5.24	24	4	2.6	0.0	7.5
Nelson CDP, Pima County	100	89	78	87.6	11	3.04	2.00	11	2	3.3	2.5	8.3
New Kingman-Butler CDP, Mohave County	5,863	4,991	3,302	66.2	1,689	2.24	2.80	872	63	6.9	4.6	11.0
New River CDP, Maricopa County	6,273	5,616	5,032	89.6	584	2.64	2.77	657	166	4.7	4.2	9.0
Nogales city, Santa Cruz County	7,260	6,601	3,371	51.1	3,230	3.26	2.97	659	42	5.5	1.4	9.5
Nolic CDP, Pima County	15	13	10	76.9	3	2.80	3.00	2	1	0.0	0.0	0.0
North Fork CDP, Navajo County	396	364	256	70.3	108	4.05	3.53	32	1	0.5	0.0	1.7
Nutrioso CDP, Apache County	30	13	11	84.6	2	1.82	3.00	17	17	0.0	0.0	0.0
Oak Springs CDP, Apache County	21	14	12	85.7	2	4.75	3.00	7	3	0.0	0.0	0.0
Oatman CDP, Mohave County	112	74	43	58.1	31	1.58	2.13	38	13	5.1	2.3	8.8
Oljato-Monument Valley CDP, Navajo County	46	35	35	100.0	0	4.40	0.00	11	10	0.0	0.0	(X)
Oracle CDP, Pinal County	1,772	1,515	1,151	76.0	364	2.39	2.58	257	59	4.3	2.7	8.9
Orange Grove Mobile Manor CDP, Yuma County	174	165	116	70.3	49	3.50	3.84	9	0	0.6	0.0	2.0
Oro Valley town, Pima County	20,340	17,804	13,786	77.4	4,018	2.34	2.16	2,536	1,459	4.2	3.0	8.0
Oxbow Estates CDP, Gila County	141	108	65	60.2	43	1.98	2.05	33	7	16.2	1.5	31.3

Table 12.
Housing Occupancy and Tenure: 2010—Con.

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State County Place	Total housing units	Occupied housing units						Vacant housing units				
			Owner occupied			Average household size				Vacancy rate		
		Total	Number	Percent of occupied housing units	Renter occupied	Owner-occupied units	Renter-occupied units	Total	For seasonal, recreational, or occasional use	Available housing	Home-owner	Rental
PLACE—Con.												
Padre Ranchitos CDP, Yuma County	46	42	33	78.6	9	4.15	3.78	4	2	0.0	0.0	0.0
Page city, Coconino County	2,787	2,518	1,767	70.2	751	2.79	3.07	269	89	3.4	1.6	7.2
Palominas CDP, Cochise County	107	98	85	86.7	13	2.19	2.00	9	2	3.9	2.3	13.3
Paradise Valley town, Maricopa County	5,643	4,860	4,584	94.3	276	2.62	2.78	783	335	4.6	4.4	7.9
Parker town, La Paz County	1,098	973	638	65.6	335	2.97	2.85	125	18	7.0	3.2	13.5
Parker Strip CDP, La Paz County	1,387	377	315	83.6	62	1.74	1.82	1,010	966	8.0	5.1	20.5
Parks CDP, Coconino County	1,288	534	464	86.9	70	2.23	2.16	754	570	6.8	6.0	11.1
Patagonia town, Santa Cruz County	576	425	262	61.6	163	2.14	2.15	151	62	7.4	4.0	12.3
Paulden CDP, Yavapai County	2,268	1,917	1,566	81.7	351	2.65	3.07	351	82	6.8	4.6	15.5
Payson town, Gila County	8,958	6,860	4,915	71.6	1,945	2.14	2.30	2,098	1,317	7.4	5.1	12.8
Peach Springs CDP, Mohave County	334	298	148	49.7	150	3.46	3.61	36	3	1.0	0.0	1.9
Peeples Valley CDP, Yavapai County	338	235	207	88.1	28	1.81	1.93	103	63	4.8	4.6	6.7
Peoria city	64,818	57,457	42,346	73.7	15,111	2.69	2.59	7,361	1,786	6.5	3.5	14.0
Maricopa County (part)	64,814	57,454	42,345	73.7	15,109	2.69	2.59	7,360	1,785	6.5	3.5	14.0
Yavapai County (part)	4	3	1	33.3	2	4.00	1.50	1	1	0.0	0.0	0.0
Peridot CDP	362	333	317	95.2	16	4.07	3.69	29	7	0.6	0.0	11.1
Gila County (part)	120	101	94	93.1	7	3.71	4.00	19	1	0.0	0.0	0.0
Graham County (part)	242	232	223	96.1	9	4.22	3.44	10	6	0.9	0.0	18.2
Phoenix city, Maricopa County	590,149	514,806	296,742	57.6	218,064	2.80	2.72	75,343	6,598	9.1	4.3	14.9
Picacho CDP, Pinal County	185	167	93	55.7	74	2.77	2.81	18	3	2.3	2.1	2.6
Picture Rocks CDP, Pima County	4,177	3,689	3,098	84.0	591	2.57	2.68	488	98	4.1	3.1	9.5
Pima town, Graham County	870	749	566	75.6	183	3.19	3.17	121	12	6.7	3.1	16.4
Pimaco Two CDP, Pima County	313	280	234	83.6	46	2.41	2.59	33	8	3.8	3.3	6.1
Pinal CDP, Gila County	199	172	127	73.8	45	2.50	2.71	27	2	8.0	1.6	22.4
Pine CDP, Gila County	2,588	994	868	87.3	126	1.99	1.90	1,594	1,394	9.3	6.9	22.1
Pinedale CDP, Navajo County	332	186	153	82.3	33	2.49	3.21	146	115	8.2	8.7	5.7
Pine Lake CDP, Mohave County	156	70	68	97.1	2	1.97	2.00	86	74	10.3	8.1	50.0
Pinetop Country Club CDP, Navajo County	3,789	805	686	85.2	119	2.17	2.59	2,984	2,509	13.0	10.6	23.9
Pinetop-Lakeside town, Navajo County	3,451	1,707	1,211	70.9	496	2.50	2.49	1,744	1,356	12.0	9.3	17.9
Pinion Pines CDP, Mohave County	102	80	70	87.5	10	2.37	2.00	22	14	2.4	2.7	0.0
Pinon CDP, Navajo County	338	256	131	51.2	125	4.06	2.98	82	27	0.4	0.0	0.8
Pirtleville CDP, Cochise County	631	532	394	74.1	138	3.30	3.22	99	7	5.0	2.2	12.4
Pisinemo CDP, Pima County	116	80	58	72.5	22	3.93	4.23	36	1	3.5	0.0	10.7
Poston CDP, La Paz County	85	81	33	40.7	48	3.06	3.81	4	1	1.2	0.0	2.0
Prescott city, Yavapai County	22,159	18,611	12,210	65.6	6,401	2.05	2.01	3,548	1,782	5.9	3.8	9.8
Prescott Valley town, Yavapai County	17,494	15,364	10,104	65.8	5,260	2.42	2.68	2,130	724	6.0	3.3	10.7
Quartzsite town, La Paz County	3,378	2,027	1,711	84.4	316	1.75	1.89	1,351	1,087	8.2	5.8	19.0
Queen Creek town	8,557	7,720	6,141	79.5	1,579	3.41	3.43	837	142	5.9	5.1	9.0
Maricopa County (part)	8,394	7,569	6,000	79.3	1,569	3.42	3.43	825	141	6.0	5.2	9.0
Pinal County (part)	163	151	141	93.4	10	2.94	3.40	12	1	2.5	2.7	0.0
Queen Valley CDP, Pinal County	621	398	362	91.0	36	1.99	1.89	223	161	8.9	7.8	18.8
Rainbow City CDP, Navajo County	226	223	157	70.4	66	3.92	5.33	3	0	0.0	0.0	0.0
Rancho Mesa Verde CDP, Yuma County	162	153	104	68.0	49	4.15	3.94	9	0	2.5	1.9	3.9
Red Mesa CDP, Apache County	202	151	22	14.6	129	2.77	3.25	51	9	20.5	0.0	23.2
Red Rock CDP (Apache County), Apache County	64	51	47	92.2	4	3.34	3.00	13	1	3.8	0.0	33.3
Red Rock CDP (Pinal County), Pinal County	786	705	622	88.2	83	3.07	3.12	81	6	4.6	4.6	4.6
Rillito CDP, Pima County	50	37	24	64.9	13	2.38	3.08	13	0	17.8	0.0	38.1
Rincon Valley CDP, Pima County	2,044	1,896	1,760	92.8	136	2.70	2.86	148	30	3.6	3.2	9.3
Rio Rico CDP, Santa Cruz County	6,356	5,625	4,553	80.9	1,072	3.42	3.15	731	126	6.2	4.5	12.8
Rio Verde CDP, Maricopa County	1,647	1,001	975	97.4	26	1.82	1.50	646	544	7.8	6.2	43.5
Rock House CDP, Gila County	42	29	27	93.1	2	1.74	1.50	13	11	0.0	0.0	0.0
Rock Point CDP, Apache County	205	166	123	74.1	43	4.12	3.14	39	5	3.5	0.0	12.0
Roosevelt CDP, Gila County	43	11	9	81.8	2	1.67	2.50	32	32	0.0	0.0	0.0
Rough Rock CDP, Apache County	160	120	65	54.2	55	4.02	2.78	40	16	12.4	0.0	23.6
Round Rock CDP, Apache County	260	211	191	90.5	20	3.58	5.25	49	28	0.5	0.0	4.8
Round Valley CDP, Gila County	227	195	176	90.3	19	2.39	2.84	32	18	2.0	0.6	13.6
Rye CDP, Gila County	63	41	26	63.4	15	1.73	1.93	22	1	26.8	0.0	50.0
Sacate Village CDP, Pinal County	50	40	14	35.0	26	3.71	4.50	10	0	0.0	0.0	0.0
Sacaton CDP, Pinal County	671	628	315	50.2	313	3.93	3.87	43	7	3.2	0.0	6.3
Sacaton Flats Village CDP, Pinal County	168	159	120	75.5	39	3.43	3.31	9	2	0.0	0.0	0.0
Saddlebrooke CDP, Pinal County	5,671	4,907	4,737	96.5	170	1.95	2.26	764	443	3.3	2.3	25.1
Safford city, Graham County	3,908	3,385	2,260	66.8	1,125	2.80	2.66	523	54	7.2	4.3	12.7
Sahuarita town, Pima County	10,615	9,020	7,615	84.4	1,405	2.73	3.14	1,595	738	5.7	4.7	10.4
St. David CDP, Cochise County	804	685	500	73.0	185	2.52	2.38	119	39	3.6	1.8	8.4
St. Johns city, Apache County	1,476	1,168	866	74.1	302	2.92	2.80	308	47	10.9	3.1	27.1
St. Johns CDP, Maricopa County	139	127	93	73.2	34	3.92	3.26	12	10	0.0	0.0	0.0
St. Michaels CDP, Apache County	518	425	372	87.5	53	3.30	2.83	93	43	0.9	0.0	7.0
Salome CDP, La Paz County	1,078	743	647	87.1	96	1.98	2.58	335	229	3.8	3.7	4.5
San Carlos CDP, Gila County	998	923	672	72.8	251	4.38	4.35	75	14	1.0	0.1	3.0

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State County Place	Total housing units	Occupied housing units						Vacant housing units				
			Owner occupied			Average household size				Vacancy rate		
		Total	Number	Percent of occupied housing units	Renter occupied	Owner-occupied units	Renter-occupied units	Total	For seasonal, recreational, or occasional use	Available housing	Home-owner	Rental
PLACE—Con.												
Sanders CDP, Apache County	242	200	77	38.5	123	3.43	2.98	42	13	5.2	1.3	7.5
San Jose CDP, Graham County	211	172	136	79.1	36	2.96	2.86	39	0	9.7	4.1	26.0
San Luis city, Yuma County	6,525	5,953	4,272	71.8	1,681	4.32	3.89	572	69	2.9	1.8	5.5
San Manuel CDP, Pinal County	1,541	1,329	1,031	77.6	298	2.64	2.77	212	26	8.1	4.6	18.4
San Miguel CDP, Pima County	79	55	50	90.9	5	3.66	2.80	24	0	14.1	0.0	64.3
San Simon CDP, Cochise County	127	80	67	83.8	13	2.07	2.00	47	13	9.1	0.0	38.1
Santa Cruz CDP, Pinal County	13	13	6	46.2	7	1.83	3.71	0	0	0.0	0.0	0.0
San Tan Valley CDP, Pinal County	29,417	24,739	19,121	77.3	5,618	3.13	3.82	4,678	1,280	7.9	8.0	7.6
Santa Rosa CDP, Pima County	223	163	131	80.4	32	4.01	3.22	60	9	3.0	0.8	11.1
Sawmill CDP, Apache County	243	196	167	85.2	29	3.74	4.24	47	9	2.5	0.0	14.7
Scenic CDP, Mohave County	779	618	528	85.4	90	2.60	2.99	161	90	6.7	6.3	9.0
Scottsdale city, Maricopa County	124,001	101,273	68,967	68.1	32,306	2.22	1.95	22,728	12,299	6.8	4.4	11.4
Seba Dalkai CDP, Navajo County	57	48	38	79.2	10	2.84	2.80	9	2	5.9	0.0	23.1
Second Mesa CDP, Navajo County	325	247	193	78.1	54	3.93	3.78	78	51	1.2	0.5	3.6
Sedona city	6,367	4,973	3,424	68.9	1,549	1.94	2.19	1,394	837	6.2	4.7	9.5
Coconino County (part)	2,004	1,491	993	66.6	498	1.90	1.92	513	330	6.1	4.6	9.0
Yavapai County (part)	4,363	3,482	2,431	69.8	1,051	1.96	2.31	881	507	6.3	4.7	9.7
Sehili CDP, Apache County	52	41	35	85.4	6	3.40	2.67	11	5	0.0	0.0	0.0
Seligman CDP, Yavapai County	292	207	142	68.6	65	1.99	2.49	85	20	5.4	2.1	11.5
Sells CDP, Pima County	736	616	392	63.6	224	3.99	3.54	120	14	6.5	0.0	16.1
Seven Mile CDP, Navajo County	176	166	105	63.3	61	3.99	4.72	10	5	1.8	0.0	4.7
Shongopovi CDP, Navajo County	240	204	193	94.6	11	4.01	5.18	36	19	0.5	0.0	8.3
Shonto CDP, Navajo County	205	175	63	36.0	112	3.38	3.38	30	11	5.9	0.0	8.9
Show Low city, Navajo County	7,722	4,368	2,846	65.2	1,522	2.39	2.49	3,354	2,375	12.8	8.9	19.2
Sierra Vista city, Cochise County	18,742	17,059	9,712	56.9	7,347	2.42	2.37	1,683	205	6.1	2.5	10.4
Sierra Vista Southeast CDP, Cochise County	6,394	5,936	5,039	84.9	897	2.47	2.59	458	92	2.7	2.2	5.7
Six Shooter Canyon CDP, Gila County	469	398	294	73.9	104	2.43	2.94	71	10	8.3	0.7	24.1
Snowflake town, Navajo County	2,074	1,739	1,270	73.0	469	3.23	3.07	335	89	8.5	5.3	16.3
So-Hi CDP, Mohave County	242	207	167	80.7	40	2.28	2.43	35	9	7.2	7.2	7.0
Solomon CDP, Graham County	171	147	119	81.0	28	2.97	2.57	24	1	6.4	1.7	22.2
Somerton city, Yuma County	4,052	3,791	2,717	71.7	1,074	3.89	3.45	261	24	3.7	1.8	8.2
Sonoita CDP, Santa Cruz County	462	379	341	90.0	38	2.21	1.74	83	36	5.0	5.0	4.8
South Komelik CDP, Pima County	65	37	34	91.9	3	3.18	1.00	28	0	0.0	0.0	0.0
South Tucson city, Pima County	2,137	1,827	663	36.3	1,164	3.10	2.83	310	8	8.8	2.9	11.8
Springerville town, Apache County	954	775	506	65.3	269	2.52	2.55	179	40	7.8	2.3	16.5
Spring Valley CDP, Yavapai County	629	517	386	74.7	131	2.18	2.33	112	27	7.1	4.7	13.6
Stanfield CDP, Pinal County	222	196	93	47.4	103	3.73	3.82	26	2	5.2	3.1	7.1
Star Valley town, Gila County	1,531	1,063	900	84.7	163	2.11	2.50	468	310	10.1	9.0	15.7
Steamboat CDP, Apache County	92	74	49	66.2	25	3.43	4.64	18	9	0.0	0.0	0.0
Stotonic Village CDP, Pinal County	181	171	103	60.2	68	4.11	3.47	10	0	0.6	0.0	1.4
Strawberry CDP, Gila County	1,293	489	445	91.0	44	1.97	1.93	804	700	8.4	6.7	21.7
Summerhaven CDP, Pima County	259	21	14	66.7	7	1.64	2.43	238	216	40.0	41.7	36.4
Summit CDP, Pima County	1,708	1,498	1,109	74.0	389	3.63	3.45	210	19	5.6	2.0	14.6
Sun City CDP, Maricopa County	28,169	23,167	19,351	83.5	3,816	1.62	1.48	5,002	2,454	5.3	4.3	10.5
Sun City West CDP, Maricopa County	18,218	14,873	13,402	90.1	1,471	1.67	1.35	3,345	2,054	4.5	2.8	17.6
Sunizona CDP, Cochise County	206	134	119	88.8	15	2.08	2.27	72	20	8.6	8.9	5.9
Sun Lakes CDP, Maricopa County	10,028	8,218	7,557	92.0	661	1.72	1.45	1,810	1,185	4.9	2.2	27.3
Sun Valley CDP, Navajo County	150	88	76	86.4	12	2.95	2.25	62	11	3.3	2.6	7.7
Sunwest CDP, La Paz County	31	7	6	85.7	1	2.33	1.00	24	21	0.0	0.0	0.0
Supai CDP, Coconino County	49	43	37	86.0	6	5.27	2.17	6	2	0.0	0.0	0.0
Superior town, Pinal County	1,465	1,103	797	72.3	306	2.61	2.48	362	53	9.4	4.4	20.3
Surprise city, Maricopa County	52,586	43,272	34,031	78.6	9,241	2.60	3.12	9,314	4,330	7.0	4.9	14.2
Sweet Water Village CDP, Pinal County	26	25	22	88.0	3	3.64	1.00	1	0	0.0	0.0	0.0
Swift Trail Junction CDP, Graham County	679	588	449	76.4	139	2.84	2.64	91	12	6.3	5.1	10.1
Tacna CDP, Yuma County	291	216	166	76.9	50	2.85	2.58	75	33	10.2	5.1	23.9
Tanque Verde CDP, Pima County	7,340	6,722	6,025	89.6	697	2.52	2.25	618	289	2.3	1.8	6.4
Tat Momoli CDP, Pinal County	9	3	3	100.0	0	3.33	0.00	6	0	0.0	0.0	(X)
Taylor town, Navajo County	1,464	1,294	1,012	78.2	282	3.18	3.16	170	36	5.3	3.9	9.8
Teec Nos Pos CDP, Apache County	258	211	133	63.0	78	3.42	3.53	47	26	7.0	0.0	16.7
Tees Toh CDP, Navajo County	149	118	107	90.7	11	3.96	2.18	31	12	1.7	0.9	8.3
Tempe city, Maricopa County	73,462	66,000	29,384	44.5	36,616	2.40	2.21	7,462	576	7.6	3.2	10.9
Thatcher town, Graham County	1,840	1,606	1,090	67.9	516	2.93	2.77	234	18	9.0	3.7	18.5
Theba CDP, Maricopa County	49	43	4	9.3	39	2.50	3.79	6	0	6.5	0.0	7.1
Three Points CDP, Pima County	2,487	2,033	1,707	84.0	326	2.77	2.62	454	84	4.5	4.1	6.3
Tolani Lake CDP, Coconino County	98	72	44	61.1	28	3.48	4.54	26	1	0.0	0.0	0.0
Tolleson city, Maricopa County	2,169	1,959	945	48.2	1,014	3.41	3.27	210	7	6.8	3.8	9.5
Tombstone city, Cochise County	864	663	450	67.9	213	2.16	1.92	201	65	10.5	5.0	20.4
Tonalea CDP, Coconino County	132	122	89	73.0	33	4.33	4.97	10	4	1.6	0.0	5.7
Tonopah CDP, Maricopa County	30	29	16	55.2	13	2.19	1.92	1	0	0.0	0.0	0.0
Tonto Basin CDP, Gila County	1,383	759	672	88.5	87	1.86	1.99	624	546	4.2	3.8	7.4
Tonto Village CDP, Gila County	215	98	79	80.6	19	2.65	2.47	117	106	6.6	5.9	9.5

Table 12.
Housing Occupancy and Tenure: 2010—Con.

[For information on confidentiality protection, nonsampling error, and definitions, see Selected Appendixes at <www.census.gov/prod/cen2010/cph-1-a.pdf>]

State County Place	Total housing units	Occupied housing units: Total	Owner occupied: Number	Owner occupied: Percent of occupied housing units	Renter occupied	Average household size: Owner-occupied units	Average household size: Renter-occupied units	Vacant housing units: Total	For seasonal, recreational, or occasional use	Vacancy rate: Available housing	Vacancy rate: Home-owner	Vacancy rate: Rental
PLACE—Con.												
Topawa CDP, Pima County	135	95	89	93.7	6	3.24	1.83	40	2	1.0	0.0	14.3
Topock CDP, Mohave County	31	8	3	37.5	5	1.67	1.00	23	21	20.0	0.0	28.6
Top-of-the-World CDP	173	120	82	68.3	38	1.93	1.92	53	42	1.6	1.2	2.5
Gila County (part)	0	0	0	(X)	0	0.00	0.00	0	0	(X)	(X)	(X)
Pinal County (part)	173	120	82	68.3	38	1.93	1.92	53	42	1.6	1.2	2.5
Toyei CDP, Apache County	6	6	2	33.3	4	2.00	2.25	0	0	0.0	0.0	0.0
Truxton CDP, Mohave County	73	51	44	86.3	7	2.61	2.71	22	3	13.3	13.5	12.5
Tsaile CDP, Apache County	346	287	95	33.1	192	3.86	3.30	59	23	4.2	0.0	6.0
Tubac CDP, Santa Cruz County	1,067	630	544	86.3	86	1.91	1.77	437	238	17.6	7.9	50.3
Tuba City CDP, Coconino County	2,465	2,249	1,309	58.2	940	4.07	3.45	216	79	1.0	0.0	2.3
Tucson city, Pima County	229,762	205,390	106,651	51.9	98,739	2.53	2.32	24,372	3,465	7.1	2.8	11.2
Tucson Estates CDP, Pima County	6,152	5,154	4,536	88.0	618	2.33	2.58	998	532	4.1	2.3	15.6
Tumacacori-Carmen CDP, Santa Cruz County	187	138	89	64.5	49	2.25	1.90	49	6	6.1	3.2	10.9
Turkey Creek CDP, Navajo County	77	71	49	69.0	22	3.82	4.86	6	1	0.0	0.0	0.0
Tusayan CDP, Coconino County	289	231	14	6.1	217	2.00	2.31	58	40	4.9	0.0	5.2
Upper Santan Village CDP, Pinal County	136	128	87	68.0	41	3.74	4.15	8	0	0.0	0.0	0.0
Utting CDP, La Paz County	103	64	56	87.5	8	1.84	2.88	39	25	5.7	6.5	0.0
Vail CDP, Pima County	3,754	3,440	2,964	86.2	476	2.90	3.36	314	43	4.1	3.7	6.6
Valva Vo CDP, Pinal County	29	26	23	88.5	3	4.91	5.00	3	0	0.0	0.0	0.0
Valencia West CDP, Pima County	3,206	2,893	2,421	83.7	472	3.16	3.59	313	16	5.4	4.6	9.4
Valentine CDP, Mohave County	14	13	3	23.1	10	2.67	3.00	1	1	0.0	0.0	0.0
Valle CDP, Coconino County	583	338	198	58.6	140	2.35	2.62	245	93	9.1	8.7	9.7
Valle Vista CDP, Mohave County	936	759	632	83.3	127	2.15	2.34	177	40	8.6	6.7	17.4
Ventana CDP, Pima County	29	15	5	33.3	10	3.40	3.20	14	0	11.1	0.0	15.4
Verde Village CDP, Yavapai County	4,989	4,514	3,361	74.5	1,153	2.43	2.95	475	84	4.2	2.7	8.2
Vernon CDP, Apache County	61	45	36	80.0	9	2.67	2.89	16	7	8.2	5.3	18.2
Vicksburg CDP, La Paz County	687	285	246	86.3	39	1.96	2.90	402	206	36.0	7.1	77.7
Village of Oak Creek (Big Park) CDP, Yavapai County	4,076	3,134	2,102	67.1	1,032	1.93	1.94	942	572	7.6	6.0	10.7
Wagon Wheel CDP, Navajo County	1,163	680	500	73.5	180	2.47	2.31	483	349	6.9	6.5	8.0
Wahak Hotrontk CDP, Pima County	46	33	25	75.8	8	3.36	3.75	13	0	0.0	0.0	0.0
Wall Lane CDP, Yuma County	115	103	77	74.8	26	3.94	4.31	12	3	3.7	2.5	6.9
Walnut Creek CDP, Mohave County	251	229	207	90.4	22	2.43	2.73	22	3	3.8	3.7	4.3
Washington Park CDP, Gila County	206	39	35	89.7	4	1.77	2.00	167	144	2.5	2.8	0.0
Wellton town, Yuma County	2,081	1,220	991	81.2	229	2.30	2.62	861	727	7.1	6.1	11.2
Wellton Hills CDP, Yuma County	131	87	68	78.2	19	3.04	2.68	44	26	4.3	2.7	9.5
Wenden CDP, La Paz County	416	281	179	63.7	102	2.50	2.74	135	50	3.1	3.2	2.9
Wet Camp Village CDP, Pinal County	76	65	52	80.0	13	3.37	3.62	11	2	0.0	0.0	0.0
Wheatfields CDP, Gila County	465	354	268	75.7	86	2.11	2.56	111	29	11.8	0.0	35.3
Whetstone CDP, Cochise County	1,163	1,055	858	81.3	197	2.46	2.59	108	19	4.7	1.1	17.5
Whispering Pines CDP, Gila County	188	63	53	84.1	10	2.17	3.30	125	114	8.6	10.2	0.0
Whitecone CDP, Navajo County	300	225	165	73.3	60	3.50	4.00	75	36	3.8	0.0	13.0
White Hills CDP, Mohave County	290	162	121	74.7	41	1.90	2.27	128	44	14.9	15.1	14.3
White Mountain Lake CDP, Navajo County	1,772	922	764	82.9	158	2.32	2.74	850	655	9.7	8.8	14.0
Whiteriver CDP, Navajo County	1,072	1,007	537	53.3	470	4.26	3.78	65	11	1.8	0.0	3.9
Why CDP, Pima County	177	96	83	86.5	13	1.78	1.46	81	66	5.8	1.2	27.8
Wickenburg town	3,619	2,909	2,009	69.1	900	2.16	2.04	710	260	10.2	6.1	18.1
Maricopa County (part)	3,617	2,909	2,009	69.1	900	2.16	2.04	708	258	10.2	6.1	18.1
Yavapai County (part)	2	0	0	(X)	0	0.00	0.00	2	2	(X)	(X)	(X)
Wide Ruins CDP, Apache County	24	18	5	27.8	13	3.40	3.69	6	1	9.5	0.0	12.5
Wikieup CDP, Mohave County	103	64	38	59.4	26	2.21	1.88	39	15	11.0	0.0	22.9
Wilhoit CDP, Yavapai County	483	388	336	86.6	52	2.17	2.67	95	49	4.0	3.4	7.1
Willcox city, Cochise County	1,659	1,421	784	55.2	637	2.65	2.59	238	12	8.6	4.6	13.2
Williams city, Coconino County	1,426	1,168	698	59.8	470	2.58	2.60	258	102	5.0	3.7	6.9
Williamson CDP, Yavapai County	2,779	2,346	2,178	92.8	168	2.26	3.01	433	245	3.2	3.1	4.5
Willow Canyon CDP, Pima County	68	1	0	0.0	1	0.00	1.00	67	67	0.0	(X)	0.0
Willow Valley CDP, Mohave County	1,326	508	412	81.1	96	2.00	2.48	818	688	8.7	7.6	13.3
Window Rock CDP, Apache County	938	827	350	42.3	477	3.51	3.05	111	11	4.8	0.0	8.0
Winkelman town	163	136	99	72.8	37	2.53	2.78	27	3	6.8	2.0	17.8
Gila County (part)	163	136	99	72.8	37	2.53	2.78	27	3	6.8	2.0	17.8
Pinal County (part)	0	0	0	(X)	0	0.00	0.00	0	0	(X)	(X)	(X)
Winslow city, Navajo County	3,362	2,914	1,657	56.9	1,257	2.74	2.84	448	56	4.9	2.1	8.4
Winslow West CDP	173	135	55	40.7	80	2.75	3.59	38	7	13.5	1.8	20.0
Coconino County (part)	34	26	0	0.0	26	0.00	3.04	8	1	21.2	(X)	21.2
Navajo County (part)	139	109	55	50.5	54	2.75	3.85	30	6	11.4	1.8	19.4

Table 12.
Housing Occupancy and Tenure: 2010—Con.

[For information on confidentiality protection, nonsampling error, and definitions, see Selected Appendixes at <www.census.gov/prod/cen2010/cph-1-a.pdf>]

State County Place	Total housing units	Occupied housing units						Vacant housing units				
		Total	Owner occupied		Renter occupied	Average household size		Total	For seasonal, recreational, or occasional use	Vacancy rate		
			Number	Percent of occupied housing units		Owner-occupied units	Renter-occupied units			Available housing	Home-owner	Rental
PLACE—Con.												
Wintersburg CDP, Maricopa County	173	89	56	62.9	33	1.57	1.45	84	45	21.6	3.4	39.7
Wittmann CDP, Maricopa County	301	237	139	58.6	98	3.19	3.27	64	9	8.8	6.0	12.4
Woodruff CDP, Navajo County	85	65	55	84.6	10	2.93	3.00	20	2	7.0	1.8	28.6
Yarnell CDP, Yavapai County	597	379	305	80.5	74	1.72	1.64	218	126	9.5	7.3	17.8
York CDP, Greenlee County	336	219	181	82.6	38	2.45	3.00	117	17	20.8	0.5	59.8
Young CDP, Gila County	667	320	258	80.6	62	2.10	2.00	347	294	3.3	1.9	8.8
Youngtown town, Maricopa County	2,831	2,470	1,334	54.0	1,136	2.61	2.17	361	30	7.0	5.3	9.0
Yucca CDP, Mohave County	98	62	46	74.2	16	2.02	2.06	36	10	10.1	2.1	27.3
Yuma city, Yuma County	38,626	30,714	19,053	62.0	11,661	2.90	2.80	7,912	5,151	5.7	2.6	10.4

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-13: FEA 2.11_8760_APSRC01413.xlsx

FEDERAL EXECUTIVE AGENCIES
SECOND SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
OCTOBER 18, 2016

FEA 2.11: Please provide APS system hourly load, by rate class, separating residential self-generation customers, and other self-generation customers, if possible, for the 2015 Test Year.

Response: Please see Attachment APSRC01413 for the APS hourly loads by class for 2015. Due to the size of this spreadsheet, this attachment will only be provided in excel format.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-14: APS response to Gayer 4.3

RICHARD GAYER'S
FOURTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
JANUARY 15, 2017

Gayer 4.3: Regarding all of your residential customers for the Test Year or more recent contiguous twelve-month period of your choice (specify which such year), state the number with load factors from 0.0 through and including 0.1, from 0.1 through and including 0.2, from 0.2 through and including 0.3, from 0.3 through and including 0.4, from 0.4 through and including 0.5, from 0.5 through and including 0.6, from 0.6 through and including 0.7, from 0.7 through and including 0.8, from 0.8 through and including 0.9, and from 0.9 through and including 1.0.

Response: Please see Attachment APSRC01645.

Witness: Chuck Miessner

Arizona Public Service Company

Non-Solar Residential Customers - bill frequency by load factor

Load Factor = (Billed Energy) / (On-Peak Demand x Billing Days x 24)

2015 Test Year

Load Factor	Monthly Bills	% Bills	Average Load Factor	Median Load Factor
1-10%	431,034	3.6%	7%	8%
11-20%	2,483,954	20.8%	16%	16%
21-30%	3,520,035	29.5%	25%	25%
31-40%	2,792,840	23.4%	35%	35%
41-50%	1,631,576	13.7%	44%	44%
51-60%	641,940	5.4%	54%	54%
61-70%	224,023	1.9%	64%	64%
71-80%	101,101	0.8%	74%	74%
81-90%	57,485	0.5%	85%	84%
91-100%	35,978	0.3%	95%	94%
Total Bills	11,919,966		31%	29%
Average Monthly Bills	993,331			

Note: Solar customers were excluded from the data because their billed kWh did not reflect the actual customer load.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-15: Gayer 4.3_Residential LF_APSRC01645.xlsx

Arizona Public Service Company

Non-Solar Residential Customers - bill frequency by load factor

Load Factor = (Billed Energy) / (On-Peak Demand x Billing Days x 24)

2015 Test Year

Load Factor	Monthly Bills	% Bills	Average Load Factor	Median Load Factor
1-10%	431,034	3.6%	7%	8%
11-20%	2,483,954	20.8%	16%	16%
21-30%	3,520,035	29.5%	25%	25%
31-40%	2,792,840	23.4%	35%	35%
41-50%	1,631,576	13.7%	44%	44%
51-60%	641,940	5.4%	54%	54%
61-70%	224,023	1.9%	64%	64%
71-80%	101,101	0.8%	74%	74%
81-90%	57,485	0.5%	85%	84%
91-100%	35,978	0.3%	95%	94%
Total Bills	11,919,966		31%	29%
Average Monthly Bills	993,331			

Note: Solar customers were excluded from the data because their billed kWh did not reflect the actual customer load.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-16: ET-1, ET-2, ECT-1, and E-12 residential solar customers

Class NCP		Date	Delivered Hour	MW		Time	Site Hour	MW
	5468	08/16/15	20	170,500	5441	08/15/15	17	193,481
	5443	08/15/15	19	169,545	5442	08/15/15	18	191,113
	5467	08/16/15	19	168,404	5440	08/15/15	16	190,830
	5440	08/15/15	20	166,941	5465	08/16/15	17	190,092

System		Date	Top System Hour	Retail Load (GW)	System Month	System Hour	Res Solar Production (MWH)	% of Max Hourly Production for Month	Site Use (MWH)	Delivered (MWH)	Delivered / Site	Residential Export (MWH)
	5441	08/15/15	1	6,557	8	17	83,967	88%	193,481	119,591	62%	10,077
	5417	08/14/15	2	6,514	8	17	82,450	86%	180,204	109,264	61%	11,510
	5442	08/15/15	3	6,509	8	18	45,263	83%	191,113	149,870	78%	4,021
	5440	08/15/15	4	6,487	8	16	117,039	90%	190,830	91,954	48%	18,164
	5416	08/14/15	5	6,476	8	16	116,930	90%	175,231	80,372	46%	22,071
	5466	08/16/15	6	6,465	8	18	50,383	92%	189,747	144,047	76%	4,683
	5418	08/14/15	7	6,433	8	18	42,175	77%	179,539	141,331	79%	3,967
	5465	08/16/15	8	6,432	8	17	89,056	93%	190,092	112,903	59%	11,867
	5393	08/13/15	9	6,348	8	17	88,679	93%	172,134	98,338	57%	14,882
	5189	08/15/15	10	6,334	8	15	138,050	90%	184,166	73,093	40%	26,977
	5175	08/14/15	11	6,317	8	15	139,204	91%	166,296	60,454	36%	33,363
	5461	08/16/15	12	6,309	8	16	120,562	93%	185,376	85,763	46%	20,949
	5394	08/13/15	13	6,305	8	18	46,951	86%	173,719	132,289	76%	5,521
	5443	08/15/15	14	6,301	8	19	12,166	65%	181,129	169,545	94%	582
	5467	08/16/15	15	6,298	8	19	13,118	70%	180,957	168,404	93%	565
	5392	08/13/15	16	6,253	8	16	123,643	95%	165,858	69,892	42%	27,676
	5201	08/05/15	17	6,231	8	17	95,395	100%	167,066	89,395	54%	17,724
	1049	06/18/15	18	6,223	6	17	90,726	93%	164,700	90,818	55%	16,843
	5489	08/17/15	19	6,222	8	17	88,334	92%	164,879	92,060	56%	15,515
	5202	08/05/15	20	6,210	8	18	54,472	100%	170,131	122,851	72%	7,193
	5490	08/17/15	21	6,185	8	18	46,503	85%	166,792	125,910	75%	5,621
	1050	06/18/15	22	6,166	6	18	49,379	87%	164,822	122,037	74%	6,594
	5419	08/14/15	23	6,166	8	19	9,217	49%	170,847	161,991	95%	361
	1058	06/18/15	24	6,144	6	16	124,512	94%	159,762	65,243	41%	29,992
	1123	06/29/15	25	6,133	6	17	82,462	84%	161,206	92,653	57%	13,909
	5488	08/17/15	26	6,118	8	16	124,035	95%	157,808	63,204	40%	29,432
	5403	08/16/15	27	6,112	8	15	144,442	95%	177,530	64,806	37%	31,718
	5200	08/05/15	28	6,110	8	16	128,969	99%	159,825	62,721	39%	31,865
	5468	08/16/15	29	6,097	8	20	165	15%	170,662	170,500	100%	3
	5177	08/04/15	30	6,097	8	17	95,857	100%	163,225	86,235	53%	18,867
	5444	08/15/15	31	6,096	8	14	151,574	92%	173,980	59,380	34%	36,974
	5395	08/13/15	32	6,083	8	15	146,366	96%	157,107	51,723	33%	40,982
	5395	08/13/15	33	6,075	8	19	12,851	69%	166,516	154,417	93%	752
	5420	08/14/15	34	6,074	8	14	152,609	92%	154,559	47,466	31%	45,516
	1122	06/29/15	35	6,070	6	16	115,653	88%	156,694	66,872	43%	25,830
	1025	06/17/15	36	6,067	6	17	91,616	94%	159,068	85,584	54%	18,132
	5178	08/04/15	37	6,060	8	18	54,009	99%	164,472	118,253	72%	7,790
	1026	06/17/15	38	6,038	6	18	51,187	90%	160,642	116,779	73%	7,324
	5203	08/05/15	39	6,026	8	19	18,630	100%	164,393	147,086	89%	1,323
	5176	08/04/15	40	6,014	8	16	129,979	100%	157,576	60,830	39%	33,232
	1110	06/29/15	41	6,009	6	18	43,467	77%	159,806	121,476	76%	5,137
	72	08/29/15	42	6,007	8	17	75,082	78%	171,595	106,958	62%	10,445
	1111	06/24/15	43	6,002	6	17	89,339	91%	158,039	85,917	54%	17,217
	5441	08/15/15	44	6,000	8	20	156	14%	167,095	166,941	100%	2
	5491	08/17/15	45	5,982	8	19	11,742	63%	160,686	149,606	93%	662
	5396	08/03/15	46	5,981	8	17	93,660	98%	159,752	84,721	53%	18,629
	1 [illegible]	06/24/15	47	5,977	6	18	51,417	91%	159,261	114,981	72%	7,137
	1024	06/17/15	48	5,962	6	16	123,951	94%	153,084	61,081	40%	31,949

[illegible]	06/25/15	49	5,960	6	17	83,890	86%	155,583	87,243	56%	15,550
[illegible]	06/18/15	50	5,956	6	15	146,891	95%	151,469	48,528	32%	43,950
[illegible]	08/20/15	51	5,953	8	17	84,654	88%	154,678	86,561	56%	16,537
[illegible]	08/29/15	52	5,948	8	16	112,198	86%	169,956	78,858	46%	21,099
[illegible]	08/03/15	53	5,944	8	18	53,521	98%	161,215	115,449	72%	7,755
[illegible]	06/18/15	54	5,938	6	19	17,619	81%	157,815	141,413	90%	1,216
[illegible]	08/14/15	55	5,935	8	20	197	18%	160,113	159,919	100%	3
[illegible]	08/29/15	56	5,934	8	18	33,389	61%	167,890	137,593	82%	3,091
[illegible]	08/28/15	57	5,931	8	17	79,975	83%	156,974	91,623	58%	14,624
[illegible]	06/25/15	58	5,931	6	18	50,270	89%	157,373	114,014	72%	6,911
[illegible]	08/17/15	59	5,920	8	15	148,291	97%	148,339	44,743	30%	44,695
[illegible]	08/05/15	60	5,910	8	15	152,107	100%	149,981	45,148	30%	47,274
[illegible]	06/23/15	61	5,909	6	18	53,136	94%	155,871	110,851	71%	8,117
[illegible]	06/24/15	62	5,908	6	16	121,708	92%	152,233	61,489	40%	30,964
[illegible]	08/24/15	63	5,904	8	17	65,726	69%	154,522	99,584	64%	10,789
[illegible]	08/03/15	64	5,899	8	16	124,654	96%	153,420	60,843	40%	32,077
[illegible]	06/23/15	65	5,899	6	17	87,498	89%	152,342	82,914	54%	18,069
[illegible]	06/29/15	66	5,898	6	15	137,973	89%	148,844	49,596	33%	38,725
[illegible]	08/24/15	67	5,888	8	16	108,966	84%	151,096	67,520	45%	25,390
[illegible]	08/20/15	68	5,884	8	18	43,718	80%	155,360	117,519	76%	5,877
[illegible]	08/20/15	69	5,877	8	16	119,754	92%	148,330	59,643	40%	31,068
[illegible]	08/13/15	70	5,874	8	14	157,314	95%	146,763	41,243	28%	51,794
[illegible]	08/21/15	71	5,871	8	17	84,517	88%	153,890	86,237	56%	16,864
[illegible]	08/04/15	72	5,868	8	19	17,294	93%	158,417	142,570	90%	1,447
[illegible]	06/25/15	73	5,865	6	16	114,362	87%	150,259	63,412	42%	27,515
[illegible]	08/28/15	74	5,863	8	16	117,034	90%	151,571	63,729	42%	29,192
[illegible]	08/28/15	75	5,858	8	18	40,230	74%	156,910	121,770	78%	5,090
[illegible]	06/26/15	76	5,852	6	17	88,605	91%	153,254	82,268	54%	17,619
[illegible]	06/28/15	77	5,850	6	17	82,690	84%	165,205	95,947	58%	13,431
[illegible]	08/16/15	78	5,849	8	14	157,577	95%	165,700	51,048	31%	42,924
[illegible]	08/13/15	79	5,846	8	20	173	15%	156,008	155,837	100%	2
[illegible]	06/17/15	80	5,844	6	19	19,763	91%	154,642	136,527	88%	1,648
[illegible]	08/30/15	81	5,844	8	17	74,940	78%	167,575	104,397	62%	11,762
[illegible]	08/29/15	82	5,843	8	15	135,356	89%	163,654	60,722	37%	32,424
[illegible]	06/26/15	83	5,838	6	18	51,419	91%	155,373	111,382	72%	7,428
[illegible]	08/16/15	84	5,838	8	21	27	38%	159,799	159,775	100%	3
[illegible]	06/28/15	85	5,836	6	18	48,474	85%	164,143	121,487	74%	5,818
[illegible]	06/19/15	86	5,835	6	17	96,467	99%	151,925	77,038	51%	21,581
[illegible]	08/12/15	87	5,834	8	17	80,777	84%	152,094	86,644	57%	15,327
[illegible]	06/16/15	88	5,831	6	17	92,674	95%	151,624	79,065	52%	20,115
[illegible]	08/17/15	89	5,830	8	20	104	9%	153,117	153,015	100%	2
[illegible]	08/05/15	90	5,829	8	20	1,011	90%	155,181	154,193	99%	23
[illegible]	08/04/15	91	5,829	8	15	152,699	100%	148,261	44,081	30%	48,518
[illegible]	08/18/15	92	5,827	8	17	89,637	94%	150,953	80,389	53%	19,074
[illegible]	08/21/15	93	5,820	8	16	120,162	92%	149,434	60,800	41%	31,528
[illegible]	07/14/15	94	5,816	7	17	89,228	88%	148,410	78,223	53%	19,042
[illegible]	06/15/15	95	5,816	6	17	90,054	92%	151,801	80,532	53%	18,785
[illegible]	07/02/15	96	5,813	7	17	92,359	91%	148,621	76,215	51%	19,954
[illegible]	06/16/15	97	5,812	6	18	53,774	95%	153,944	108,714	71%	8,544
[illegible]	08/30/15	98	5,810	8	18	35,673	65%	164,985	133,047	81%	3,735
[illegible]	08/12/15	99	5,809	8	18	45,032	83%	154,226	114,860	74%	5,666
[illegible]	08/18/15	100	5,808	8	18	47,043	86%	153,326	113,097	74%	6,814

Ratio of Average Hourly Production to Maximum Hourly Production for Month

Month	Month	Hour 13	Hour 14	Hour 15	Hour 16	Hour 17	Hour 18	Hour 19	Hour 20
	Month	**1:00 PM**	**2:00 PM**	**3:00 PM**	**4:00 PM**	**5:00 PM**	**6:00 PM**	**7:00 PM**	**8:00 PM**
1	Jan	75%	73%	63%	44%	20%	3%	0%	0%
2	Feb	86%	84%	74%	57%	34%	10%	0%	0%
3	March	87%	84%	77%	62%	41%	18%	2%	0%
4	April	92%	88%	81%	66%	44%	22%	4%	0%
5	May	90%	88%	80%	66%	47%	26%	8%	0%
6	June	89%	86%	79%	66%	48%	28%	10%	1%
7	July	89%	86%	79%	66%	49%	28%	10%	1%
8	August	92%	91%	83%	68%	47%	25%	7%	0%
9	Sept	88%	83%	74%	59%	37%	14%	1%	0%
10	Oct	79%	75%	64%	46%	24%	5%	0%	0%
11	Nov	88%	81%	67%	45%	18%	1%	0%	0%
12	Dec	80%	74%	61%	41%	16%	1%	0%	0%

	E-12				ET-2				ECT-2				ECT-1				ET-1			
Date	Delivered	Site	Exported	Produced	Delivered	Site	Exported	Produced	Delivered	Site	Exported	Produced	Delivered	Site	Exported	Produced	Delivered	Site	Exported	Produced
1/1/2015	14677.61	17224.62	2830.839	5377.848	23553.14	28004.68	3623.823	8075.368	2407.253	2768.088	230.8517	591.687	1029.822	1182.084	81.74365	234.0062	9818.952	11684.42	1565.816	3431.28
1/2/2015	13675.55	16917.6	5577.193	8819.246	21163.91	26719.68	7582.319	13138.09	2207.401	2684.783	511.406	988.7881	921.5882	1125.903	194.0233	398.338	8830.091	11147.01	3345.538	5662.456
1/3/2015	13103.46	16647.89	5678.639	9223.07	20826.95	26588.59	7185.549	12947.19	2166.211	2655.161	485.406	974.3558	912.3529	1123.148	188.4628	399.2574	8765.744	11217.55	3113.319	5565.121
1/4/2015	11901.27	15496.35	6095.848	9690.926	19242.57	24813.71	7391.422	12962.57	2010.653	2485.117	502.7898	977.2542	857.7909	1064.238	192.9028	399.3499	8083.29	10420.99	3214.957	5552.66
1/5/2015	10181.6	13441.92	6768.838	10029.16	16111.99	20811.66	8253.827	12953.49	1688.983	2094.16	571.7666	976.9439	712.7013	881.8682	225.6759	394.8428	6712.985	8642.805	3593.266	5523.085
1/6/2015	9166.677	12322.04	7130.718	10286.08	14755.77	19280.3	8512.819	13037.35	1543.778	1941.302	585.9415	983.4645	657.1184	823.7805	228.0233	394.6855	6146.041	7984.861	3708.969	5547.788
1/7/2015	8553.515	11534.45	6454.605	9435.538	13978.26	18197.71	7445.787	11665.24	1464.813	1836.443	511.9789	883.6091	636.3199	785.5615	203.9743	353.2159	5804.709	7523.214	3259.615	4978.12
1/8/2015	8420.753	11204.04	5193.027	7976.315	13562.56	17382.34	5733.254	9553.038	1445.974	1778.388	403.7881	736.2014	604.1409	742.8381	157.0279	295.7251	5608.836	7194.421	2521.714	4107.299
1/9/2015	8352.766	11404.92	6873.938	9926.09	13501.57	17876.48	8148.618	12523.53	1427.235	1813.646	567.5696	953.9802	617.0876	778.3148	222.3078	383.535	5647.309	7436.155	3563.077	5351.924
1/10/2015	9919.116	12173.77	1989.981	4244.635	15699.43	19091.55	2336.813	5728.933	1644.948	1931.804	157.4068	444.2626	694.4632	814.0437	70.8045	190.385	6696.53	8139.336	1017.271	2460.077
1/11/2015	9376.523	12082.09	4104.053	6809.622	14964.13	19161.61	5306.678	9504.166	1581.448	1942.428	354.129	715.1089	658.4392	808.8202	133.9882	284.3692	6251.812	8027.774	2286.038	4061.999
1/12/2015	8753.838	11226.56	3614.736	6087.461	13766.36	17297.87	4430.936	7962.45	1468.243	1771.751	298.0085	601.5166	612.5479	737.531	112.5077	237.4908	5723.057	7188.498	1881.444	3346.885
1/13/2015	9344.781	11718.94	3812.276	6186.434	14609.55	17929.08	4453.926	7773.459	1543.394	1823.671	299.3805	579.6569	663.7179	777.5058	107.8882	221.676	6104.075	7495.56	1894.779	3286.264
1/14/2015	9214.528	12331.02	7137.194	10253.69	14185.61	18718.1	8909.145	13441.63	1497.299	1901.365	620.0739	1024.141	638.9826	802.5084	246.6886	410.2144	5953.197	7808.213	3889.965	5744.981
1/15/2015	8947.311	12213.39	7841.895	11107.97	14001.75	18567.73	9369.945	13935.92	1483.976	1898.099	645.2335	1059.356	632.4646	800.0336	258.5464	426.1155	5823.822	7685.483	4069.409	5931.07
1/16/2015	8640.189	11890.36	7859.376	11109.55	13377.45	17959.81	9465.853	14048.21	1412.457	1823.935	658.6587	1070.136	606.1784	778.7151	258.9914	431.5281	5580.51	7441.723	4120.764	5981.977
1/17/2015	8556.338	11988.57	7444.918	10877.15	13898.7	19009.52	8746.428	13857.25	1454.411	1903.05	605.8509	1054.49	629.2078	811.3529	240.6253	422.7704	5897.027	8018.366	3786.016	5907.355
1/18/2015	8486.079	11830.65	6444.83	9789.402	13969.21	18954.91	7409.098	12394.8	1455.529	1885.305	515.4998	945.276	644.6607	822.9663	202.1513	380.457	5907.118	7973.144	3206.221	5272.247
1/19/2015	8190.183	11474.63	6714.185	9998.634	13273.95	18079.7	7898.714	12704.46	1426.883	1859.832	537.0566	970.006	602.9676	772.6397	220.6913	390.3634	5508.362	7451.323	3475.642	5418.603
1/20/2015	8381.16	11369.44	6155.343	9143.628	13185.43	17481.54	7822.784	12118.9	1412.282	1801.017	536.5724	925.3076	607.8865	771.2589	216.5356	379.908	5549.254	7310.814	3439.623	5201.182
1/21/2015	8472.918	11280.12	6295.987	9103.187	12813.52	17015.02	8378.841	12580.35	1375.433	1748.024	583.0494	955.641	586.7206	740.1897	233.8656	387.3346	5371.833	7096.945	3678.317	5403.429
1/22/2015	8499.52	11940.31	8075.939	11516.72	12985.93	17777.23	9808.114	14599.41	1416.157	1849.617	700.1746	1133.635	602.7466	777.7573	279.9873	454.9981	5550.083	7530.095	4306.069	6286.08
1/23/2015	9568.363	10314.42	6707.208	7453.264	14901.86	15914.17	7877.351	8889.661	1615.971	1716.294	545.2632	645.5858	685.8961	726.9928	210.3867	251.4834	6301.547	6698.477	3399.595	3796.525
1/24/2015	8759.504	12412.49	8215.916	11868.9	14043.29	19462.96	9513.82	14933.48	1484.912	1968.809	658.3487	1142.246	652.4162	852.8977	264.1602	464.6418	5992.641	8218.98	4122.325	6348.665
1/25/2015	8487.559	11829.31	6895.377	10237.12	14038.19	18962.39	7551.984	12476.19	1497.397	1929.223	524.6555	956.481	632.3671	813.0244	213.0294	393.6867	5923.014	7973.92	3297.498	5348.404
1/26/2015	9167.372	11594.53	2464.695	4891.858	14705.16	17864.62	2381.764	5541.221	1554.483	1834.416	167.9645	447.8973	653.9689	771.5646	74.90699	192.5027	6131.24	7459.726	1052.358	2380.844
1/27/2015	7799.16	10723.36	6836.674	9760.876	12749.49	16931.01	8338.035	12519.55	1375.916	1740.301	580.6781	945.0632	582.8261	734.5974	216.047	367.8183	5295.095	7000.222	3614.396	5319.522
1/28/2015	7752.372	10751.6	6925.573	9924.803	12562.65	16769.21	8156.366	12362.93	1364.857	1747.187	569.5611	951.8915	574.3061	727.1287	236.479	389.3017	5244.254	6952.3	3565.157	5273.203
1/29/2015	8676.211	10783.3	1966.28	4073.369	13948.21	16821.79	2124.888	4998.477	1513.635	1769.819	142.7341	398.9176	624.2852	730.5408	57.95739	164.2131	5737.62	6934.675	923.1735	2120.229
1/30/2015	10169.89	11541.9	485.6899	1857.702	16083.99	17826.14	457.2706	2199.421	1732.709	1870.118	24.79958	162.209	717.0526	771.8425	9.592663	64.38257	6682.257	7399.661	179.6806	897.0848
1/31/2015	8987.413	11678.44	2789.323	5480.349	15111.03	18804.09	2467.523	6160.584	1601.371	1905.248	160.0457	463.923	673.7318	798.4954	51.8987	176.6623	6356.602	7910.063	1005.843	2559.303
2/1/2015	8291.054	12063.98	7922.52	11695.45	13899.65	19442.98	8644.965	14188.3	1417.922	1892.836	573.3471	1048.261	601.003	787.9503	240.3853	427.3326	5762.807	8032.013	3711.119	5980.325
2/2/2015	8091.699	11515	8399.202	11822.51	12937.12	17747.79	9675.463	14486.14	1352.9	1772.379	656.9414	1076.42	561.1153	728.5795	270.7496	438.2137	5315.91	7245.796	4165.314	6095.2
2/3/2015	7700.464	11044.39	8886.374	12230.3	12511.15	17275.24	10285.31	15049.4	1310.001	1728.053	696.0756	1114.128	540.8009	712.3002	284.7004	456.1997	5139.842	7051.619	4441.594	6353.371
2/4/2015	7501.889	10806.5	9253.758	12558.37	12276.77	17044.73	10691.43	15459.39	1292.901	1714.198	730.4232	1151.72	535.0965	707.7896	296.8411	469.5342	5043.775	6964.159	4587.662	6508.046
2/5/2015	7404.22	10745.48	9396.447	12737.71	12092.59	16878.44	10939.19	15725.04	1286.197	1711.468	747.0939	1172.365	539.7421	714.1386	299.2713	473.6678	4971.55	6874.308	4706.202	6608.96
2/6/2015	7291.721	10663.7	9377.53	12749.51	11957.31	16846.36	10848.23	15737.28	1264.443	1697.103	744.5993	1177.26	537.1059	714.8176	297.9142	475.6259	4883.314	6835.278	4664.775	6616.739
2/7/2015	7241.252	10848.13	9289.078	12895.96	12267.09	17741.51	10581.96	16056.38	1298.991	1775.582	725.8405	1202.432	539.1646	734.1999	290.4525	485.4878	5085.186	7330.369	4501.921	6747.104
2/8/2015	7261.827	10867.29	9079.654	12685.12	12548.51	18068.3	10298.17	15817.96	1322.147	1810.185	697.0424	1185.08	546.0452	740.3327	284.1633	478.4508	5187.285	7450.295	4385.742	6648.752
2/9/2015	7083.738	10467.21	9458.465	12841.94	11975.78	16881.15	11072.57	15977.94	1267.037	1702.852	765.6815	1201.496	525.0752	701.6669	306.5854	483.1772	4849.821	6811.851	4751.931	6713.96
2/10/2015	7031.634	10403.43	9760.607	13132.4	11784.48	16660.58	11448.32	16324.42	1271.985	1718.298	795.9249	1242.238	526.5532	706.5199	315.2962	495.2629	4774.39	6713.627	4918.149	6857.386
2/11/2015	7154.712	10604.94	10241.73	13691.96	11765.35	16719.3	11991.99	16945.94	1248.801	1702.282	840.5532	1294.034	513.518	693.8102	331.7624	512.0546	4754.905	6728.732	5144.794	7118.621
2/12/2015	7127.16	10580.9	10130	13583.74	11696.06	16685.21	11860.5	16849.64	1257.648	1715.553	825.8468	1283.752	512.033	691.8595	332.843	512.6695	4718.887	6716.844	5081.462	7079.42
2/13/2015	7054.461	10507.2	10070.95	13523.69	11686.39	16749.15	11741.32	16804.08	1241.499	1691.673	834.0381	1284.212	526.1422	712.3532	322.0837	508.2947	4758.982	6764.52	5043.523	7049.061
2/14/2015	7145.294	10687.6	8535.739	12078.04	12408.37	17769.4	9343.238	14704.27	1323.29	1793.194	657.4893	1127.393	550.6144	741.8906	264.0715	455.3477	5078.8	7251.898	4011.279	6184.377
2/15/2015	7223.744	10660.99	7326.598	10763.84	12606.67	17736.37	7614.572	12744.27	1341.214	1791.507	526.8756	977.1681	551.2511	734.0422	205.5573	388.3483	5119.829	7216.045	3221.082	5317.299
2/16/2015	7175.337	10852.72	10024.56	13701.94	12082.11	17557.19	11483.7	16958.78	1291.439	1783.088	805.398	1297.047	531.684	726.7452	319.3198	514.381	4845.579	7009.023	4951	7114.445
2/17/2015	7196.124	10751.88	10484.3	14040.06	11793.62	16939.72	12289.43	17435.53	1273.901	1739.683	866.5895	1332.372	519.0919	703.1382	345.3035	529.3499	4740.025	6780.813	5277.607	7318.396
2/18/2015	7331.183	10822.82	10031.4	13523.04	11992.06	16988.65	11715.19	16711.79	1289.188	1739.717	831.1738	1281.703	533.4997	714.2577	330.6868	511.4448	4844.668	6845.653	5016.818	7017.803
2/19/2015	7157.655	10583.37	8940.666	12366.38	11964.3	16838.84	10121.81	14996.35	1292.233	1733.622	703.2635	1144.653	533.789	711.0537	271.2843	448.5489	4848.647	6811.624	4310.689	6273.665
2/20/2015	7484.768	10633.44	5670.715	8819.39	12394.87	16837.66	6636.856	11079.64	1343.021	1737.446	462.2977	856.7222	555.1039	717.865	182.1079	344.869	5009.978	6813.87	2821.577	4625.469

2/21/2015	7278.425	10950.54	8554.398	12226.52	12264.96	17714.05	9360.895	14809.98	1311.067	1794.399	663.8048	1147.137	534.5638	732.5491	269.4244	467.4097	5047.592	7277.802	3968.665	6198.875
2/22/2015	7959.869	11280.31	6830.553	10150.99	13604.47	18266.9	7018.628	11681.06	1438.083	1841.049	477.1253	880.0918	603.3076	763.6352	188.399	348.7266	5595.755	7503.232	2964.016	4871.494
2/23/2015	8471.01	11339.74	5143.491	8012.221	12947.91	17095.66	6274.573	10422.32	1381.929	1741.819	425.7533	785.6429	565.5047	714.697	158.5778	307.7701	5240.491	6935.247	2611.855	4306.612
2/24/2015	8164.472	11644.65	9196.095	12676.27	12470.78	17524.64	11559.88	16613.74	1319.371	1775.653	817.4977	1273.78	546.3045	732.6931	333.3361	519.7246	5126.068	7174.106	4951.458	6999.496
2/25/2015	7916.194	11655.58	10973.54	14712.92	12394.26	17769.28	13335.63	18710.65	1314.59	1801.799	954.5112	1441.72	544.6483	740.4012	386.0623	581.8153	5098.413	7272.695	5697.2	7871.482
2/26/2015	7740.464	11284.67	9659.781	13203.99	12061.14	17242.79	12829.87	18011.52	1304.377	1784.035	908.649	1388.307	537.9716	728.8763	371.8593	562.764	4955.374	7052.298	5511.192	7608.116
2/27/2015	8012.511	11493.74	9078.458	12559.69	12010.52	17253.05	12769.41	18011.94	1284.425	1762.183	913.916	1391.674	543.8968	742.1084	372.0857	570.2974	4934.534	7057.576	5521.731	7644.772
2/28/2015	8700.204	11664.75	4719.526	7684.068	13934.37	18111.98	4750.724	8928.335	1483.746	1831.448	308.6905	656.3916	623.934	762.5074	108.5843	247.1577	5755.043	7498.164	1953.701	3696.822
3/1/2015	9482.821	12093.33	3475.491	6086	14384.14	18559.75	4573.832	8749.447	1439.584	1774.006	296.0461	630.4681	613.9721	761.8747	113.6737	261.5762	5825.421	7553.984	1932.303	3660.866
3/2/2015	10051.1	12422.62	2208.935	4580.451	14843.18	18200.17	2468.106	5825.093	1498.425	1756.625	148.9917	407.1915	629.6264	738.0685	55.5995	164.0416	5965.115	7340.268	990.0931	2365.246
3/3/2015	8674.752	12155.17	8285.77	11766.19	13048.78	18067.51	10532.61	15551.34	1316.154	1741.614	696.3411	1121.801	574.2574	752.29	297.5597	475.5923	5352.521	7368.546	4444.679	6460.704
3/4/2015	8136.111	12027.57	11636.46	15527.91	12377.79	17943.52	14089.94	19655.67	1249.811	1725.424	954.3849	1429.997	541.4063	749.5621	402.0219	610.1777	5084.569	7324.352	5996.902	8236.685
3/5/2015	7911.995	11851.69	11965.72	15905.42	12154.89	17776.81	14394.28	20016.2	1249.416	1740.895	972.1591	1463.638	538.7425	743.6532	418.817	623.7276	4988.966	7266.807	6100.58	8378.422
3/6/2015	7509.683	11442.21	12149.2	16081.72	11713.43	17350.04	14542.79	20179.39	1197.043	1687.467	990.6919	1481.115	523.1217	734.1432	424.308	635.3294	4775.484	7049.442	6173.61	8447.568
3/7/2015	7227.517	11325.78	11419.16	15517.43	11862.93	18094.49	13126.59	19358.15	1188.141	1722.941	884.6167	1419.416	524.6043	749.9729	378.6652	604.0337	4811.999	7324.437	5536.556	8048.995
3/8/2015	7104.337	11296.83	11559.53	15752.02	12055.67	18433.34	13144.08	19521.75	1203.299	1749.587	887.5701	1433.858	517.7195	750.7686	380.2199	613.2689	4843.95	7416.358	5541.262	8113.67
3/9/2015	7016.859	10958.12	11653.1	15594.36	11635.94	17329.91	13568.16	19262.13	1181.803	1679.467	925.2719	1422.936	505.0908	711.4192	396.999	603.3274	4632.135	6900.891	5742.009	8010.765
3/10/2015	6934.678	10881.49	12114.1	16060.91	11567.27	17352.02	14042.84	19827.59	1187.54	1698.372	959.536	1470.368	504.3075	712.5343	408.8517	617.0785	4600.541	6864.08	5974.943	8238.482
3/11/2015	7169.268	10801.29	8314.618	11946.64	12008.67	17352.64	9865.093	15209.06	1231.119	1691.783	684.1858	1144.85	522.8711	721.5187	295.123	493.7707	4710.922	6826.017	4212.505	6327.601
3/12/2015	7619.691	10903.53	6125.6	9409.439	12925.15	17737.45	7440.225	12252.53	1338.768	1749.961	493.1413	904.3342	576.482	751.7033	221.0085	396.2298	5022.695	6926.787	3199.734	5103.825
3/13/2015	7169.485	11257.76	11627.14	15715.42	12394.47	18590.34	13442.36	19638.23	1278.877	1826.127	912.4998	1459.75	555.3577	787.8946	385.7622	618.2992	4850.913	7262.601	5745.567	8157.254
3/14/2015	7168.14	11544.08	11306.84	15682.78	13108.32	20063.23	12573.65	19528.56	1346.191	1950.076	847.6013	1451.486	568.5985	822.258	359.4681	613.1277	5171.206	7942.144	5336.513	8107.452
3/15/2015	7156.86	11650.52	11967.58	16461.24	13254.32	20447.53	13246.56	20439.77	1340.086	1971.747	894.3614	1526.023	560.5629	819.5573	382.7849	641.7793	5206.954	8054.147	5633.35	8480.543
3/16/2015	7216.883	11479.16	12008.79	16271.07	13139.53	19749.08	13552.12	20161.67	1326.671	1912.577	922.4462	1508.352	568.5783	809.872	392.895	634.1887	5095.818	7666.89	5788.72	8359.792
3/17/2015	7454.601	11523.59	10015.7	14084.69	13555.95	20094.11	12264.67	18802.83	1381.517	1958.934	828.8882	1406.306	575.5654	822.4952	356.6368	603.5666	5180.545	7709.325	5326.234	7855.014
3/18/2015	7793.505	10844.58	4214.376	7265.448	13877.03	18293.8	4504.36	8921.133	1419.515	1792.351	303.4727	676.3091	617.0785	777.1851	135.2724	295.379	5338.54	7097.897	1963.49	3722.847
3/19/2015	7620.83	10721.68	5622.03	8722.877	12938.16	17500.27	6942.94	11505.05	1337.511	1744.997	482.852	890.3384	551.8856	726.7208	206.0673	380.9025	5007.969	6850.994	2965.81	4808.835
3/20/2015	6814.633	10929.19	12203.21	16317.77	11908.86	18187.8	13948.61	20227.54	1239.375	1798.072	957.0934	1515.79	518.5873	748.0115	403.7447	633.1688	4637.54	7083.889	5952.51	8398.86
3/21/2015	6926.112	11418.39	12195.32	16687.59	12624.05	19779.5	13624.94	20780.39	1291.331	1915.074	935.6229	1559.365	550.9427	811.1548	388.6717	648.8838	4975.718	7808.302	5779.156	8611.74
3/22/2015	7086.144	11646.31	11922.83	16482.99	13107.39	20444.89	13393.31	20730.82	1339.252	1986.196	910.0681	1557.012	556.9033	815.9546	389.0944	648.1456	5121.047	8022.928	5690.806	8592.687
3/23/2015	6954.733	11302.1	12814.36	17161.73	12441.94	19097.21	14698.14	21353.41	1297.17	1896.009	1010.464	1609.304	539.5006	778.7365	425.3011	664.5371	4816.527	7388.755	6261.08	8833.308
3/24/2015	6936.976	11107.41	12247.97	16418.4	12188.3	18552.86	14728.87	21093.43	1283.057	1859.984	1009.19	1586.118	530.9707	761.3843	430.5564	660.97	4741.146	7194.294	6288.073	8741.22
3/25/2015	7023.348	11315.88	12670.55	16963.08	12623.81	19196.42	14596.52	21169.14	1303.701	1897.974	996.7445	1591.018	553.5551	794.8366	418.6548	659.9363	4892.244	7446.703	6200.541	8754.999
3/26/2015	7124.864	11600.97	12438.27	16914.38	13032.37	19985.53	14201.05	21154.22	1364.265	1987.924	971.4045	1595.063	568.9605	822.4303	408.4658	661.9356	5021.265	7704.026	6059.564	8742.325
3/27/2015	7400.144	12008.65	12585.6	17194.11	13627.26	20906.28	14208.43	21487.45	1394.582	2046.698	966.8754	1618.992	585.6618	849.0301	405.6311	668.9995	5207.066	8015.907	6063.104	8871.945
3/28/2015	7631.639	12607.51	12222.39	17198.27	14600.01	22836.64	13260.97	21497.6	1472.194	2188.455	906.6183	1622.879	610.5991	900.958	377.4758	667.8346	5642.018	8844.816	5673.025	8875.824
3/29/2015	8055.448	13145.62	11035.15	16125.33	15615.28	24094.76	12065.5	20544.99	1593.361	2336.909	808.2199	1551.768	643.3563	945.0299	342.4155	644.0891	6017.996	9335.5	5173.71	8491.214
3/30/2015	8240.438	13275.81	11271.51	16306.89	15714.19	23777.21	12362.24	20425.26	1586.819	2294.126	838.428	1545.735	647.4452	927.9911	357.1141	637.6601	6011.686	9140.868	5316.323	8445.506
3/31/2015	8063.617	13005.01	11856.76	16798.16	15516.63	23502.67	13143.25	21129.28	1567.104	2270.347	889.4425	1592.685	655.1905	945.2186	370.6695	660.6977	5959.011	9029.178	5654.156	8724.323
4/1/2015	7694.795	12737.86	12445.05	17488.11	14742.52	22825.61	13506.38	21589.47	1445.467	2129.981	871.0797	1555.594	610.1632	892.0142	363.3556	645.2065	5628.92	8725.831	5738.237	8835.148
4/2/2015	6986.945	11517.84	12292.49	16823.38	12991.09	19957.8	13397.27	20363.99	1309.485	1913.675	867.2303	1471.42	559.71	805.795	362.2572	608.3422	4979.435	7668.992	5643.509	8333.066
4/3/2015	6945.75	11672.25	13189.97	17916.47	12826.13	20224.96	14811.42	22210.25	1293.739	1923.963	976.819	1607.043	550.2347	809.9894	399.9284	659.683	4905.9	7729.815	6263.225	9087.14
4/4/2015	7276.723	12227.45	12116.5	17067.23	13913.14	21900.87	13033.41	21021.14	1418.826	2103.691	833.0403	1517.905	595.2665	870.9344	346.8034	622.4713	5425.866	8552.306	5460.266	8586.706
4/5/2015	7350.904	12441.44	11841.62	16932.15	14394.61	22594.66	12393.26	20593.31	1446.337	2144.102	785.1619	1482.928	617.2464	903.0215	324.8768	610.6519	5529.267	8722.162	5218.192	8411.088
4/6/2015	6733.688	11327.49	13762.78	18356.58	12308.1	19389.48	15605.82	22687.2	1217.709	1827.292	1026.311	1635.894	520.6283	767.0663	423.6939	670.1319	4732.015	7438.309	6564.769	9271.063
4/7/2015	6615.369	11001.08	12664.78	17050.49	11762.97	18417.72	14845.35	21500.11	1195.585	1766.497	976.5222	1547.434	504.162	739.4224	407.4486	642.709	4547.876	7120.963	6216.594	8789.68
4/8/2015	6317.728	10722.81	14339.3	18744.38	11183.18	17846.67	16602.67	23266.15	1131.384	1707.465	1100.697	1676.777	482.2925	716.6353	456.9626	691.3055	4350.634	6904.622	6950.003	9503.992
4/9/2015	6492.483	10859.34	14123.88	18490.74	11475.67	18089.63	16534.05	23148.01	1154.608	1723.01	1102.765	1671.167	496.0242	726.8156	458.5485	689.3398	4428.043	6973.273	6917.969	9463.199
4/10/2015	6559.053	10990.14	13059.89	17490.98	11851.07	18626.5	15215.7	21991.13	1205.13	1788.133	1007.272	1590.274	499.6372	734.8566	413.3248	648.5442	4535.761	7122.946	6391.175	8978.36
4/11/2015	6723.127	11448.36	12387.06	17112.29	12745.08	20358.55	13209.53	20822.99	1273.317	1915.868	856.4756	1499.026	538.1034	805.1661	339.2523	606.315	4968.418	7936.585	5510.546	8478.712
4/12/2015	7014.064	11771.84	11629.92	16387.7	13483.54	21184.54	12633.87	20334.87	1328.443	1980.835	827.5204	1479.913	569.1241	838.9675	349.9827	619.826	5232.122	8230.15	5314.621	8312.65
4/13/2015	7301.365	12197.82	13291.94	18188.4	13885.92	21666.9	14936.11	22717.09	1376.126	2046.777	978.4548	1649.106	572.4787	847.7112	396.7653	671.9978	5336.355	8304.883	6289.923	9258.45
4/14/2015	7434.672	12447.59	13196.21	18209.13	14267.57	22347.71	14480.84	22560.98	1415.889	2121.525	941.5547	1647.191	600.9998	898.2716	375.1999	672.4717	5471.673	8552.859	6117.966	9199.152

4/15/2015	6533.681	11195.43	14411.04	19072.79	12051.38	19413.34	16295.12	23657.08	1221.632	1863.857	1080.797	1723.023	521.3922	788.6762	435.185	702.4689	4657.582	7476.434	6811.681	9630.534
4/16/2015	6446.541	10796.65	14314.96	18665.07	11021.1	17706.53	17391.31	24076.74	1103.829	1686.917	1177.734	1760.822	477.366	718.568	479.3348	720.5368	4311.213	6894.99	7221.611	9805.388
4/17/2015	6547.287	11004.92	13863.87	18321.51	11384.77	18327.52	16701.66	23644.4	1137.925	1742.709	1119.004	1723.788	484.0328	729.8754	460.2624	706.105	4412.031	7096.612	6951.264	9635.845
4/18/2015	6893.696	11826.01	13813.55	18745.86	13140.09	21395.51	15278.65	23534.07	1296.615	2001.827	1012.254	1717.467	552.2529	839.7295	410.6097	698.0863	5074.131	8272.694	6362.795	9561.358
4/19/2015	7573.442	12753.08	12192.15	17371.8	14890.45	23838.48	13998.49	22946.51	1473.77	2241.87	909.9806	1678.081	619.6078	932.9018	372.8912	686.1853	5738.813	9179.558	5913.453	9354.197
4/20/2015	7483.267	12513.15	12756.93	17786.82	14545.16	22807.46	14687.48	22949.78	1424.893	2144.434	959.7244	1679.266	612.152	894.9799	398.3334	681.1614	5541.717	8669.068	6216.647	9343.998
4/21/2015	7118.776	11936.69	13191.41	18009.32	13907.99	21655.69	14671.37	22419.08	1368.342	2033.466	977.4221	1642.546	587.3554	862.6012	397.001	672.2469	5321.122	8268.225	6167.239	9114.343
4/22/2015	6754.785	11536.1	14100.4	18881.72	13033.67	20751.51	15754.01	23471.85	1291.476	1964.865	1044.567	1717.956	562.7915	831.3262	430.3186	698.8534	4998.732	7910.72	6615.49	9527.479
4/23/2015	6668.266	11234.52	13317.95	17884.2	12796.92	20089.56	15073.59	22366.23	1287.153	1920.792	1008.641	1642.28	559.8106	823.4211	408.6475	672.258	4902.778	7665.776	6299.973	9062.971
4/24/2015	7010.24	10899.1	8617.652	12506.52	12976.91	18844.27	9851.885	15719.25	1323.686	1818.877	643.9098	1139.101	553.2082	757.399	274.0375	478.2283	4949.005	7209.297	4095.928	6356.22
4/25/2015	7319.781	11215.77	7824.414	11720.4	13228.18	19584.47	9668.914	16025.2	1333.491	1871.277	634.3594	1172.145	563.6146	794.8934	272.717	503.9958	5149.514	7624.485	4050.927	6525.898
4/26/2015	7065.713	11254.84	9520.968	13710.09	12868.78	19290.17	10806.72	17228.11	1281.794	1806.985	689.4674	1214.659	557.9246	775.2582	278.6161	495.9497	5027.18	7518.43	4434.121	6925.372
4/27/2015	6784.731	11427.11	14372.39	19014.77	12527.85	19804.51	16694.43	23971.09	1241.349	1868.425	1123.869	1750.945	515.8933	766.5983	473.857	724.562	4799.635	7587.464	6945.437	9733.267
4/28/2015	7442.855	12332.33	13479.22	18368.7	14565.71	22573.99	15312.65	23320.94	1433.43	2138.04	1014.355	1718.965	597.1841	890.605	420.9974	714.4183	5520.535	8557.414	6427.173	9464.051
4/29/2015	8041.779	13601.1	13297.57	18856.9	16135.64	25345.72	14510.4	23720.48	1555.822	2339.196	954.2597	1737.634	655.4927	981.9021	398.1383	724.5477	6117.913	9619.862	6094.227	9596.176
4/30/2015	8640.492	14519.32	12142.19	18021.01	17618.12	27317.54	13069.21	22768.63	1698.165	2519.634	851.5872	1673.056	727.1611	1077.298	350.0863	700.2237	6669.845	10363.6	5527.326	9221.079
5/1/2015	9035.531	15187.52	12121.25	18273.24	18556.07	28832.44	12746.15	23022.52	1730.786	2568.84	783.7582	1621.813	737.2293	1080.595	317.6379	661.0033	6997.198	10898.68	5342.63	9244.107
5/2/2015	9347.475	15570.9	10740.71	16964.13	19730.4	30669.41	11439.18	22378.18	1834.134	2699.586	706.5256	1571.978	770.5152	1131.485	281.4081	642.3782	7499.235	11728.2	4775.976	9004.94
5/3/2015	9487.085	16017.67	11731.93	18262.52	20214.28	31497.93	11733.08	23016.73	1866.802	2766.601	723.4313	1623.231	798.1007	1179.4	287.7618	669.0614	7757.249	12133.54	4904.631	9280.926
5/4/2015	7861.198	12586.21	10367.56	15092.57	15557.91	23464.89	12727.01	20633.98	1480.033	2136.207	804.653	1460.827	627.5322	899.9461	342.3304	614.7443	5905.033	8978.211	5342.163	8415.341
5/5/2015	7529.89	12283.21	11006.14	15759.46	14782.16	22877.34	13678.76	21773.95	1420.799	2081.261	861.2823	1521.744	589.5548	864.6545	349.2254	624.325	5606.155	8712.867	5677.713	8784.425
5/6/2015	7184.903	12419.86	13165.54	18400.5	14681.28	23448.53	14659.14	23426.39	1436.789	2175.011	918.6335	1656.856	598.2327	897.5639	377.771	677.1022	5568.355	8911.194	6067.098	9409.936
5/7/2015	6633.413	11499.15	14029.03	18894.77	13232.02	21219.87	15620.05	23607.9	1309.573	1983.299	1000.192	1673.918	552.0053	819.1742	399.8552	667.0241	5025.071	8037.617	6454.625	9467.171
5/8/2015	6370.094	10562.06	11011.86	15203.82	11730.62	18273.11	12808.84	19351.34	1174.614	1726.917	829.8608	1382.164	493.3746	722.7726	318.0815	547.4795	4492.059	7006.039	5180.939	7694.919
5/9/2015	6290.873	10973.02	13505.32	18187.47	11714.05	19639.19	16719.59	24644.73	1147.845	1805.853	1105.116	1763.124	500.8017	775.9416	439.9845	715.1244	4551.15	7617.206	6882.86	9948.916
5/10/2015	6840.902	11993.43	14359.6	19512.12	14011.75	22898.43	15915.6	24802.28	1358.179	2107.946	1029.535	1779.303	569.9247	869.454	410.9896	710.519	5349.951	8756.092	6568.656	9974.796
5/11/2015	7601.252	13195.34	13781.08	19375.16	15999.18	25453.67	14978.71	24433.19	1529.873	2320.144	956.6176	1746.889	640.9103	952.9287	384.52	696.5383	6042.534	9631.218	6226.365	9815.049
5/12/2015	7376.172	12794.68	11865.04	17283.55	15684.04	24853.21	12950.87	22120.04	1516.191	2286.053	829.0541	1598.916	621.6264	930.9513	325.0921	634.4169	5888.979	9379.687	5419.548	8910.257
5/13/2015	7614.304	13069.57	13127.58	18582.85	16280.49	25532.73	14113.11	23365.34	1560.042	2334.917	917.5854	1692.461	651.6825	968.8101	354.2631	671.3907	6151.985	9671.533	5867.254	9386.802
5/14/2015	7116.092	11895.62	11085.32	15864.85	14911.21	22849.26	12325.18	20263.23	1494.531	2178.39	789.9165	1473.775	622.3779	899.0187	317.1809	593.8217	5658.212	8698.128	5087.614	8127.53
5/15/2015	6969.008	10542.29	5694.144	9267.425	12795.58	18457.91	6781.501	12443.83	1317.711	1786.636	438.3543	907.2797	541.8485	734.0423	177.3993	369.5931	4893.538	7084.533	2749.473	4940.468
5/16/2015	6310.77	10816.39	12239.66	16745.28	12145.84	19630.06	14305.74	21789.97	1250.872	1869.71	931.9705	1550.808	517.0584	770.2615	354.7381	607.9412	4695.648	7581.273	5805.151	8690.777
5/17/2015	6601.87	11902.62	14683.82	19984.57	13839.96	23063.01	16141.75	25364.79	1385.892	2167.947	1055.549	1837.603	555.5127	869.2668	415.6913	729.4454	5264.46	8778.7	6644.585	10158.82
5/18/2015	6825.006	11906.21	13167.98	18249.19	13985.19	22805.61	15869.03	24689.45	1388.849	2151.644	1039.243	1802.039	552.7193	851.605	418.7302	717.6159	5294.513	8635.107	6604.745	9945.339
5/19/2015	6651.498	11790.72	15025.2	20164.42	13805.37	22544.39	16893.96	25632.98	1383.733	2144.768	1120.101	1881.135	571.9262	875.6329	432.6709	736.3776	5233.886	8543.931	6963.179	10273.22
5/20/2015	7116.501	12257.97	12455.9	17597.37	15329.66	23961.3	13394.09	22025.73	1499.973	2237.698	878.8314	1616.557	622.1999	909.4885	342.934	630.2227	5771.495	9031.885	5567.059	8827.449
5/21/2015	7018.204	12179.48	12074.1	17235.37	15039.75	23801.39	13183.9	21945.55	1486.809	2237.278	870.3702	1620.839	614.9368	917.0769	330.9478	633.088	5663.241	8996.347	5466.043	8799.15
5/22/2015	6342.187	11356.91	14072.22	19086.94	12866.22	21542.02	16704.51	25380.3	1294.463	2054.409	1119.707	1879.653	533.403	829.6203	431.5874	727.8046	4854.326	8111.056	6923.708	10180.44
5/23/2015	6550.543	11632.13	13143.69	18225.28	13346.2	22325.29	16036.51	25015.6	1305.017	2077.439	1092.001	1864.423	551.8971	864.5767	413.4313	726.1109	5044.483	8481.265	6640.499	10077.28
5/24/2015	6945.16	12216.45	11304.01	16575.3	14473.32	23654.74	13170.92	22352.34	1409.021	2194.12	877.4687	1662.567	585.8483	897.4371	330.7154	642.3043	5406.464	8909.941	5484.536	8988.013
5/25/2015	7809.587	13658.62	12135.78	17984.82	16626.7	27186.44	14224.18	24783.92	1614.418	2518.797	948.2705	1852.65	645.8546	997.4263	369.9603	721.5321	6184.122	10177.45	6002.001	9995.333
5/26/2015	8186.341	14177.61	12841.67	18832.94	17859.06	28197.72	13548.09	23886.76	1715.717	2600.563	899.3325	1784.178	696.8548	1044.02	348.2155	695.3803	6676.524	10584.18	5677.435	9585.089
5/27/2015	8263.195	13812.84	9941.927	15491.57	18204.53	27629.66	10589.14	20014.26	1750.617	2548.97	703.2368	1501.59	713.3758	1028.933	275.6542	591.2113	6808.913	10410.54	4404.745	8006.37
5/28/2015	8684.961	15186.84	13329.83	19831.72	19040.68	30421.41	13708.59	25089.33	1831.373	2801.088	915.9987	1885.714	738.0229	1112.664	347.8444	722.4851	7162.984	11479.59	5711.054	10027.66
5/29/2015	9648.318	16649.78	12350.62	19352.08	20960.77	33150.28	12754.36	24943.88	2003.81	3040.107	840.3006	1876.598	810.9539	1210.588	319.6924	719.3268	7926.68	12606.13	5300.24	9979.69
5/30/2015	10797.1	18459.72	11155.68	18818.3	23767.36	37193.15	11013.76	24439.55	2240.459	3356.352	725.0009	1840.894	930.1131	1372.204	259.7515	701.8422	9056.277	14266.04	4573.275	9783.038
5/31/2015	11989.41	20134.3	10687.16	18832.05	26384.75	40468.79	10195.27	24279.32	2482.601	3647.06	662.4634	1826.922	1013.794	1463.389	237.2149	686.8102	10067.33	15553.21	4220.747	9706.635
6/1/2015	11075.96	19028.24	12039.71	19991.98	23928.9	37324.03	11805.03	25200.15	2187.028	3263.02	719.4027	1795.395	886.2756	1299.637	268.4772	681.8382	9073.891	14213.26	4839.303	9978.667
6/2/2015	10273.92	17968.09	12381.37	20075.55	22322.7	35404.87	12225.27	25307.43	2048.95	3104.57	746.15	1801.77	832.5176	1242.695	269.9142	680.0914	8474.169	13493.95	4984.837	10004.62
6/3/2015	9312.098	16564.09	13233.06	20485.05	20367.03	32917.26	13294.29	25844.51	1867.456	2886.25	827.7486	1846.542	772.736	1161.111	304.4184	692.7938	7689.897	12488.94	5411.896	10210.94
6/4/2015	9231.409	14561.76	10082.32	15412.67	20196.82	28676.43	9231.061	17710.68	1884.974	2572.94	557.6914	1245.657	759.8106	1014.866	209.5982	464.6533	7671.118	10859.26	3783.718	6971.862
6/5/2015	9088.126	13887.13	7385.447	12184.45	19652.46	27196.93	6861.252	14405.71	1821.176	2411.46	409.7599	1000.044	729.7122	951.6471	153.2075	375.1424	7392.714	10304.56	2808.057	5719.902
6/6/2015	8578.574	15310.19	13046.61	19778.22	19181.19	31111.53	13229.54	25159.88	1782.863	2743.037	815.7248	1775.898	715.4281	1073.119	300.8418	658.5329	7252.768	11795.09	5402.625	9944.942

6/7/2015	9734.403	17059.15	12763.03	20087.78	21581.56	34590.4	12592.54	25601.38	1980.603	3033.043	786.1904	1838.63	793.6136	1185.884	292.096	684.3665	8164.815	13131.98	5142.688	10109.85
6/8/2015	12368.71	19127.65	9095.128	15854.07	26556.9	37621.58	8450.983	19515.66	2383.551	3269.388	517.9474	1403.784	934.2125	1266.992	191.872	524.6515	10042.01	14318.84	3452.219	7729.046
6/9/2015	12734.51	16886.45	3106.736	7258.671	27278.67	33709.35	2855.007	9285.686	2462.174	2970.866	170.6875	679.3794	972.8548	1168.132	61.15824	256.435	10315.03	12821.11	1165.102	3671.18
6/10/2015	11608.09	17927.27	8757.215	15076.39	25074.66	35629.9	8921.43	19476.67	2268.677	3101.189	551.2947	1383.807	898.6237	1223.556	199.8512	524.7836	9466.763	13530.42	3624.714	7688.375
6/11/2015	11457.04	19301.6	11010.59	18855.15	24614.48	38080.76	11203.25	24669.52	2259.202	3336.235	694.2011	1771.233	883.6689	1297.53	257.8047	671.6663	9264.952	14410.9	4581.588	9727.54
6/12/2015	11892.42	19834.25	10346.39	18288.22	25119.55	38751.31	10968.38	24600.15	2275.387	3360.487	676.1636	1761.263	913.3148	1329.094	245.0281	660.8075	9546.295	14783.41	4496.804	9733.915
6/13/2015	11827.64	19477.45	9097.926	16747.73	25485.47	38701.48	9065.981	22281.99	2314.009	3341.583	562.2116	1589.786	915.0169	1299.145	206.271	590.3988	9676.478	14755.69	3754.337	8833.551
6/14/2015	13254.17	22458.11	9132.206	18336.15	28358.63	44104.63	8448.659	24194.66	2577.207	3789.631	523.612	1736.036	998.1332	1462.393	192.1411	656.4008	10761.56	16821.96	3500.534	9560.927
6/15/2015	15818.98	25326.25	9035.079	18542.35	33109.31	48742.04	8589.083	24221.81	2981.46	4205.47	522.5731	1746.583	1183.662	1646.394	189.9279	652.6598	12571	18591.42	3540.381	9560.795
6/16/2015	15715.62	25485.94	9487.441	19257.76	33080.88	48800.18	8784.385	24503.68	2995.572	4228.929	536.8802	1770.237	1187.933	1653.067	189.5683	654.7029	12571.93	18622.91	3613.964	9664.94
6/17/2015	16488.16	26575.79	9192.886	19280.51	34681.19	50886.18	8367.571	24572.56	3155.23	4429.846	502.4324	1777.049	1233.459	1713.352	177.7205	657.6133	13115.66	19355.82	3439.975	9680.132
6/18/2015	17224.61	27687.2	8676.747	19139.33	36184.64	52841.94	7755.113	24412.42	3293.367	4596.251	468.0175	1770.902	1285.221	1779.949	165.6147	660.3428	13688.15	20119.19	3186.703	9617.739
6/19/2015	15558.28	25684.69	9410.789	19537.2	32630.56	49029.06	8581.386	24979.89	2984.195	4267.411	519.0895	1802.305	1180.195	1667.21	184.3195	671.3341	12334.89	18658.25	3494.031	9817.389
6/20/2015	15404.14	25424.3	9562.898	19583.05	32368.89	48738.69	8793.101	25162.9	2945.24	4223.22	540.1262	1818.106	1168.185	1656.201	191.7796	679.7956	12233.63	18541.79	3586.071	9894.236
6/21/2015	16270.3	26506.45	9037.521	19273.67	34410.8	50950.74	8041.053	24580.99	3112.578	4396.85	491.5664	1775.838	1246.227	1739.066	170.8535	663.6925	12995.12	19351.37	3300.181	9656.437
6/22/2015	16095.05	26017.93	9220.246	19143.12	33145.25	48883.43	8756.077	24494.26	3013.973	4241.023	544.4217	1771.472	1181.439	1651.108	195.3016	664.971	12469.16	18516.1	3592.033	9638.968
6/23/2015	16918.28	26384.76	8172.591	17639.08	34770.75	49825.55	7784.466	22839.26	3168.508	4340.088	480.4058	1651.986	1249.02	1699.236	170.2996	620.5162	13139.84	18923.71	3187.773	8971.641
6/24/2015	17209.45	27265.79	8283.02	18339.36	35099.22	51057.84	8001.713	23960.33	3214.001	4461.142	491.4658	1738.608	1278.892	1759.825	173.899	654.8316	13299.45	19488.46	3260.06	9449.061
6/25/2015	17923.12	27848.94	7709.864	17635.69	36562.59	52459.59	7395.962	23292.96	3383.168	4633.081	462.1557	1712.069	1318.349	1795.058	158.5257	635.2351	13825.06	20011.5	3021.649	9208.092
6/26/2015	18074.12	28280.06	8167.278	18373.22	36753.58	52915.46	7821.944	23983.83	3343.753	4619.91	481.4114	1757.569	1324.631	1802.505	171.7804	649.654	13880.47	20125.74	3189.102	9434.363
6/27/2015	18573.45	27908.53	6475.71	15810.79	38344.22	52599.46	5532.694	19787.94	3482.031	4593.914	328.5923	1440.475	1364.55	1776.768	108.2267	520.4442	14528.5	20053.15	2207.246	7731.894
6/28/2015	18324.83	28615.07	7230.802	17521.04	38332.97	55191.5	6549.264	23407.8	3494.92	4815.132	401.1901	1721.402	1355.947	1852.563	140.9367	637.5531	14551.08	21102.76	2693.893	9245.58
6/29/2015	18487.06	28624.86	7297.713	17435.51	37951.6	54230.45	6933.163	23212.02	3459.925	4729.582	424.1556	1693.813	1349.454	1831.106	152.3473	633.9986	14458.9	20756.43	2843.39	9140.921
6/30/2015	17718.39	27084.09	7876.956	17242.65	36086.38	51336.99	7751.312	23001.92	3312.794	4515.271	476.4239	1678.902	1319.107	1780.457	166.5999	627.9493	13742.69	19639.66	3145.735	9042.702
7/1/2015	17069.54	26425.06	7929.585	17285.11	34879.7	49874.15	7721.377	22715.83	2978.622	4084.305	427.6324	1533.315	1221.063	1658.348	157.8329	595.1181	13075.43	18801.86	3111.12	8837.554
7/2/2015	17183.8	27406.1	8571.065	18793.36	34772.33	51027.63	8378.925	24634.22	2991.362	4184.945	466.8798	1660.463	1188.186	1658.033	174.6561	644.5038	13006.09	19217.71	3356.748	9568.368
7/3/2015	17080.34	23565.39	4939.307	11424.36	34565.14	43817.72	4066.571	13319.14	2925.945	3607.482	227.0777	908.6149	1164.299	1438.06	83.44917	357.2101	12935.64	16476.61	1614.373	5155.346
7/4/2015	15937.42	24385.86	6616.453	15064.89	33712.26	47931.79	6342.061	20561.59	2927.657	3985.621	339.5009	1397.465	1178.422	1602.114	132.5542	556.2467	12720.18	18255.51	2566.767	8102.093
7/5/2015	15359.32	23385.16	6911.304	14937.14	33117.54	46777.45	6757.995	20417.91	2838.012	3825.897	360.2234	1348.108	1137.154	1530.7	131.6146	525.1603	12382.53	17626.34	2682.143	7925.951
7/6/2015	14530	23448.06	9497.083	18415.14	30948.3	45867.69	9442.102	24361.49	2664.177	3766.803	541.0848	1643.711	1072.415	1508.597	202.5549	638.7367	11586.52	17299.45	3761.866	9474.795
7/7/2015	15363.74	24324.68	8527.875	17488.81	33200.2	48893.6	8650.941	24344.35	2838.166	4001.822	487.7479	1651.405	1154.432	1614.395	182.1223	642.0848	12374.22	18349.69	3480.853	9456.328
7/8/2015	14470.84	23686.4	9711.568	18927.13	31577.67	47083.5	9194.522	24700.35	2752.932	3900.989	527.0693	1675.126	1130.199	1581.794	193.1838	644.7789	11792.81	17688.49	3679.597	9575.278
7/9/2015	11493.09	19196.97	10852.75	18556.63	25243.49	38328.08	10840.31	23924.9	2315.174	3306.426	617.6271	1608.879	920.6012	1304.549	220.1255	604.0729	9374.752	14321.29	4286.192	9232.731
7/10/2015	11877.36	19845.01	11358.18	19325.83	26203.34	40096.53	11447.21	25340.4	2334.202	3381.862	682.3431	1730.003	926.5556	1338.659	246.9523	659.0554	9689.201	14914.41	4577.924	9803.135
7/11/2015	13937.91	22722.53	9121.351	17905.98	30971.25	46210.46	8413.835	23653.04	2760.338	3893.292	487.0738	1620.028	1100.678	1542.494	167.2973	609.1134	11528.98	17296.29	3358.698	9126.006
7/12/2015	14757.7	23417.11	8474.703	17134.12	32122.67	46682.25	7738.843	22298.43	2820.372	3903.051	443.2453	1525.924	1122.079	1541.838	154.8687	574.6271	11904.71	17404.99	3095.328	8595.613
7/13/2015	16236.56	25562.79	8119.656	17445.89	34659.43	49962.57	7705.52	23008.66	3000.844	4126.644	448.9735	1574.773	1196.086	1618.118	160.5135	582.5464	12875.87	18681.24	3031.655	8837.026
7/14/2015	16499.89	26005.09	8512.796	18018	35609.72	51579.16	8226.478	24195.91	3097.13	4288.895	480.109	1671.874	1231.568	1696.504	165.7669	630.7033	13234.1	19332.05	3269.904	9367.853
7/15/2015	16283.8	25852.82	9140.824	18709.84	35073.55	51021.49	8634.381	24582.33	3064.003	4250.439	512.9061	1699.343	1222.841	1678.085	180.5314	635.7752	13018.74	19068.3	3439.96	9489.519
7/16/2015	16579.46	26384.13	8923.045	18727.72	35260.42	51520.61	8601.284	24861.47	3070.4	4282.695	509.165	1721.461	1218.151	1685.059	176.918	643.8263	13049.94	19227.87	3417.813	9595.742
7/17/2015	16058.09	24656.52	8121.699	16720.13	34177.86	48678.31	8072.662	22573.12	2920.264	3990.967	491.9475	1562.651	1167.556	1596.942	169.0575	598.4438	12617.62	18140.26	3242.046	8764.678
7/18/2015	13832.25	20373.99	6563.163	13104.91	30333.89	41353.24	6365.733	17385.09	2645.628	3470.85	379.3189	1204.541	1079.386	1404.381	125.7273	450.7226	11328.04	15529.76	2505.583	6707.306
7/19/2015	13007.79	20800.48	8805.075	16597.77	28750.53	42723.02	9185.013	23157.5	2509.089	3549.202	556.0671	1596.179	1003.337	1409.144	193.5612	599.3679	10626.11	15912.19	3684.831	8970.915
7/20/2015	14737.71	23141.66	8474.721	16878.66	31725.4	46105.89	8813.737	23194.22	2758.529	3828.495	532.6221	1602.588	1106.784	1538.677	179.9673	611.8602	11697.96	17122.68	3522.818	8947.539
7/21/2015	15390.11	24803.98	9375.958	18789.82	33005.53	48808.2	8986.923	24789.59	2873.261	4047.209	541.5687	1715.516	1160.727	1616.932	182.4925	638.6968	12155.11	18094.9	3589.23	9529.02
7/22/2015	14734.79	24045.81	10459.73	19770.76	31846.77	47365.32	10180.69	25699.24	2767.45	3928.052	621.2223	1781.824	1130.612	1590.036	200.3799	659.8042	11701.03	17506.92	4058.177	9864.072
7/23/2015	14435.14	23500.28	10416	19481.14	31257.46	46543.82	10179.48	25465.83	2722.79	3875.787	624.4631	1777.46	1099.866	1548.728	209.0577	657.9203	11491.38	17224.96	4063.683	9797.263
7/24/2015	16013.98	24903.48	8135.42	17024.92	34261.01	48854.98	7759.239	22353.21	2995.089	4080.052	447.4735	1532.437	1194.208	1604.136	147.3804	557.3082	12613.14	18081.54	3064.083	8532.477
7/25/2015	15691.48	25473.33	9076.728	18858.57	33963.05	50287.18	8366.11	24690.24	2954.662	4176.728	494.1513	1716.218	1184.497	1657.151	165.3176	637.9717	12530.15	18650.47	3352.533	9472.849
7/26/2015	16033.35	25224.56	8490.909	17682.12	34664.89	49876.16	7674.406	22885.67	3040.168	4178.252	454.5881	1592.672	1204.395	1641.923	151.8617	589.3894	12793.4	18513.55	3043.49	8763.645
7/27/2015	16159.48	26012.83	9643.665	19497.01	34518.04	50729.73	9079.98	25291.67	3014.975	4233.378	547.8695	1766.272	1192.136	1655.483	187.0992	650.4464	12728.26	18810	3607.352	9689.091
7/28/2015	17450.14	26682.47	8121.414	17353.75	37238.92	52117.89	7438.018	22316.99	3203.977	4313.68	439.2944	1548.997	1281.527	1706.116	139.7035	564.2925	13678.38	19229.27	2941.429	8492.323
7/29/2015	17171.12	23568.28	4848.697	11245.85	35876.93	46345.33	4825.215	15293.61	3060.877	3871.697	297.0579	1107.878	1217.485	1543.841	103.2656	429.6216	13232.88	17234.92	1923.512	5925.552

7/30/2015	16623.19	25434.02	7505.177	16316.01	35434.97	50780.43	8083.083	23428.55	3043.933	4197.313	483.999	1637.379	1220.485	1670.429	168.2547	618.1992	13057.55	18847.66	3241.997	9032.11
7/31/2015	16581.14	24206.49	6091.614	13716.96	35194.3	48008.88	5944.579	18759.16	3035.078	3980.945	354.9952	1300.862	1239.451	1613.889	121.8763	496.3149	12984.08	17787.86	2417.571	7221.355
8/1/2015	15849.13	24678.92	7551.426	16381.22	34649.63	50258.82	7638.722	23247.92	2815.998	3917.996	431.4442	1533.441	1178.419	1624.009	151.1667	596.7566	12647.1	18486.92	3033.36	8873.177
8/2/2015	17286.03	27180.74	8051.965	17946.68	38124.91	55251.9	7571.332	24698.32	3102.154	4307.635	421.3395	1626.82	1290.909	1770.775	147.2842	627.1497	13948.28	20362.35	2987.686	9401.759
8/3/2015	17287.36	27230.29	8550.023	18492.95	37297.63	53995.97	8167.601	24865.95	3077.085	4261.571	452.793	1637.279	1252.562	1720.877	163.1745	631.489	13510.82	19718.84	3235.123	9443.144
8/4/2015	17237.04	27540.35	8870.538	19173.85	37632.43	54588.11	8196.237	25151.92	3113.5	4320.396	450.2365	1657.133	1274.814	1745.243	165.2451	635.6742	13617.01	19910.1	3243.633	9536.719
8/5/2015	17911.16	28294.67	8831.394	19214.9	38762.5	55841.6	8182.132	25261.23	3194.927	4407.405	447.1569	1659.636	1303.489	1781.184	160.3206	638.0159	14045.65	20396.18	3249.085	9599.614
8/6/2015	18791.43	25723.21	5096.626	12028.41	40618.97	51615.6	4219.47	15216.1	3356.611	4141.837	222.5504	1007.776	1335.424	1642.815	78.30653	385.6969	14715	18870.41	1642.983	5798.389
8/7/2015	16643.55	25876.97	7768.072	17001.5	36027.53	51453.16	7405.66	22831.28	2981.434	4069.77	411.1163	1499.452	1180.296	1601.436	143.7419	564.8826	12971.49	18759.99	2930.199	8718.703
8/8/2015	15529.2	24876.83	8909.352	18256.98	34398	50635.14	8453.331	24690.47	2858.469	4038.65	459.7981	1639.979	1131.156	1587.86	170.2325	626.9357	12411.14	18478.57	3363.441	9430.868
8/9/2015	17403.56	27224.2	7855.51	17676.15	38709.47	55699.46	7188.476	24178.46	3174.901	4393.286	387.1371	1605.522	1286.949	1761.706	139.9778	614.7351	14059.68	20439.62	2850.781	9230.719
8/10/2015	17221.39	25625.87	7457.782	15862.26	37337.54	51217.45	7299.189	21179.1	3077.858	4063.968	402.3928	1388.503	1232.635	1619.984	138.7711	526.1206	13602.28	18790.25	2849.545	8037.515
8/11/2015	16225.13	21600.59	4694.073	10069.54	35533.01	44158.29	4702.993	13328.27	2984.357	3593.219	254.6043	863.4665	1181.585	1421.686	85.7215	325.8223	12933.81	16152.32	1802.124	5020.627
8/12/2015	16427.43	25257.05	8156.604	16986.23	36270.08	51647.26	8207.972	23585.15	3013.802	4122.922	465.5961	1574.717	1221.375	1661.351	161.0305	601.0073	13218.43	19009.83	3243.282	9034.681
8/13/2015	19040.2	29265.12	7448.697	17673.62	41392.67	58477.19	6969.182	24053.71	3445.412	4661.952	386.9633	1603.503	1403.614	1880.816	133.2533	610.4552	15164.82	21605.45	2724.772	9165.395
8/14/2015	20521.93	30360.41	6495.233	16333.71	44526.38	61356.47	6164.285	22994.37	3683.478	4875.219	347.1607	1538.902	1509.08	1982.836	116.5957	590.3513	16330.22	22692.17	2441.512	8803.455
8/15/2015	22281.05	33166.89	6080.509	16966.35	48434.33	66614.19	5115.843	23295.7	3994.237	5272.867	269.1325	1547.763	1606.855	2099.109	92.29465	584.5482	17779.15	24636.47	2038.509	8895.826
8/16/2015	22175.5	33383.04	6645.817	17853.36	48113.79	66441.61	5527.26	23855.08	3972.632	5282.019	289.2788	1598.666	1606.405	2106.491	102.4176	602.5037	17624.16	24545.99	2195.824	9117.654
8/17/2015	20305.5	30828	7813.566	18336.07	42815.57	59702.14	7373.935	24260.51	3594.335	4814.628	404.6417	1624.935	1448.464	1918.441	142.702	612.6793	15718.13	22063.1	2909.622	9254.592
8/18/2015	17706.02	27488.98	8597.082	18380.04	37065.95	52732.46	8605.94	24272.45	3129.018	4274.654	484.5944	1630.231	1261.637	1710.247	164.7935	613.4034	13540.09	19377.98	3406.854	9244.749
8/19/2015	17119.71	26588.14	8806.397	18274.83	36389.35	51855.45	8801.431	24267.53	3065.274	4195.818	498.9479	1629.493	1222.146	1666.452	171.4436	615.7503	13171.87	18939.38	3479.491	9247.003
8/20/2015	17474.02	27169.37	8360.916	18056.27	37609.75	53527.8	7906.391	23824.44	3210.085	4366.484	441.7427	1598.141	1274.701	1718.849	158.1062	602.2538	13666.81	19602.81	3140.696	9076.695
8/21/2015	17922.59	27553.17	8229.792	17860.36	38746.89	54607.72	7596.29	23457.13	3299.922	4450.194	419.6796	1569.952	1311.289	1753.938	148.2258	590.8744	14087.32	20034.8	2991.569	8939.048
8/22/2015	18146.29	28237.66	8027.139	18118.52	39578.85	56496.07	7121.27	24038.49	3351.33	4585.03	381.782	1615.482	1353.015	1821.063	139.0266	607.0745	14369.23	20690.02	2837.654	9158.442
8/23/2015	18502.1	28102.72	6886.635	16487.26	40421.63	57202.55	6597.007	23377.93	3383.786	4597.014	351.4699	1564.697	1353.153	1818.082	126.5761	591.5045	14671.84	20937.97	2666.913	8933.052
8/24/2015	18034.54	27160.75	7648.108	16774.32	38533.37	53677.88	7443.148	22587.66	3232.061	4332.569	418.0216	1518.53	1297.629	1724.168	148.1567	574.6955	13950.61	19609.83	2977.166	8636.392
8/25/2015	16990.43	23653.15	5483.406	12146.13	36239.29	47371.2	5965.2	17097.11	3085.059	3908.433	334.6336	1158.007	1230.11	1549.869	116.4981	436.2561	13154.94	17331.56	2357.276	6533.901
8/26/2015	16551.17	25171.75	7936.381	16556.96	35855.57	50613.91	8282.663	23041	3017.269	4096.669	463.1249	1542.525	1214.314	1636.769	163.5913	586.0463	12942.17	18433.26	3299.567	8790.661
8/27/2015	16663.49	24216.02	6109.933	13662.46	35666.39	48584.03	6430.964	19348.6	3063.286	4008.521	360.2376	1305.473	1209.271	1583.527	129.9921	504.2484	12858.14	17714.92	2549.24	7406.015
8/28/2015	16941.56	26211.93	8392.24	17662.61	36016.66	51389.8	8279.838	23652.97	3016.4	4130.352	481.5161	1595.469	1198.266	1638.651	161.6073	601.9923	13065.6	18783.44	3266.145	8983.994
8/29/2015	18648.17	28085.25	6721.218	16158.29	41060.61	57740.68	6284.186	22964.26	3417.199	4614.186	351.7688	1548.756	1360.877	1831.733	122.9391	593.7952	14987.18	21247.26	2510.989	8771.068
8/30/2015	18529.27	28060.41	7018.888	16550.03	40817.27	57338.47	6466.908	22988.11	3396.091	4593.79	359.0969	1556.795	1375.395	1836.369	127.6508	588.6246	14858.02	21048.07	2571.53	8761.589
8/31/2015	17394.72	26549.87	7562.961	16718.11	37419.82	52899.07	7632.098	23111.35	3151.13	4284.894	426.0883	1559.852	1239.535	1674.716	151.9399	587.121	13554.63	19359.91	2988.031	8793.305
9/1/2015	15197.48	23232.97	8496.665	16532.15	32960.6	46405.22	8678.363	22122.99	2650.117	3579.577	459.4465	1388.907	1044.322	1402.514	172.0721	530.2635	11751.36	16690.31	3370.803	8309.753
9/2/2015	15254.59	22934.22	7978.932	15658.56	33338.88	45913.06	7745.82	20320	2705.008	3548.67	402.4049	1246.066	1053.102	1371.119	130.5963	448.613	11795.86	16372.63	2971.772	7548.542
9/3/2015	14173.72	21532.96	8706.472	16065.71	30812.24	43321.05	8678.79	21187.6	2520.103	3398.361	461.4257	1339.684	981.8796	1326.618	171.7647	516.5036	10914.55	15525.8	3413.218	8024.464
9/4/2015	13372.54	20219.55	8549.234	15396.24	28809.61	40508.81	9242.777	20941.98	2330.242	3161.21	510.974	1341.942	940.5713	1270.315	192.7809	522.5248	10293.59	14594.66	3631.322	7932.388
9/5/2015	13677.13	21003.05	8207.38	15533.31	30056.35	43396.91	8916.007	22256.57	2425.865	3346.269	474.0837	1394.488	971.579	1328.376	180.2934	537.0904	10752.9	15667.54	3496.686	8411.328
9/6/2015	15524.46	23701.71	7890.572	16067.83	34537.86	49181.77	7751.224	22395.13	2749.762	3750.166	417.3813	1417.785	1100.767	1487.116	152.9487	539.2982	12432.99	17822.39	3037.476	8426.885
9/7/2015	16444.62	23539.15	5865.99	12960.52	36609.77	49149.93	5825.768	18365.93	2903.319	3727.35	298.499	1122.53	1136.007	1438.553	105.7793	408.325	13042.83	17637.78	2289.454	6884.396
9/8/2015	16417.62	24459.03	7783.767	15825.18	36273.65	50402.24	7735.655	21864.25	2911.567	3877.806	421.5547	1387.794	1172.609	1555.865	145.9487	529.2054	12976.57	18207.04	3038.462	8268.93
9/9/2015	15745.59	20688.72	4475.911	9419.036	34157.46	41514.6	3287.546	10644.69	2714.891	3216.959	169.4107	671.4783	1102.86	1302.564	50.73043	250.4341	12174.69	14868.3	1231.972	3925.577
9/10/2015	14860.83	20587.47	5392.829	11119.47	32236.93	41420.61	5129.495	14313.18	2606.408	3236.37	270.4928	900.4553	1029.101	1264.315	83.18658	318.4008	11447.89	14818.22	1964.1	5334.436
9/11/2015	14549.46	22649.32	9353.416	17453.27	31033.51	44760.39	9580.871	23307.76	2488.91	3447.397	523.6479	1482.135	999.0301	1364.962	190.0686	556.0005	11024.21	16038.67	3750.422	8764.885
9/12/2015	16649.91	24787.79	6974.491	15112.37	36833.28	51708.61	6958.421	21833.75	2952.503	3982.207	371.5799	1401.284	1195.949	1589.705	128.3796	522.1352	13180.32	18639.41	2759.201	8218.289
9/13/2015	16623.63	24267.17	6050.793	13694.33	37294.22	51059.32	5791.298	19556.4	2996.667	3954.46	311.1108	1268.904	1210.807	1595.743	112.1125	497.0486	13343.08	18428.93	2333.824	7419.67
9/14/2015	13607.64	20903.04	9307.64	16603.04	29501.63	42208.52	10075.33	22782.22	2423.8	3318.72	549.3563	1444.276	968.8342	1322.313	196.9485	550.4269	10509.68	15148.08	3950.117	8588.519
9/15/2015	13120.4	20030.52	9803.075	16713.19	28768.11	41007.7	10633.23	22872.83	2394.966	3266.678	579.7467	1451.459	949.5262	1295.323	206.4198	552.2164	10228.59	14711.89	4137.133	8620.434
9/16/2015	13065.72	19898.7	9385.508	16218.48	28914.54	40991.68	10193.05	22270.19	2385.429	3236.331	560.8606	1411.763	936.7769	1273.028	200.0059	536.2573	10303.34	14678.85	3990.339	8365.849
9/17/2015	12004.05	19086.88	11001.2	18084.04	26604.45	39058.76	11630.4	24084.71	2259.984	3159.876	635.8425	1535.735	853.5879	1197.997	227.8347	572.2439	9412.982	13924.19	4535.772	9046.982
9/18/2015	12243.69	19437.56	10315.87	17509.74	26981.22	39587.07	10704.3	23310.15	2295.059	3196.859	584.859	1486.659	881.2511	1231.902	205.6037	556.255	9479.009	14063.35	4179.558	8763.896
9/19/2015	13849.98	21389.07	9220.989	16760.07	31059.19	44604.2	9033.192	22578.2	2622.291	3579.259	484.2449	1441.213	1011.225	1381.511	173.7624	544.0489	10994.62	15938.33	3570.691	8514.407
9/20/2015	15904.73	24389.2	8546.345	17030.82	35384.45	50180.28	8016.191	22812.02	2941.473	3983.519	417.669	1459.715	1125.488	1515.393	154.0029	543.9078	12580.48	18003.91	3149.378	8572.803

9/21/2015	14576.75	18371.06	2500.094	6294.402	31598.33	37425.78	2167.09	7994.536	2649.001	3053.935	106.9496	511.883	1025.121	1180.015	34.44859	189.3434	11264.48	13419.04	812.0207	2966.585
9/22/2015	12235.52	16962.08	6024.974	10751.53	26405.02	34912.53	7693.509	16201.02	2246.048	2860.015	434.6572	1048.625	854.8168	1090.644	152.4264	388.254	9326.947	12443.83	2961.722	6078.603
9/23/2015	12288.75	19027.79	10348.4	17087.44	26937.46	38924.01	10981.96	22968.51	2269.306	3135.003	608.1585	1473.855	867.9146	1193.414	212.8336	538.3331	9471.743	13807.85	4283.49	8619.6
9/24/2015	14367.45	21995.19	9241.755	16869.5	31455.2	44557.69	9370.479	22472.97	2636.929	3570.959	518.978	1453.009	1015.215	1368.146	177.4195	530.3507	11144.26	15938.19	3652.24	8446.176
9/25/2015	14591.92	22505.51	9463.649	17377.24	31834.65	45448.26	9780.915	23394.52	2694.06	3669.499	540.4511	1515.889	1033.744	1404.118	185.0111	555.3854	11353.16	16330.28	3817.441	8794.562
9/26/2015	15085.23	23353.91	8712.678	16981.36	34010.62	48594.31	8284.206	22867.9	2856.572	3900.755	438.4246	1482.607	1108.197	1500.357	152.7747	544.9353	12148.24	17490.92	3239.493	8582.179
9/27/2015	15402.87	23488.32	8412.825	16498.27	34277.52	48459.01	7991.112	22172.6	2858.908	3868.124	431.1223	1440.338	1070.701	1443.995	153.664	526.9574	12152.06	17334.61	3132.899	8315.45
9/28/2015	15295.02	22423.99	7833.714	14962.68	32964.28	45170.53	8143.431	20349.68	2760.417	3635.845	453.1056	1328.534	1027.818	1355.898	161.8609	489.941	11686.45	16127.88	3193.07	7634.503
9/29/2015	15029.67	22716.25	8608.875	16295.46	32130.85	45230.72	8999.399	22099.27	2725.981	3672.762	498.4836	1445.265	1013.778	1360.901	177.1133	524.2367	11366.17	16129.89	3510.706	8274.423
9/30/2015	14913.63	22505.35	8710.405	16302.12	32123.23	45043.86	9031.686	21952.31	2738.585	3674.907	500.8088	1437.131	1008.052	1353.521	174.496	519.9658	11365.76	16052.02	3518.343	8204.6
10/1/2015	14149.5	21608.86	9495.299	16954.67	31167.8	44117.54	9771.175	22720.92	2588.825	3493.161	509.5942	1413.93	976.8338	1314.823	182.4012	520.3899	10868.86	15486.8	3757.727	8375.663
10/2/2015	11816.57	18628.33	10419.72	17231.48	26179.06	38240.82	11103.06	23164.81	2189.525	3038.608	593.8734	1442.956	834.9444	1157.047	207.1495	529.2519	9112.779	13396.09	4261.063	8544.376
10/3/2015	10270.59	16463.54	11100.85	17293.8	23187.65	34661.21	11907.44	23381	1956.151	2775.744	639.9428	1459.535	733.6915	1039.718	231.958	537.9848	8041.204	12081.9	4571.893	8612.589
10/4/2015	11635.23	16854.63	7111.831	12331.23	26505.07	36061.59	8198.62	17755.14	2198.829	2867.42	433.7913	1102.382	811.1797	1056.716	163.0388	408.5754	9204.196	12599.39	3136.37	6531.567
10/5/2015	10527.83	15003.73	7081.562	11557.46	22942.7	30972.02	8888.687	16918	1957.291	2534.74	484.5479	1061.997	723.7815	940.7427	183.3571	400.3183	7908.259	10758.78	3430.514	6281.032
10/6/2015	9418.216	12559.19	4541.975	7682.951	19846.69	24942.64	5166.214	10262.17	1725.601	2093.554	285.778	653.731	629.525	763.4766	120.4945	254.4461	6861.962	8655.524	2011.511	3805.073
10/7/2015	8458.221	12998.49	11524.39	16064.66	17878.64	26097.04	14244.15	22462.56	1554.524	2166.856	797.5991	1409.931	568.1683	783.5787	289.6404	505.0508	6167.355	8996.641	5464.074	8293.36
10/8/2015	9691.33	14979.99	11123.72	16412.38	21147.33	30707.61	12771.23	22331.51	1805.507	2513.106	714.9045	1422.504	652.4276	908.9356	256.9371	513.4451	7278.226	10591.5	4908.353	8221.622
10/9/2015	10707.15	16630.55	10583.73	16507.13	23623.77	34279.09	11833.34	22488.66	2003.616	2781.722	652.8161	1430.922	734.0944	1017.999	230.1791	514.0833	8099.471	11833.97	4542.832	8277.33
10/10/2015	11730.43	17365.98	7742.444	13378	26465.32	36474.7	7676.507	17685.89	2233.334	2946.051	410.0541	1122.77	819.2905	1083.799	142.1736	406.6819	9173.53	12744.59	2928.194	6499.258
10/11/2015	12375.53	18885.01	9206.746	15716.23	27747.46	39609.02	9424.113	21285.67	2337.266	3183.093	507.0565	1352.883	860.8692	1173.022	174.2099	486.3625	9631.951	13848.7	3609.949	7826.695
10/12/2015	12627.66	18399.96	8341.779	14114.08	27344.63	37393.27	8684.004	18732.65	2266.943	2995.594	484.5442	1213.196	841.7632	1110.681	168.2712	437.189	9437.356	12981.61	3367.25	6911.508
10/13/2015	12765.48	19098.63	9264.027	15597.18	27526.03	38652.13	10010.13	21136.23	2287.505	3087.403	550.2994	1350.197	827.7618	1121.967	192.8651	487.0699	9480.24	13388.6	3870.257	7778.616
10/14/2015	13193.28	19636.42	9053.783	15496.92	28501.8	39839.52	9695.462	21033.18	2360.287	3180.18	524.4179	1344.311	859.2567	1152.12	188.6057	481.4691	9800.474	13776.3	3739.869	7715.692
10/15/2015	13326.92	18650.11	7269.443	12592.63	28590.25	37803.54	7714.558	16927.85	2392.913	3061.677	431.0659	1099.83	859.0067	1104.276	151.3415	396.6105	9871.897	13139.43	3027.688	6295.222
10/16/2015	12889.14	16785.66	5195.603	9092.122	27377.9	33819.66	5465.242	11907	2319.196	2790.771	299.8463	771.4213	843.8771	1019.541	106.3141	281.9783	9495.04	11781.01	2117.726	4403.699
10/17/2015	11395.16	15758.15	5662.249	10025.24	24708.86	32205.73	6064.712	13561.58	2140.281	2679.113	311.9799	850.8117	777.3092	966.1217	106.2396	295.0521	8587.152	11235.72	2254.572	4903.143
10/18/2015	11452.52	16358.62	6140.818	11046.92	25446.92	34024.84	6677.922	15255.84	2161.931	2778.829	354.5428	971.4403	784.3017	1000.31	121.5173	337.5252	8741.608	11764.53	2547.103	5570.029
10/19/2015	10390.85	14897.56	8354.674	12861.38	22200.21	30209.5	10183.04	18192.33	1895.003	2497.656	588.6706	1191.324	678.141	890.9013	212.3561	425.1164	7554.026	10329.53	3918.666	6694.165
10/20/2015	9880.563	12904.35	4345.329	7369.12	20024.75	25255.25	5703.018	10933.52	1775.982	2175.516	333.8502	733.3834	635.8492	788.6467	130.5414	283.3389	6798.114	8658.941	2189.94	4050.768
10/21/2015	8725.752	12298.06	8006.895	11579.2	17370.27	23563.37	10258.7	16451.8	1553.25	2023.312	598.6581	1068.72	565.8425	735.1615	224.5969	393.9158	5944.585	8095.338	3932.898	6083.652
10/22/2015	8385.029	12495.41	10473.85	14584.23	16734.07	24001.49	13891.62	21159.04	1511.175	2077.333	809.5765	1375.734	535.1006	732.2418	282.6992	479.8404	5687.963	8186.398	5292.43	7790.864
10/23/2015	8600.253	13016.64	10938.36	15354.74	17816.46	25626.05	13216.97	21026.55	1594.507	2192.529	777.2739	1375.296	586.1279	798.3351	269.7092	481.9163	6019.287	8691.806	5045.918	7718.437
10/24/2015	9245.779	14194.18	10584.31	15532.71	20152.38	29327.29	12001.98	21176.88	1772.368	2474.566	688.8307	1391.029	648.2254	885.9217	243.1732	480.8695	6888.793	10089.23	4566.027	7766.463
10/25/2015	10121.74	14262.95	5594.494	9735.704	22263.66	29528.24	6225.971	13490.55	1943.137	2488.326	355.8535	901.0423	694.873	886.3509	122.6317	314.1096	7536.668	10095.67	2378.55	4937.549
10/26/2015	9724.194	14426.02	9456.264	14158.1	20787.12	29146.11	11193.38	19552.37	1838.952	2472.073	648.0065	1281.128	660.864	882.2295	221.781	443.1465	7025.845	9907.078	4272.709	7153.942
10/27/2015	9285.527	13620.64	9714.285	14049.39	19603.05	27155.14	11470.61	19022.7	1738.549	2317.19	677.9417	1256.583	632.1944	834.4661	232.7264	434.9981	6591.179	9197.664	4343.054	6949.54
10/28/2015	9482.424	13135.1	6362.494	10015.17	19851.41	25976.15	7579.959	13704.69	1785.371	2252.516	440.7518	907.8963	631.4889	794.0595	145.7826	308.3532	6695.028	8857.772	2833.732	4996.476
10/29/2015	9594.506	12881.91	6581.13	9868.537	18854.01	24669.72	8728.178	14543.88	1723.359	2182.244	513.8544	972.7397	603.6521	768.0515	191.282	355.6814	6420.038	8454.458	3365.777	5400.198
10/30/2015	8580.472	12512.78	9814.189	13746.5	16594.75	23392.59	12661.77	19459.62	1517.592	2040.001	760.2688	1282.678	555.2269	738.0926	248.4928	431.3586	5647.934	7985.842	4764.436	7102.344
10/31/2015	8422.024	12886.41	10802.69	15267.07	16994.87	24905.4	13046.35	20956.88	1557.586	2156.772	789.3826	1388.568	557.6571	766.6154	264.9803	473.9386	5826.703	8549.107	4933.943	7656.347
11/1/2015	8736.032	13274.12	10557.14	15095.23	18007.55	26120.05	12486.28	20598.78	1554.458	2148.155	691.5482	1285.245	561.1533	769.928	246.906	455.6807	6139.121	8924.54	4709.122	7494.541
11/2/2015	8675.219	12863.38	10979.14	15167.3	17431.1	24603.85	13422.09	20594.84	1508.519	2041.938	758.4116	1291.831	552.8729	742.2472	265.5968	454.9711	5883.083	8331.792	5044.822	7493.531
11/3/2015	9056.504	12290.89	5873.45	9107.832	17136.1	22661.8	8043.978	13569.68	1500.028	1911.237	469.1668	880.3752	558.5937	715.7644	180.6355	337.8062	5797.861	7751.538	3068.897	5022.573
11/4/2015	9930.504	12804.36	5731.313	8605.167	17266.02	22002.18	7633.865	12370.02	1506.419	1843.737	423.8776	761.1958	543.7042	661.7853	143.6079	261.689	5971.801	7630.06	2806.415	4464.673
11/5/2015	8966.884	12773.02	10543.43	14349.57	15452.88	21763.71	14132.57	20443.4	1377.925	1850.202	817.143	1289.42	501.6533	668.5087	286.5217	453.3771	5377.294	7563.309	5281.422	7467.437
11/6/2015	8758.396	12738.1	11191.46	15171.17	15344.07	21783.23	14555.23	20994.4	1348.273	1825.389	853.049	1330.165	496.9862	674.2734	286.3713	463.6585	5371.178	7589.273	5426.983	7645.078
11/7/2015	8656.797	12871.08	10916.71	15131	15970.29	23117.05	13506.7	20653.45	1419.81	1949.126	785.2143	1314.53	523.5762	708.3972	271.7396	456.5606	5642.446	8138.068	5014.797	7510.419
11/8/2015	8892.132	13214.82	10395.16	14717.85	16914.85	24294.54	12662.61	20042.31	1484.322	2029.299	731.0741	1276.051	539.4844	727.2554	255.0166	442.7875	5847.47	8398.298	4729.371	7280.2
11/9/2015	8634.893	12549.56	10558.6	14473.27	15904.47	22250.18	13539.06	19884.77	1410.753	1891.292	790.5442	1271.083	519.3669	691.2524	271.6456	443.5311	5488.529	7659.836	5058.625	7229.932
11/10/2015	9685.404	12953.41	6733.947	10001.95	16692.18	21834.54	8810.129	13952.5	1483.089	1843.741	504.2029	864.8547	545.8659	678.4576	159.1026	291.6943	5764.354	7563.952	3196.867	4996.466
11/11/2015	9276.606	13378.52	10866.47	14968.38	16104.69	22777.53	13879.19	20552.04	1414.213	1913.187	813.0134	1311.987	533.4501	705.1076	284.208	455.8655	5621.73	7877.181	5199.84	7455.29
11/12/2015	9282.912	13251.92	10646.07	14615.08	16229.74	22512.43	13821.22	20103.92	1428.298	1895.793	819.7643	1287.259	525.1272	692.2126	283.0823	450.1676	5675.918	7830.596	5137.961	7292.639

11/13/2015	8931.566	12869.69	10554.32	14492.44	15852.51	22129.54	13551.94	19828.96	1395.95	1861.032	802.357	1267.439	525.7892	697.129	272.8242	444.1639	5484.128	7624.405	5038.341	7178.618
11/14/2015	8984.495	13142.5	10092.32	14250.33	16353.74	23285.61	12619.45	19551.32	1437.568	1958.417	737.4297	1258.279	530.8319	712.5208	255.1915	436.8803	5699.685	8110.268	4670.098	7080.681
11/15/2015	11509.32	14163.06	2111.582	4765.323	20753.11	24613.86	2111.907	5972.658	1802.073	2066.625	113.4826	378.0349	636.5663	731.7553	41.24178	136.4307	7259.019	8631.04	742.5232	2114.545
11/16/2015	11506.99	14564.57	5270.344	8327.924	18532.07	23637.71	7884.831	12990.47	1636.727	2004.264	442.4127	809.9493	598.7016	730.4303	157.4421	289.1709	6481.694	8278.333	2891.222	4687.861
11/17/2015	10373.99	14459.7	10275.27	14360.98	17829.33	24194.11	13519.01	19883.8	1556.05	2028.674	802.7377	1275.361	593.7043	768.6542	269.7687	444.7186	6277.187	8474.364	5019.127	7216.304
11/18/2015	9959.009	13922.04	9690.53	13653.56	17711.23	23929.43	12488.58	18706.77	1536.756	1997.35	746.6264	1207.22	580.0984	748.6385	255.0434	423.5834	6264.81	8418.67	4645.806	6799.666
11/19/2015	9586.864	13475.74	10049.14	13938.02	17214.05	23363.66	12974.3	19123.91	1539.285	2008.601	763.9678	1233.283	568.1299	732.6863	260.6913	425.2476	6045.756	8174.288	4798.86	6927.392
11/20/2015	9122.513	12933.89	9844.465	13655.84	16601.58	22732.42	12606.02	18736.86	1474.999	1937.223	744.6846	1206.909	539.4991	704.775	251.3985	416.6745	5774.524	7893.772	4663.434	6782.681
11/21/2015	9110.028	13225.04	9741.53	13856.54	16875.78	23784.5	12082.9	18991.62	1477.341	1998.876	705.4899	1227.025	553.0364	731.6772	242.0649	420.7057	5907.756	8320.79	4455.43	6868.464
11/22/2015	9543.558	13764.87	9487.182	13708.5	17497.97	24577.92	11711.97	18791.92	1536.276	2063.248	683.5094	1210.481	562.7584	740.465	239.6384	417.345	6060.884	8509.89	4340.553	6789.559
11/23/2015	9363.134	13212.66	9433.528	13283.05	16916.11	23101.4	12002.26	18187.54	1498.38	1973.507	704.0932	1179.22	544.9737	704.5609	244.679	404.2662	5811.738	7931.023	4451.65	6570.935
11/24/2015	9388.198	13183.96	9513.716	13309.48	17008.4	23123.81	12088.22	18203.63	1493.641	1965.255	711.7919	1183.406	556.7283	719.5108	239.9936	402.7761	5814.97	7905.791	4491.114	6581.935
11/25/2015	10215.44	13562.41	5450.75	8797.72	18897.95	24023.64	6067.341	11193.03	1660.526	2018	337.322	694.7961	603.2388	726.9993	94.59191	218.3524	6423.032	8193.701	2188.815	3959.483
11/26/2015	10658.79	15131.83	6884.396	11357.44	19753.8	27150.94	7986.68	15383.82	1705.734	2228.166	456.1524	978.5843	655.4073	837.3079	135.9013	317.8019	6828.067	9376.437	2938.416	5486.785
11/27/2015	11039.07	15126.96	8580.072	12667.96	18908.4	25686.42	11584.95	18362.96	1668.014	2171.177	690.6458	1193.809	623.0672	800.6405	228.2621	405.8353	6718.113	9068.585	4289.559	6640.031
11/28/2015	11371.5	15755.45	9065.641	13449.6	20014.14	27136.97	11346.79	18469.61	1760.719	2290.241	675.6768	1205.199	657.5669	840.1547	224.172	406.7597	7202.596	9707.712	4162.354	6667.47
11/29/2015	12446.18	16711.62	7024.561	11290	21938.61	29045.47	9282.163	16389.02	1931.237	2451.345	544.2886	1064.397	703.5934	883.5427	187.8116	367.7609	7785.994	10278.86	3403.633	5896.501
11/30/2015	12530.3	16788.71	9221.529	13479.93	21919.59	28490.32	11910.95	18481.68	1893.656	2387.868	710.3538	1204.566	715.7404	889.3343	230.5826	404.1766	7746.553	10030.94	4384.711	6669.1
12/1/2015	12590.61	16809.26	9296.688	13515.34	22108.5	28625.66	11828.71	18345.87	1839.14	2315.183	663.526	1139.57	717.1396	892.2031	221.0035	396.067	7839.631	10096.44	4339.562	6596.366
12/2/2015	12055.22	16165.58	9088.87	13199.24	21352.35	27760.96	11640.85	18049.47	1777.567	2234.66	657.1398	1114.232	678.0753	845.9968	219.1733	387.0948	7502.058	9725.806	4256.555	6480.302
12/3/2015	11578	15546.55	8869.548	12838.09	20463.91	26690.89	11459.7	17686.67	1720.057	2171.819	648.7306	1100.493	645.6706	808.3218	218.0693	380.7205	7166.966	9298.819	4216.191	6348.044
12/4/2015	11535.07	15171.35	5781.145	9417.43	20117.67	25804.27	7667.187	13353.79	1676.682	2079.589	432.0344	834.9416	638.9518	785.2016	145.2903	291.5401	7063.855	9038.062	2805.479	4779.686
12/5/2015	11170.85	15391.86	8784.371	13005.38	20357.29	27276.01	10764.8	17683.52	1702.316	2192.942	605.0694	1095.695	647.9137	824.54	201.5584	378.1848	7234.778	9660.931	3915.538	6341.691
12/6/2015	11764.55	15810.51	6279.195	10325.15	21401.69	27954.23	7956.577	14509.11	1773.421	2233.445	451.1132	911.1365	666.8748	831.7494	152.9983	317.8729	7526.473	9802.583	2925.389	5201.499
12/7/2015	10988.12	14760.87	8164.43	11937.18	19503.74	25438.33	10423.47	16358.06	1658.901	2090.238	591.0556	1022.392	617.8759	769.1458	204.4763	355.7463	6757.061	8792.103	3840.776	5875.818
12/8/2015	10870.13	14610.2	8386.971	12127.04	19679.84	25575.63	10625.77	16521.56	1680.066	2114.013	598.9776	1032.924	628.2967	780.9647	201.3026	353.9706	6849.163	8885.477	3899.511	5935.825
12/9/2015	10996.84	14430.08	5040.22	8473.455	19958.5	25347.11	6414.461	11803.07	1721.686	2114.566	357.0581	749.938	637.6735	777.7133	123.5413	263.581	6967.685	8846.061	2372.831	4251.207
12/10/2015	10562.33	14221.65	7903.792	11563.12	19659.4	25479.31	9909.782	15729.69	1709.792	2132.269	566.0896	988.5668	633.1519	790.2396	183.145	340.2327	6876.55	8893.92	3635.863	5653.234
12/11/2015	12023.33	14386.51	1823.338	4186.519	22199.58	25638.77	2083.664	5522.853	1909.041	2140.219	108.7864	339.964	719.0346	799.7437	35.68732	116.3964	7729.426	8949.926	745.5941	1966.094
12/12/2015	13004.34	16369.89	5183.551	8549.096	22507.65	28283.57	6858.265	12634.19	1950.588	2347.282	365.5951	762.2884	718.35	854.0107	112.9625	248.6233	7943.837	9982.953	2489.55	4528.667
12/13/2015	13191.17	17713.9	8175.453	12698.18	23786.48	31320.25	10330.96	17864.72	2047.955	2591.25	581.6885	1124.984	751.3229	943.7295	193.8974	386.304	8479.064	11131.37	3788.371	6440.682
12/14/2015	15316.87	18241.59	4765.795	7690.514	25961.55	30879.44	6825.724	11743.61	2218.85	2554.932	382.2562	718.3372	804.8525	925.5397	117.5286	238.2157	9085.818	10816.74	2484.037	4214.959
12/15/2015	15160.21	19250.8	8183.835	12274.43	26205.15	33058.33	11247.91	18101.1	2235.63	2738.33	641.5933	1144.293	825.3053	1010.232	204.7154	389.642	9265.793	11689	4102.598	6525.807
12/16/2015	15291.96	19641.01	8439.468	12788.52	27000.71	34016.14	11098.07	18113.5	2299.788	2814.611	631.9474	1146.77	852.937	1042.86	200.324	390.2467	9508.978	11973.5	4048.839	6513.359
12/17/2015	15034.9	19519.11	8400.21	12884.42	27142.25	34321.25	10894.95	18073.96	2323.543	2856.536	614.1023	1147.096	860.7948	1047.135	202.6223	388.9623	9576.203	12063.02	3991.466	6478.284
12/18/2015	13644.8	17875.14	8496.91	12727.25	24815.42	31687.06	10813.5	17685.13	2127.453	2622.241	629.5838	1124.372	779.234	958.72	200.15	379.636	8688.968	11059.3	3954.617	6324.949
12/19/2015	14162.09	17744.97	3148.258	6731.136	25934.8	31452.26	3463.873	8981.334	2181.646	2562.9	186.2378	567.4918	816.1916	949.6813	59.03127	192.5209	9155.362	11098.53	1241.231	3184.403
12/20/2015	13176.44	17126.69	7082.477	11032.72	23854.08	30628.61	9186.358	15960.89	2059.327	2552.195	525.1736	1018.042	743.9103	917.4355	168.1567	341.6818	8405.413	10750.81	3355.124	5700.521
12/21/2015	13535.06	17471.82	5505.404	9442.162	24043.83	30349.96	6957.658	13263.79	2089.011	2556.097	380.5289	847.6146	753.9414	913.6677	118.9993	278.7256	8450.161	10636.69	2518.898	4705.423
12/22/2015	16406.86	18221.12	674.3085	2488.574	29153.94	31903.57	680.2811	3429.913	2499.89	2686.392	34.85805	221.3596	892.2687	960.4928	14.61208	82.83618	10041.5	11016.62	245.8013	1220.919
12/23/2015	13533.18	16432.33	2913.311	5812.466	24402.12	29055.26	3794.488	8447.626	2131.747	2460.648	215.2884	544.1886	757.6934	873.1674	70.08783	185.5619	8438.174	10041.94	1346.24	2950.003
12/24/2015	13320.5	16949.05	4492.993	8121.542	24425.06	30335.67	5610.743	11521.35	2128.307	2554.812	319.0981	745.6035	745.5388	892.9231	101.5109	248.8952	8405.954	10450.46	2017.389	4061.89
12/25/2015	13487.58	17974.25	6630.18	11116.85	24868.43	32447.18	7812.366	15391.12	2226.336	2787.536	433.6905	994.8905	769.991	956.003	137.2735	323.2855	8582.766	11182.33	2857.503	5457.067
12/26/2015	15209.17	20194.1	8427.652	13412.58	26931.52	35091.99	10661.11	18821.58	2349.357	2952.287	629.182	1232.112	826.7726	1036.4	185.8764	395.5039	9528.344	12407.44	3833.315	6712.414
12/27/2015	14608.9	19438.44	8516.913	13346.45	26165.19	34020.29	10610.87	18465.97	2294.034	2879.438	620.5801	1205.984	807.8339	1002.849	196.2339	391.2493	9237.126	11988.63	3824.458	6575.963
12/28/2015	14907.29	19391.75	7467.349	11951.81	26733.36	33797.42	9139.853	16203.91	2342.541	2870.764	531.9251	1060.148	852.5024	1035.845	160.1624	343.5051	9404.633	11842.5	3325.049	5762.918
12/29/2015	14844.72	19138.69	7965.152	12259.12	26304.45	33172.84	10301.73	17170.11	2313.497	2818.69	605.0519	1110.246	824.8768	1002.058	179.6221	356.8038	9264.463	11640.85	3727.55	6103.94
12/30/2015	15188.47	19836.11	8603.811	13251.46	27122.84	34555.95	10881.48	18314.59	2408.755	2959.326	654.4256	1204.997	848.6912	1042.505	199.3678	393.182	9553.274	12105.12	3965.234	6517.077
12/31/2015	15097.01	19832.93	8242.572	12978.49	27155.22	34700.31	10173.66	17718.74	2407.486	2970.001	607.2853	1169.801	851.1999	1045.103	183.5266	377.4296	9597.722	12207.94	3691.607	6301.825

	Peak Retail Load Rank	Retail Load (MWH)	Res Solar Production (MWH)
5443	1	6,557	84.0
5419	2	6,514	82.5
5444	3	6,509	45.3
5442	4	6,487	117.0
5418	5	6,476	116.9
5468	6	6,465	50.4
5420	7	6,433	42.2
5467	8	6,432	89.1
5395	9	6,348	88.7
5441	10	6,334	138.1
5417	11	6,317	139.2
5466	12	6,309	120.6
5396	13	6,305	47.0
5445	14	6,301	12.2
5469	15	6,298	13.1
5394	16	6,253	123.6
5203	17	6,231	95.4
4051	18	6,223	90.7
5491	19	6,222	88.3
5204	20	6,210	54.5
5492	21	6,185	46.5
4052	22	6,166	49.4
5421	23	6,166	9.2
4050	24	6,144	124.5
4315	25	6,133	82.5
5490	26	6,118	124.0
5465	27	6,112	144.4
5202	28	6,110	129.0
5470	29	6,097	0.2
5179	30	6,097	95.9
5440	31	6,096	151.6
5393	32	6,083	146.4
5397	33	6,075	12.9
5416	34	6,074	152.6

Top	Average System Demand (MWH)	Average Coincident Residential Solar Production (MWH)	Min Solar Production (MWH)	Max Solar Production (MWH)	Hours with Solar Production < 5 MW
4 Hours	6,517	82.2	45.3	117.0	0
20 Hours	6,361	81.9	12.2	139.2	0
50 Hours	6,175	81.8	0.2	152.6	2
100 Hours	6,024	79.6	0.0	157.6	7

4314	35	6,070	115.7
4027	36	6,067	91.6
5180	37	6,060	54.0
4028	38	6,038	51.2
5205	39	6,026	18.6
5178	40	6,014	130.0
4316	41	6,009	43.5
5779	42	6,007	75.1
4195	43	6,002	89.3
5446	44	6,000	0.2
5493	45	5,982	11.7
5155	46	5,981	93.7
4196	47	5,977	51.4
4026	48	5,962	124.0
4219	49	5,960	83.9
4049	50	5,956	146.9
5563	51	5,953	84.7
5778	52	5,948	112.2
5156	53	5,944	53.5
4053	54	5,938	17.6
5422	55	5,935	0.2
5780	56	5,934	33.4
5755	57	5,931	80.0
4220	58	5,931	50.3
5489	59	5,920	148.3
5201	60	5,910	152.1
4172	61	5,909	53.1
4194	62	5,908	121.7
5659	63	5,904	65.7
5154	64	5,899	124.7
4171	65	5,899	87.5
4313	66	5,898	138.0
5658	67	5,888	109.0
5564	68	5,884	43.7
5562	69	5,877	119.8
5392	70	5,874	157.3
5587	71	5,871	84.5
5181	72	5,868	17.3

4218	73	5,865	114.4
5754	74	5,863	117.0
5756	75	5,858	40.2
4243	76	5,852	88.6
4291	77	5,850	82.7
5464	78	5,849	157.6
5398	79	5,846	0.2
4029	80	5,844	19.8
5803	81	5,844	74.9
5777	82	5,843	135.4
4244	83	5,838	51.4
5471	84	5,838	0.0
4292	85	5,836	48.5
4075	86	5,835	96.5
5371	87	5,834	80.8
4003	88	5,831	92.7
5494	89	5,830	0.1
5206	90	5,829	1.0
5177	91	5,829	152.7
5515	92	5,827	89.6
5586	93	5,820	120.2
4675	94	5,816	89.2
3979	95	5,816	90.1
4387	96	5,813	92.4
4004	97	5,812	53.8
5804	98	5,810	35.7
5372	99	5,809	45.0
5516	100	5,808	47.0

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-17: RUCO 4.19_Total Hourly Retail Load 2016_APSRC0168.xlsx

Arizona Public Service Company
2016 Total Hourly Retail Load
Through September 30, 2016

DT	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24
01/01/16	3387.741	3366.789	3357.941	3381.015	3441.016	3562.22	3712.763	3785.464	3650.933	3431.401	3275.887	3136.599	3000.695	2884.51	2797.314	2773.277	2881.936	3224.993	3481.748	3485.138	3473.638	3435.102	3317.163	3170.405
01/02/16	3074.225	3026.429	2996.087	3014.114	3080.286	3224.582	3435.293	3573.394	3490.849	3333.849	3206.527	3090.922	2985.493	2884.349	2831.045	2822.509	2907.127	3222.433	3459.237	3443.79	3424.793	3366.048	3239.02	3094.785
01/03/16	3005.046	2946.393	2910.896	2894.68	2924.164	3021.206	3177.499	3285.058	3231.529	3096.349	3020.637	2949.702	2898.367	2848.361	2833.74	2854.46	2978.719	3285.894	3508.549	3479.962	3408.229	3276.669	3061.281	2862.116
01/04/16	2779.118	2718.132	2682.572	2715.773	2820.31	3092.305	3461.939	3591.668	3492.972	3442.115	3428.377	3422.583	3402.084	3356.672	3307.038	3312.629	3414.733	3671.671	3841.617	3809.825	3727.431	3586.197	3344.425	3111.488
01/05/16	2988.012	2918.18	2870.101	2882.752	2978.899	3250.384	3609.506	3723.216	3628.997	3518.893	3434.949	3389.72	3335.991	3291.197	3286.885	3322.452	3426.961	3661.51	3794.171	3769.325	3677.171	3531.756	3303.366	3063.347
01/06/16	2935.059	2859.163	2836.649	2869.65	2991.027	3256.098	3625.926	3784.717	3633.627	3453.097	3362.415	3293.052	3234.182	3209.464	3162.103	3142.927	3226.242	3533.459	3768.313	3777.49	3729.525	3614.891	3383.604	3164.405
01/07/16	3049.039	2973.457	2926.462	2928.695	3056.828	3319.219	3686.121	3809.583	3756.312	3736.482	3717.311	3643.107	3544.623	3384.803	3312.92	3367.716	3513.45	3778.495	3972.029	3971.006	3892.672	3770.344	3526.964	3297.911
01/08/16	3186.584	3118.394	3093.263	3125.199	3259.269	3531.04	3923.811	4068.102	3944.739	3821.356	3686.516	3510.785	3346.336	3299.145	3211.274	3187.202	3326.155	3604.178	3796.951	3773.704	3717.776	3635.046	3490.491	3320.2
01/09/16	3227.479	3191.806	3182.027	3220.518	3305.634	3469.553	3683.293	3845.504	3796.971	3589.071	3418.468	3253.429	3120.561	3017.836	2939.063	2923.883	3007.24	3334.81	3618.042	3624.11	3619.293	3553.856	3438.89	3293.189
01/10/16	3210.837	3159.715	3138.415	3150.312	3185.436	3280.188	3428.798	3568.341	3571.629	3563.338	3510.994	3360.366	3210.558	3127.52	3063.237	3098.167	3242.48	3521.17	3738.245	3714.812	3663.399	3562.769	3353.104	3183.144
01/11/16	3155.301	3134.983	3157.495	3232.036	3413.113	3751.944	4205.306	4378.66	4124.894	3798.16	3578.249	3403.028	3238.389	3117.668	3041.075	3019.344	3117.477	3476.74	3806.081	3855.409	3851.927	3363.484	2904.566	2725.551
01/12/16	3290.739	3263.767	3311.505	3387.26	3558.322	3900.257	4376.648	4535.025	4253.027	3879.303	3625.528	3427.865	3246.113	3123.996	3039.215	3027.771	3109.901	3442.765	3774.248	3833.17	3840.527	3749.467	3541.307	3355.711
01/13/16	3298.094	3268.62	3286.497	3365.053	3522.026	3873.883	4322.667	4469.196	4165.799	3789.472	3532.172	3326.201	3174.168	3071.973	2997.62	2967.549	3065.996	3375.136	3705.485	3747.742	3756.63	3695.349	3519.795	3318.554
01/14/16	3274.388	3221.264	3226.869	3305.294	3484.967	3832.801	4293.746	4451.963	4173.001	3797.764	3519.503	3326.577	3180.679	3071.209	2996.728	3007.751	3099.045	3376.467	3711.844	3771.242	3748.662	3677.9	3483.481	3294.632
01/15/16	3224.026	3182.299	3170.659	3209.436	3336.013	3638.151	4046.864	4204.516	4058.843	3847.719	3712.454	3534.711	3311.89	3270.088	3254.864	3205.464	3202.319	3477.265	3750.543	3770.769	3741.186	3674.568	3533.272	3343.398
01/16/16	3255.217	3203.44	3206.769	3248.021	3335.91	3522.409	3757.052	3937.156	3852.583	3615.235	3414.577	3245.014	3104.496	2978.01	2953.104	3004.73	3138.933	3365.498	3558.792	3506.407	3461.2	3383.996	3299.799	3138.918
01/17/16	3053.774	3021.813	3015.968	3051.895	3120.505	3266.546	3472.711	3644.864	3568.841	3344.639	3175.662	3028.176	2917.426	2811.658	2755.807	2734.962	2813.105	3071.812	3398.271	3388.169	3357.816	3296.293	3158.235	3022.328
01/18/16	2957.341	2932.798	2939.587	3001.57	3133.169	3390.21	3693.778	3846.302	3795.414	3652.146	3527.983	3367.36	3233.951	3108.503	3056.469	3037.8	3131.933	3390.809	3666.469	3697.666	3652.425	3559.497	3332.321	3133.05
01/19/16	3049.433	3012.396	3032.111	3093.278	3246.309	3579.608	4024.77	4167.872	3901.696	3569.823	3351.967	3199.934	3087.552	3011.119	2981.291	2991.735	3082.363	3379.906	3644.838	3650.158	3571.995	3457.485	3236.486	3016.259
01/20/16	2916.092	2863.035	2853.486	2903.891	3046.459	3360.204	3807.979	3957.395	3706.345	3425.959	3254.916	3126.076	3035.765	2971.684	2931.009	2917.176	2994.75	3240.758	3547.144	3569.049	3521.783	3419.381	3214.911	3021.314
01/21/16	2914.019	2861.947	2859.197	2913.899	3048.015	3362.198	3794.552	3938.844	3700.602	3435.328	3273.337	3128.538	3031.333	2965.892	2926.188	2953.089	3032.818	3258.67	3579.919	3606.104	3586.116	3493.643	3283.664	3108.039
01/22/16	3013.772	2969.357	2966.132	3003.771	3102.504	3364.068	3813.94	3986.286	3728.392	3471.309	3284.185	3150.909	3040.603	2951.758	2905.274	2902.647	2964.077	3222.526	3439.905	3423.169	3375.488	3295.371	3144.603	2981.388
01/23/16	2891.643	2842.932	2820.515	2838.057	2901.826	3036.739	3256.116	3429.555	3427.568	3315.22	3157.338	3023.162	2915.903	2848.771	2805.014	2808.189	2878.365	3119.926	3338.806	3312.54	3257.287	3183.531	3061.541	2903.915
01/24/16	2819.91	2778.498	2776.459	2802.608	2858.585	2982.474	3185.878	3349.625	3299.599	3147.448	3033.354	2949.76	2889.402	2830.209	2788.883	2766.479	2810.294	3051.387	3363.623	3399.846	3409.23	3301.629	3115.398	2938.285
01/25/16	2883.481	2860.578	2863.026	2918.257	3077.294	3421.553	3880.793	4044.978	3848.319	3553.508	3353.699	3222.784	3108.982	3021.003	2963.082	2944.682	3012.534	3285.455	3623.609	3660.946	3619.098	3513.225	3296.411	3095.813
01/26/16	2989.504	2940.072	2935.993	2985.953	3138.929	3463.909	3909.708	4053.725	3785.221	3493.338	3318.046	3155.278	3053.917	2998.16	2949.846	2934.577	2985.211	3250.558	3611.631	3667.466	3643.119	3540.381	3319.956	3115.244
01/27/16	3036.343	2988.343	2992.653	3051.656	3193.174	3493.489	3932.573	4086.169	3807.504	3479.168	3284.215	3161.92	3071.705	2994.805	2944.488	2929.799	2984.316	3266.287	3594.895	3619.859	3598.15	3507.182	3307.544	3126.237
01/28/16	3043.356	3008.251	3013.075	3069.787	3204.253	3511.262	3930.012	4050.768	3802.495	3520.578	3312.025	3139.677	3024.243	2953.393	2904.106	2889.158	2965.357	3169.385	3490.637	3534.65	3511.947	3417.521	3216.754	3020.32
01/29/16	2946.592	2908.945	2907.876	2969.907	3119.91	3460.614	3888.439	4026.508	3767.767	3456.951	3268.167	3129.475	3043.324	2974.85	2927.184	2912.145	2948.951	3126.94	3406.86	3425.98	3393.736	3325.613	3195.355	3018.672
01/30/16	2911.79	2871.093	2863.86	2886.37	2961.373	3106.827	3324.108	3487.012	3405.918	3240.591	3119.131	3010.115	2926.429	2856.644	2821.011	2792.958	2837.804	3033.553	3292.576	3296.508	3267.81	3177.777	3045.674	2853.862
01/31/16	2760.005	2697.972	2675.076	2684.147	2728.517	2844.291	3030.687	3162.169	3094.228	2978.654	2918.106	2861.648	2818.062	2800.501	2833.71	2845.551	2917.076	3130.199	3395.083	3394.452	3305.329	3185.801	3113.905	2778.713
02/01/16	2688.322	2668.021	2696.571	2770.757	2916.613	3244.46	3693.455	3867.473	3773.789	3727.075	3696.764	3580.548	3537.286	3524.335	3532.45	3533.311	3615.921	3827.295	4061.516	4085.234	4020.814	3894.901	3656.822	3455.916
02/02/16	3383.2	3355.642	3357.635	3426.966	3580.04	3915.135	4352.616	4485.64	4185.225	3876.723	3659.604	3486.465	3352.309	3221.592	3123.214	3093.768	3177.104	3485.66	3916.061	4035.406	4036.58	3961.073	3759.831	3568.102
02/03/16	3510.305	3493.604	3519.176	3598.03	3758.673	4071.138	4513.942	4633.773	4294.468	3925.825	3681.645	3465.361	3305.163	3180.148	3120.076	3090.388	3143.737	3416.084	3839.821	3976.034	3971.366	3905.477	3708.245	3528.457
02/04/16	3398.814	3429.089	3463.309	3525.639	3663.491	4002.841	4450.286	4555.166	4216.361	3865.339	3642.992	3414.821	3236.514	3133.901	3047.211	3017.232	3060.881	3292.297	3678.769	3805.012	3809.095	3747.429	3546.39	3323.525
02/05/16	3231.665	3197.471	3211.157	3251.216	3373.777	3660.809	4094.887	4201.935	3909.318	3592.865	3413.841	3248.509	3111.029	3023.742	2955.546	2930.369	2965.087	3160.448	3458.565	3526.768	3512.491	3422.704	3283.118	3106.548
02/06/16	3012.185	2969.319	2958.679	2987.262	3060.5	3221.166	3458.639	3598.109	3488.769	3303.373	3168.651	3034.6	2918.238	2833.294	2780.923	2764.696	2799.318	2977.454	3282.329	3341.824	3310.706	3247.55	3095.514	2934.641
02/07/16	2904.02	2857.718	2849.775	2865.207	2924.354	3045.724	3253.022	3373.765	3289.908	3144.674	3041.499	2957.643	2905.586	2866.613	2852.356	2835.366	2822.55	2921.147	3166.813	3214.025	3207.896	3230.767	3003.302	2802.615
02/08/16	2693.696	2627.513	2631.212	2687.085	2806.84	3071.602	3498.069	3616.132	3402.001	3227.282	3159.082	3105.764	3073.751	3046.493	3011.162	3008.83	3054.425	3222.212	3478.255	3532.741	3444.511	3312.966	3078.23	2839.713
02/09/16	2716.781	2640.656	2612.986	2644.79	2747.868	2996.617	3372.516	3466.152	3273.451	3134.63	3093.741	3056.246	3036.465	3041.165	3047.612	3066.052	3149.641	3307.005	3534.536	3568.95	3504.249	3370.91	3121.219	2869.23
02/10/16	2737.666	2666.029	2644.985	2671.834	2777.051	3022.347	3406.893	3494.965	3277.628	3139.67	3077.648	3089.613	3082.413	3086.023	3082.753	3124.338	3156.386	3295.877	3526.112	3560.41	3488.543	3364.585	3106.612	2911.359
02/11/16	2773.545	2695.329	2664.772	2689.037	2787.753	3037.691	3425.788	3513.247	3313.753	3159.159	3082.929	3027.886	3039.414	3045.077	3076.79	3096.376	3147.703	3288.403	3499.316	3534.136	3457.759	3332.773	3102.41	2866.358
02/12/16	2749.408	2663.918	2638.689	2663.439	2747.614	2979.857	3329.443	3438.655	3269.132	3145.398	3086.49	3060.71	3039.935	3034.474	3051.829	3046.058	3082.919	3205.152	3378.171	3387.31	3320.74	3224.524	3048.911	2843.886
02/13/16	2727.957	2646.733	2598.503	2574.247	2604.489	2691.402	2863.716	2963.895	2923.286	2878.209	2872.1	2871.246	2859.344	2852.809	2859.725	2892.032	2952.67	3087.285	3292.445	3294.539	3218.898	3117.362	2965.643	2781.723
02/14/16	2656.011	2588.218	2546.249	2542.682	2570.529	2627.758	2789.017	2870.286	2837.125	2819.661	2799.633	2783.924	2774.729	2770.17	2773.271	2809.912	2894.812	3011.365	3246.121	3283.89	3207.038	3091.503	2886.702	2708.547
02/15/16	2605.622	2528.952	2498.461	2520.609	2613.964	2789.555	3057.351	3150.4	3083.102	3031.445	3027.179	3028.08	3035.139	3035.009	3040.141	3074.815	3130.132	3270.368	3488.686	3540.972	3457.04	3313.252	3063.371	2822.891
02/16/16	2687.987	2606.986	2557.263	2573.007	2662.758	2890.053	3231.699	3315.408	3173.057	3074.539	3072.389	3069.939	3077.678	3116.627	3140.787	3180.053	3239.329	3363.335	3542.781	3592.059	3526.033	3387.806	3126.751	2887.843
02/17/16	2746.541	2658.054	2616.626	2636.892	2715.894	2932.527	3288.072	3360.866	3191.321	3065.353	3062.542	3070.616	3118.462	3173.034	3213.277	3266.056	3314.731	3448.402	3623.266	3672.183	3569.748	3411.875	3171.467	2910.531
02/18/16	2761.161	2648.619	2602.3	2619.584	2697.562	2913.929	3258.222	3313.673	3234.627	3217.404	3176.031	3137.431	3093.023	3097.521	3096.289	3115.879	3159.637	3249.592	3484.81	3547.743	3462.966	3325.227	3097.584	2857.548

Arizona Public Service Company
2016 Total Hourly Retail Load
Through September 30, 2016

DT	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24
02/19/16	2716.303	2631.734	2579.759	2601.258	2668.34	2881.763	3220.777	3300.626	3238.267	3193.304	3128.732	3083.437	3059.688	3055.199	3048.213	3048.415	3064.421	3177.261	3345.227	3391.871	3279.49	3163.913	3004.138	2795.372
02/20/16	2661.151	2614.03	2575.026	2564.35	2592.854	2693.104	2862.328	2929.958	2902.831	2885.285	2879.071	2875.582	2877.167	2882.936	2905.093	2937.431	3015.094	3141.36	3321.341	3345.687	3249.462	3130.994	2976.068	2789.107
02/21/16	2651.877	2560.25	2515.961	2508.841	2533.389	2600.64	2731.21	2780.425	2766.402	2755.767	2778.547	2790.408	2805.204	2821.163	2855.698	2912.032	2995.317	3137.093	3339.535	3407.547	3316.282	3160.411	2936.233	2720.094
02/22/16	2584.964	2504.6	2474.511	2527.318	2636.169	2871.765	3253.274	3328.02	3175.946	3093.961	3076.916	3047.209	3045.61	3071.133	3089.606	3114.099	3145.172	3271.76	3492.111	3574.1	3486.197	3332.264	3097.978	2869.661
02/23/16	2743.631	2662.818	2620.262	2638.503	2724.019	2952.927	3293.598	3342.132	3180.13	3064.919	3047.63	3020.482	2988.856	2973.371	2966.557	2963.484	3007.656	3157.487	3399.098	3487.644	3417.836	3282.281	3045.424	2829.525
02/24/16	2712.085	2642.347	2617.697	2642.594	2730.441	2963.422	3333.623	3365.547	3187.102	3086.917	3047.228	3008.712	2962.098	2941.395	2942.566	2967.494	2992.477	3126.101	3376.897	3478.178	3409.443	3278.956	3054.946	2841.37
02/25/16	2721.028	2648.095	2637.819	2677.039	2780.04	3034.831	3394.716	3424.278	3224.489	3100.271	3055.336	2994.509	3001.025	3002.077	3039.413	3077.989	3132.842	3218.387	3421.311	3504.237	3428.068	3299.322	3064.751	2838.998
02/26/16	2705.664	2625.969	2617.308	2628.228	2720.609	2939.829	3277.93	3338.625	3183.677	3106.743	3094.305	3067.131	3064.319	3093.858	3123.552	3167.969	3218.69	3316.088	3456.883	3477.144	3360.056	3229.472	3032.129	2817.505
02/27/16	2675.24	2617.821	2584.199	2574.094	2596.638	2678.978	2835.438	2884.108	2879.351	2881.365	2912.043	2902.166	2881.098	2886.849	2920.109	2971.119	3032.124	3155.941	3304.569	3352.438	3280.705	3153.808	2992.643	2790.277
02/28/16	2662.37	2570.39	2523.853	2508.19	2522.753	2586.72	2710.997	2726.89	2722.926	2752.299	2780.129	2797.083	2821.62	2857.931	2905.541	2970.659	3060.095	3183.682	3388.319	3445.871	3354.854	3192.445	2949.243	2729.699
02/29/16	2598.767	2501.552	2465.575	2496.161	2597.926	2830.763	3178.078	3210.264	3093.862	3041.854	3059.412	3067.953	3088.475	3133.071	3185.375	3241.536	3294.762	3411.817	3588.578	3654.33	3537.652	3399.434	3155.186	2896.667
03/01/16	2731.014	2634.865	2586.63	2580.428	2670.056	2886.374	3209.77	3228.856	3114.437	3079.489	3085.797	3093.921	3122.239	3178.282	3226.874	3282.204	3343.466	3440.667	3603.167	3686.403	3568.788	3406.361	3133.899	2882.719
03/02/16	2749.048	2654.083	2593.952	2576.5	2637.294	2846.582	3159.829	3176.597	3074.482	3045.982	3053.84	3069.299	3131.888	3187.901	3234.325	3282.006	3340.176	3439.554	3599.198	3683.177	3564.879	3398.909	3138.363	2866.629
03/03/16	2719.826	2611.43	2570.464	2574.047	2650.282	2860.498	3172.433	3199.183	3105.364	3059.384	3089.115	3129.713	3146.336	3221.255	3301.846	3370.007	3438.728	3523.312	3614.581	3678.024	3566.308	3398.948	3172.824	2915.401
03/04/16	2765.961	2671.92	2611.981	2608.633	2683.052	2885.884	3200.692	3224.563	3128.603	3069.821	3101.635	3127.558	3166.734	3215.374	3267.257	3323.372	3357.105	3455.996	3601.537	3656.289	3551.469	3389.209	3137.771	2884.53
03/05/16	2702.949	2613.553	2555.566	2552.867	2632.983	2818.938	3099.403	3084.284	2977.042	2948.858	2969.61	2996.279	3022.265	3076.42	3118.964	3194.275	3274.886	3316.197	3435.899	3493.371	3401.476	3265.033	3046.37	2814.537
03/06/16	2663.355	2589.248	2560.169	2536.504	2525.662	2581.276	2706.404	2734.428	2806.963	2835.846	2854.652	2858.272	2874.451	2879.324	2884.783	2911.606	2952.488	3042.682	3218.999	3306.215	3252.456	3147.19	2986.555	2816.195
03/07/16	2679.157	2581.024	2533.266	2520.316	2548.979	2638.636	2805.055	2843.008	2854.84	2909.396	2957.057	2972.765	3005.62	2998.873	3007.213	3029.955	3073.381	3167.028	3345.314	3470.565	3379.179	3229.296	3011.124	2795.327
03/08/16	2656.576	2577.063	2545.043	2582.545	2662.873	2871.632	3180.389	3204.798	3116.878	3064.235	3042.579	3023.32	2996	2984.22	2960.025	2951.654	2973.995	3109.617	3362.938	3489.146	3424.998	3285.987	3057.565	2842.611
03/09/16	2716.977	2644.045	2607.122	2618.517	2701.8	2944.246	3255.116	3269.9	3116.368	3038.103	3007.52	2989.527	2964.292	2951.592	2927.219	2940.485	2975.484	3080.062	3299.196	3452.089	3384.989	3260.264	3035.842	2817.692
03/10/16	2701.636	2629.047	2605.647	2629.911	2746.767	2978.542	3295.665	3297.596	3143.904	3067.629	3051.611	3036.578	3037.6	3074.013	3089.716	3121.948	3165.588	3261.266	3437.638	3562.581	3484.052	3330.48	3102.906	2880.399
03/11/16	2750.684	2667.701	2618.319	2629.354	2705.634	2908.213	3198.149	3205.9	3124.234	3102.878	3112.962	3111.572	3137.414	3180.794	3199.553	3248.369	3317.611	3383.948	3516.594	3587.195	3489.242	3351.967	3091.945	2846.704
03/12/16	2693.011	2604.085	2548.308	2544.445	2611.65	2776.474	3004.106	2985.017	2920.856	2895.687	2898.68	2896.339	2897.504	2917.272	2943.641	2968.374	3007.601	3078.75	3225.006	3346.538	3283.498	3177.786	3003.399	2774.688
03/13/16	2624.885	2563.202	2503.489	2466.274	2474.915	2548.719	2672.164	2683.932	2741.095	2775.439	2807.296	2798.617	2775.732	2748.653	2731.316	2744.451	2795.696	2887.114	3069.405	3202.697	3144.653	3059.779	2947.928	2789.735
03/14/16	2681.795	2606.244	2574.334	2578.379	2624.031	2733.069	2905.86	2923.529	2951.309	2986.131	2998.692	2960.723	2958.68	2946.167	2956.046	2984.215	3029.475	3159.584	3349.147	3475.581	3409.763	3276.419	3019.412	2783.69
03/15/16	2710.709	2625.066	2591.435	2603.558	2680.841	2875.306	3127.256	3120.099	3061.907	3048.577	3083.224	3103.528	3109.439	3140.723	3152.271	3187.6	3241.326	3335.751	3496.059	3632.061	3540.286	3394.117	3147.193	2905.782
03/16/16	2750.846	2664.944	2614.375	2617.121	2691.878	2885.581	3129.668	3123.742	3059.737	3070.779	3108.704	3137.174	3162.491	3203.257	3251.879	3300.456	3347.256	3429.765	3558.989	3659.156	3555.06	3400.603	3154.226	2909.998
03/17/16	2784.92	2689.5	2644.073	2632.598	2720.846	2883.884	3141.545	3146.21	3083.654	3108.605	3148.599	3170.722	3210.118	3268.991	3321.38	3397.39	3463.827	3538.007	3636.021	3740.455	3633.29	3461.577	3174.249	2904.411
03/18/16	2770.596	2683.656	2646.443	2614.74	2687.959	2863.707	3113.599	3109.804	3051.787	3081.025	3123.164	3156.901	3183.602	3263.653	3336.686	3414.728	3467.829	3528.117	3598.908	3683.147	3574.321	3419.458	3161.65	2917.978
03/19/16	2753.567	2655.587	2590.205	2581.904	2635.931	2769.501	2956.842	2942.603	2887.758	2899.674	2961.276	2998.789	3066.373	3129.677	3209.318	3300.088	3379.835	3452.886	3531.098	3616.782	3513.367	3342.334	3140.87	2906.651
03/20/16	2741.697	2636.159	2563.528	2537.223	2545.693	2603.053	2701.592	2709.652	2761.03	2843.133	2929.748	3008.886	3063.715	3153.07	3248.409	3352.61	3466.292	3559.409	3587.527	3630.78	3494.132	3380.509	3178.73	2967.313
03/21/16	2804.132	2695.037	2624.755	2601.396	2622.685	2705.078	2826.247	2826.259	2917.009	3023.556	3139.896	3240.456	3341.549	3447.357	3560.475	3681.501	3780.188	3859.33	3927.296	3958.02	3814.346	3618.481	3306.727	3031.939
03/22/16	2819.278	2707.14	2651.677	2642.2	2701.142	2879.601	3171.117	3168.212	3147.435	3186.417	3245.122	3319.486	3409.201	3510.398	3620.327	3709.092	3764.572	3812.298	3869.322	3962.526	3829.294	3613.421	3309.131	3032.514
03/23/16	2853.283	2739.926	2685.895	2667.244	2713.393	2880.512	3114.66	3098.449	3083.739	3137.521	3187.329	3203.715	3200.126	3225.34	3225.027	3294.663	3316.897	3343.118	3482.708	3651.815	3544.543	3384.21	3137.963	2912.506
03/24/16	2776.537	2676.598	2632.607	2632.306	2691.38	2881.552	3148.297	3121.47	3063.107	3063.579	3088.635	3090.723	3074.19	3083.493	3100.599	3137.29	3176.415	3244.827	3386.625	3564.509	3497.845	3358.16	3124.122	2882.119
03/25/16	2739.438	2671.864	2626.763	2630.9	2697.958	2899.49	3147.246	3110.932	3030.155	3014.788	3023.848	3049.482	3054.892	3083.407	3114.383	3162.332	3226.237	3295.892	3429.026	3571.912	3493.239	3345.602	3111.896	2875.447
03/26/16	2730.326	2646.298	2598.937	2592.677	2654.276	2800.609	2965.612	2929.885	2881.974	2882.339	2927.405	2946.502	2962.111	2997.848	3053.002	3132.842	3206.009	3285.005	3366.392	3484.457	3403.452	3266.884	3051.93	2854.67
03/27/16	2707.147	2605.077	2543.181	2521.838	2532.273	2594.748	2663.235	2662.823	2740.75	2814.759	2894.65	2909.696	2956.264	3003.455	3073.2	3173.984	3251.121	3316.483	3375.263	3514.643	3354.44	3255.383	3057.341	2824.993
03/28/16	2691.747	2607.624	2567.665	2558.471	2602.711	2704.914	2826.982	2829.643	2898.289	2998.184	3068.61	3108.634	3149.449	3213.249	3279.55	3307.131	3357.61	3419.955	3483.41	3607.094	3532.52	3386.264	3148.188	2922.538
03/29/16	2775.935	2681.93	2618.535	2621.483	2681.006	2879.638	3128.425	3133.604	3147.777	3158.356	3185.726	3195.78	3210.28	3206.695	3188.664	3188.532	3216.415	3279.182	3417.395	3583.655	3533.033	3400.421	3160.553	2922.893
03/30/16	2779.928	2670.034	2596.193	2589.862	2655.221	2845.039	3103.562	3128.049	3120.521	3113.279	3098.43	3050.077	3029.479	3004.715	2986.336	2976.21	3008.736	3095.851	3279.031	3499.194	3456.195	3313.244	3046.419	2837.376
03/31/16	2740.04	2702.488	2659.253	2669.877	2754.438	2964.558	3218.858	3187.599	3108.971	3048.098	3011.37	2978.498	2963.866	2957.101	2954.281	2976.269	3040.115	3136.144	3297.415	3494.015	3451.897	3322.772	3101.415	2881.699
04/01/16	2750.842	2690.59	2675.028	2692.553	2774.424	2985.203	3213.656	3240.176	3141.998	3087.552	3071.526	3051.971	3048.88	3034.388	3009.5	3003.188	3045.993	3130.171	3258.672	3463.884	3425.292	3285.321	3056.595	2829.479
04/02/16	2681.636	2604.165	2574.777	2582.152	2646.915	2810.116	2985.531	2964.102	2888.618	2860.945	2882.064	2872.992	2861.853	2876.031	2896.953	2942.965	3006.74	3072.766	3168.045	3334.132	3274.757	3170.507	3007.173	2804.443
04/03/16	2666.218	2580.384	2524.157	2508.02	2527.146	2597.672	2637.728	2657.479	2722.828	2789.543	2846.07	2882.147	2912.908	2956.554	3008.24	3082.669	3172.332	3244.952	3311.472	3437.138	3348.136	3220.016	3015.118	2789.138
04/04/16	2672.666	2586.624	2553.052	2548.572	2574.43	2655.702	2717.788	2779.011	2909.495	3013.223	3106.451	3181.524	3263.092	3354.814	3444.262	3562.063	3657.115	3760.903	3778.712	3885.893	3774.505	3574.401	3292.318	3006.136
04/05/16	2831.892	2719.999	2659.056	2652.967	2716.524	2866.772	3059.731	3093.958	3081.005	3112.32	3191.153	3273.744	3358.049	3491.372	3599.24	3719.879	3786.078	3848.153	3875.975	3968.705	3834.385	3642.561	3291.45	2957.252
04/06/16	2829.852	2709.656	2638.147	2634.716	2687.061	2861.694	3027.497	3053.595	3049.991	3097.177	3178.148	3256.722	3362.026	3506.554	3623.976	3742.857	3857.075	3911.962	3894.024	4004.864	3869.824	3663.374	3363.141	3060.635
04/07/16	2820.005	2704.499	2647.232	2641.377	2706.64	2914.399	3110.501	3178.17	3241.694	3275.666	3376.15	3468.477	3600.778	3803.991	3947.391	4119.405	4179.485	4164.561	4102.611	4168.095	3994.821	3810.778	3494.931	3169.173

Arizona Public Service Company
2016 Total Hourly Retail Load
Through September 30, 2016

DT	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24
04/08/16	2962.18	2817.637	2720.464	2706.887	2759.93	2929.895	3117.648	3198.591	3219.715	3224.76	3302.493	3367.008	3449.338	3563.182	3594.23	3596.28	3586.742	3600.349	3672.142	3818.827	3777.604	3631.313	3360.066	3071.56
04/09/16	2891.05	2767.168	2687.415	2651.226	2696.173	2833.968	2972.75	2995.732	2993.177	3026.879	3113.482	3160.361	3193.663	3241.02	3229.898	3256.311	3263.788	3274.224	3349.209	3488.968	3427.122	3303.913	3122.465	2902.484
04/10/16	2747.793	2646.464	2584.197	2553.183	2550.621	2599.959	2614.649	2685.648	2796.427	2896.162	2997.856	3017.11	3061.398	3087.967	3135.502	3175.044	3204.393	3242.766	3291.417	3422.616	3348.899	3232.382	3078.238	2881.365
04/11/16	2726.119	2615.584	2548.88	2525.705	2548.167	2633.989	2651.751	2711.366	2833.018	2937.716	3002.634	2994.274	2999.559	3014.07	2975.863	2962.063	2973.598	3051.285	3181.645	3381.143	3336.099	3205.066	3005.916	2796.565
04/12/16	2670.046	2597.413	2554.683	2566.018	2641.606	2838.548	3007.801	3015.71	2985.545	2990.309	3027.008	3042.158	3051.387	3066.495	3077.368	3113.589	3163.615	3222.333	3334.53	3557.447	3505.449	3368.182	3123.944	2876.137
04/13/16	2726.287	2642.127	2584.522	2583.935	2652.47	2846.414	3005.489	3029.991	3021.15	3048.954	3098.533	3153.98	3208.383	3260.353	3300.136	3356.665	3414.9	3489.357	3557.739	3733.532	3677.371	3519.675	3260.82	2996.945
04/14/16	2810.95	2703.765	2624.733	2619.926	2706.428	2898.073	3050.714	3070.204	3096.503	3153.872	3238.543	3292.405	3364.181	3441.105	3533.996	3616.352	3692.831	3762.429	3776.421	3906.082	3803.053	3603.389	3301.258	3021.318
04/15/16	2844.484	2732.663	2667.82	2663.754	2720.338	2894.293	3030.055	3065.28	3055.322	3108.113	3200.715	3278.36	3355.807	3451.329	3526.024	3600.617	3671.225	3705.764	3712.809	3844.753	3754.313	3575.486	3292.411	3009.14
04/16/16	2829.325	2711.46	2634.828	2614.733	2661.661	2816.742	2924.514	2935.116	2900.134	2924.47	2978.427	2996.801	3007.955	3044.742	3080.753	3102.905	3107.325	3115.674	3145.945	3319.383	3290.015	3190.188	2991.997	2794.99
04/17/16	2654.033	2571.573	2538.333	2522.33	2529.699	2590.232	2576.412	2615.77	2705.914	2774.783	2822.724	2860.712	2872.235	2897.365	2944.65	3015.342	3095.952	3140.644	3201.859	3364.254	3320.736	3205.918	3036.486	2844.09
04/18/16	2714.678	2608.619	2547.891	2527.041	2557.01	2636.645	2648.418	2711.383	2843.6	2953.957	3036.009	3084.804	3135.234	3182.895	3243.631	3325.289	3398.019	3482.602	3545.908	3683.277	3617.186	3461.269	3196.045	2935.678
04/19/16	2764.676	2665.375	2608.996	2609.662	2675.006	2855.506	2993.126	3023.038	3046.418	3125.977	3227.168	3278.4	3325.416	3414.779	3502.012	3590.81	3657.885	3718.555	3755.005	3886.282	3794.309	3611.453	3299.628	3020.965
04/20/16	2852.289	2711.4	2635.535	2622.675	2672.533	2848.279	2987.667	3025.01	3086.077	3162.485	3251.221	3343.718	3442.526	3567.341	3699.459	3808.985	3855.278	3869.796	3897.371	4035.3	3932.588	3727.623	3402.492	3086.826
04/21/16	2901.998	2793.507	2716.487	2700.386	2772.497	2911.904	3030.413	3076.286	3142.377	3230.817	3360.62	3502.478	3650.909	3816.084	3977.726	4105.225	4190.47	4244.852	4218.589	4263.025	4095.063	3858.119	3508.794	3172.278
04/22/16	2983.983	2849.915	2755.18	2722.726	2777.724	2941.321	3059.536	3106.586	3167.102	3287.789	3441.053	3580.035	3743.753	3953.412	4132.578	4287.848	4389.967	4382.305	4300.116	4329.147	4168.973	3933.21	3595.764	3241.151
04/23/16	3028.576	2865.605	2791.941	2751.946	2779.066	2880.256	2933.983	2978.778	3081.319	3219.574	3388.472	3545.601	3688.488	3853.127	4013.077	4147.925	4257.949	4284.181	4206.109	4193.601	4052.234	3841.467	3572.577	3267.059
04/24/16	3052.035	2882.485	2767.544	2698.837	2674.462	2680.886	2629.556	2692.965	2872.104	3036.339	3199.439	3318.918	3396.915	3477.778	3569.875	3650.208	3698.882	3705.882	3673.344	3693.592	3597.508	3440.957	3256.689	3017.873
04/25/16	2832.119	2717.157	2637.094	2612.21	2635.913	2713.279	2703.312	2767.868	2895.752	3000.604	3101.521	3183.254	3310.116	3457.839	3565.186	3662.599	3743.449	3817.511	3808.482	3886.436	3803.911	3654.059	3357.783	3077.239
04/26/16	2876.625	2746.441	2673.277	2660.858	2712.161	2883.046	2997.428	3017.491	3057.504	3105.685	3147.452	3167.754	3186.293	3252.632	3270.988	3304.758	3327.803	3365.145	3408.249	3603.435	3559.116	3427.191	3136.679	2883.547
04/27/16	2759.861	2678.382	2646.233	2643.023	2704.184	2873.917	2989.334	2999.678	3003.662	3032.036	3075.407	3098.595	3080.213	3108.046	3141.182	3205.772	3260.625	3340.182	3419.544	3625.094	3598.459	3449.497	3178.09	2928.284
04/28/16	2777.371	2663.985	2606.601	2604.949	2670.411	2846.651	2963.414	2997.695	3001.704	3012.757	3049.046	3074.712	3085.222	3143.935	3218.936	3315.312	3387.192	3445.71	3509.214	3703.487	3686.647	3538.816	3269.29	2998.439
04/29/16	2833.014	2733.053	2659.873	2638.07	2690.065	2858.502	2998.377	3052.36	3036.778	3058.146	3089.238	3053.913	3057.324	3074.474	3075.623	3128.817	3190.369	3248.761	3282.165	3486.269	3487.612	3357.639	3104.424	2849.456
04/30/16	2722.35	2641.968	2596.648	2580.78	2624.576	2757.976	2839.905	2864.109	2861.056	2901.056	2954.248	2992.051	3027.781	3092.015	3186.348	3253.74	3285.646	3292.262	3289.444	3443.929	3437.331	3329.322	3143.301	2920.952
05/01/16	2783.092	2680.125	2615.335	2587.395	2588.896	2606.864	2605.773	2695.123	2803.555	2893.168	2962.031	2982.483	3035.825	3046.889	3027.413	3035.581	3041.515	3014.243	3047.154	3184.331	3185.806	3106.5	2963.194	2800.376
05/02/16	2661.62	2575.028	2515.611	2512.505	2537.726	2588.544	2608.62	2669.415	2803.995	2923.996	3001.079	3037.27	3070.018	3113.269	3160.579	3227.298	3304.501	3393.27	3453.268	3592.855	3574.657	3431.013	3181.729	2926.969
05/03/16	2788.599	2684.795	2624.834	2626.275	2677.074	2821.114	2969.115	3012.376	3074.816	3142.098	3228.383	3312.578	3393.333	3511.199	3617.482	3733.4	3825.389	3897.495	3919.863	4001.202	3935.805	3761.898	3446.045	3143.86
05/04/16	2957.791	2831.79	2722.731	2686.868	2729.17	2881.337	3033.787	3110.799	3210.199	3352.257	3502.303	3634.082	3764.644	3917.058	4054.703	4199.697	4316.943	4379.455	4356.201	4374.872	4247.096	4000.772	3638.719	3286.633
05/05/16	3078.55	2901.116	2790.329	2748.005	2792.201	2932.729	3108.078	3204.043	3313.444	3483.37	3690.102	3874.956	4058.357	4269.883	4462.51	4631.668	4752.452	4798.546	4716.853	4678.992	4505.375	4235.198	3817.61	3420.206
05/06/16	3166.461	2983.689	2854.078	2795.129	2822.038	2923.975	3080.428	3191.577	3287.915	3431.584	3606.277	3722.982	3858.334	4006.133	4140.181	4270.973	4317.853	4309.236	4173.056	4129.102	4013.448	3797.907	3469.395	3142.971
05/07/16	2941.008	2795.777	2703.304	2663.989	2692.419	2769.16	2856.374	2920.355	2965.08	3021.719	3096.665	3143.957	3170.914	3193.809	3171.946	3196.204	3187.946	3194.686	3225.293	3311.147	3295.372	3197.014	3031.056	2820.595
05/08/16	2693.659	2580.786	2528.815	2497.989	2508.823	2539.762	2519.634	2606.051	2707.755	2784.116	2853.595	2904.93	2935.696	2982.813	3029.499	3096.707	3120.151	3138.818	3148.605	3288.007	3307.574	3218.074	3060.613	2865.051
05/09/16	2722.775	2620.81	2554.743	2543.934	2565.823	2591.645	2595.916	2690.16	2835.91	2947.964	3030.665	3099.182	3157.425	3190.469	3246.679	3310.602	3345.995	3393.666	3424.134	3545.737	3563.889	3444.095	3191.664	2940.241
05/10/16	2773.71	2661.964	2596.346	2579.381	2643.221	2786.75	2942.235	2992.446	3030.785	3102.935	3182.336	3214.788	3274.092	3379.266	3475.866	3569.51	3623.671	3660.974	3738.12	3841.708	3829.617	3672.879	3375.596	3085.993
05/11/16	2913.68	2802.777	2722.024	2697.108	2745.008	2867.91	3029.768	3090.63	3155.312	3253.475	3404.106	3519.136	3621.289	3769.546	3909.623	4046.95	4158.319	4212.061	4187.65	4203.949	4116.61	3903.268	3496.693	3164.169
05/12/16	2992.464	2864.815	2769.272	2738.724	2781.292	2889.337	3039.762	3157.916	3247.528	3411.177	3587.919	3733.194	3895.94	4081.793	4271.759	4439.712	4550.238	4606.146	4553.953	4548.528	4411.461	4149.607	3741.914	3340.362
05/13/16	3123.801	2973.633	2894.925	2852.287	2876.325	2974.828	3116.302	3208.17	3374.089	3601.911	3829.607	4070.844	4273.587	4513.688	4717.403	4932.563	5061.272	5103.212	5011.761	4913.517	4690.929	4355.319	3925.45	3522.325
05/14/16	3264.446	3095.602	2957.622	2890.891	2898.83	2955.034	3071.583	3190.652	3316.33	3537.32	3833.229	4071.827	4268.86	4522.95	4762.167	4975.082	5097.059	5090.751	4979.709	4858.55	4620.908	4317.338	3962.763	3599.469
05/15/16	3341.575	3157.476	3019.101	2899.289	2862.092	2813.243	2814.968	2976.698	3257.397	3559.081	3860.22	4124.196	4353.321	4561.735	4743.059	4887.451	4935.034	4870.285	4701.433	4576.165	4411.791	4162.058	3850.758	3530.372
05/16/16	3276.285	3059.429	2909.922	2824.661	2803.467	2801.358	2829.177	3004.143	3260.805	3500.847	3717.809	3884.17	4025.079	4174.71	4330.001	4460.538	4524.899	4550.991	4440.517	4376.129	4284.196	4068.956	3712.09	3364.634
05/17/16	3156.454	2996.338	2882.211	2833.571	2858.323	2958.363	3127.788	3262.446	3357.151	3505.815	3648.487	3777.433	3899.847	4035.678	4166.946	4310.709	4398.453	4451.326	4372.467	4353.384	4258.845	4059.04	3699.162	3342.726
05/18/16	3125.494	2975.123	2864.315	2820.965	2848.255	2960.485	3136.115	3253.293	3346.183	3479.16	3595.115	3666.829	3770.675	3925.815	4048.723	4170.753	4209.852	4152.378	4028.201	4048.998	3997.506	3844.428	3555.208	3261.877
05/19/16	3061.097	2933.056	2861.694	2827.563	2874.25	2984.656	3114.597	3199.94	3249.183	3350.441	3412.469	3483.154	3566.083	3718.391	3855.667	3958.952	4014.397	4026.899	3976.933	4036.304	4019.065	3862.454	3556.318	3249.575
05/20/16	3067.192	2942.701	2852.983	2833.443	2864.173	2963.845	3139.398	3256.841	3371.498	3524.874	3699.925	3825.436	3967.958	4138.971	4299.06	4458.292	4549.928	4595.988	4535.057	4488.989	4403.024	4166.465	3799.226	3451.042
05/21/16	3219.659	3065.184	2955.437	2904.851	2903.539	2949.348	3061.685	3199.867	3337.402	3496.478	3686.994	3841.193	3988.298	4154.643	4296.972	4434.522	4522.952	4504.953	4368.452	4284.568	4167.873	3946.033	3597.753	3254.302
05/22/16	3044.615	2895.292	2807.057	2727.399	2733.051	2699.29	2682.954	2795.431	3002.293	3189.251	3359.412	3476.524	3591.496	3729.011	3854.063	3968.95	4040.456	4039.493	3939.861	3856.28	3774.71	3623.842	3404.11	3152.718
05/23/16	2966.294	2811.918	2705.001	2658.252	2654.761	2653.721	2681.387	2812.191	3026.143	3222.086	3385.778	3490.927	3605.987	3735.867	3851.375	3965.219	4046.688	4094.561	4058.429	4023.689	3969.737	3778.206	3418.126	3081.413
05/24/16	2898.17	2778.641	2719.458	2684.076	2728.59	2824.889	2946.06	3035.426	3147.826	3274.425	3412.074	3509.528	3605.271	3739.88	3886.544	4022.906	4124.669	4177.059	4160.876	4159.417	4100.293	3896.88	3572.184	3248.205
05/25/16	3055.629	2894.906	2787.775	2741.837	2778.266	2871.952	2970.468	3082.026	3210.085	3335.516	3464.092	3571.212	3661.758	3788.579	3912.18	4025.653	4093.144	4118.537	4077.998	4078.053	4031.241	3828.087	3502.183	3191.295
05/26/16	2999.628	2825.433	2730.495	2699.517	2741.596	2834.422	2987.651	3054.171	3167.278	3285.387	3428.497	3520.565	3624.902	3763.715	3893.897	4039.745	4124.862	4133.462	4066.328	4061.506	4000.001	3829.756	3512.426	3204.705

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DT	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24
05/27/16	3024.348	2884.501	2788.33	2759.106	2787.572	2860.217	2935.408	3022.233	3122.478	3240.554	3367.611	3452.352	3563.72	3679.208	3786.468	3901.668	3993.291	4025.293	3984.306	4000.916	3973.204	3812.958	3523.856	3220.623
05/28/16	3016.009	2882.213	2777.247	2730.497	2758.265	2784.072	2834.744	2927.184	3068.303	3212.775	3390.208	3547.483	3694.913	3841.78	3986.761	4121.054	4216.693	4268.503	4229.638	4192.185	4086.709	3884.188	3591.495	3286.892
05/29/16	3068.778	2903.227	2787.131	2713.087	2675.715	2628.988	2620.615	2738.441	2959.265	3206.584	3456.058	3664.14	3826.536	4034.309	4192.091	4368.712	4483.833	4503.446	4429.525	4306.74	4159.678	3948.186	3629.052	3289.504
05/30/16	3078.451	2915.21	2805.794	2716.536	2669.828	2605.283	2572.19	2710.827	2933.642	3184.209	3426.016	3629.521	3813.337	3993.155	4171.596	4317.593	4434.034	4490.252	4429.358	4295.491	4151.268	3945.407	3635.043	3306.724
05/31/16	3072.556	2894.199	2784.23	2713.601	2710.922	2709.62	2733.785	2867.004	3107.174	3351.69	3605.725	3805.499	3983.26	4155.514	4326.631	4486.337	4591.641	4648.669	4577.066	4468.953	4305.806	4068.228	3705.424	3350.719
06/01/16	3122.941	2983.668	2872.246	2824.05	2836.585	2905.121	3029.445	3180.303	3374.938	3592.996	3858.996	4109.854	4317.133	4535.108	4736.141	4915.419	5037.167	5082.477	5023.39	4952.919	4842.048	4560.861	4088.97	3657.563
06/02/16	3393.183	3227.409	3117.445	3039.722	3051.511	3101.765	3247.05	3429.07	3665.55	3907.723	4182.458	4401.518	4610.915	4865.129	5126.12	5327.37	5447.715	5477.318	5403.338	5254.346	5108.963	4831.337	4386.704	3973.04
06/03/16	3675.738	3462.815	3279.362	3175.825	3157.824	3179.512	3323.693	3524.957	3781.729	4073.278	4392.826	4662.116	4929.143	5228.454	5499.442	5741.571	5854.345	5887.932	5799.5	5614.744	5370.247	5016.499	4503.972	4028.695
06/04/16	3707.324	3484.445	3317.843	3211.136	3187.219	3171.564	3285.77	3497.191	3779.666	4106.976	4516.885	4891.51	5229.719	5596.229	5890.384	6106.914	6225.081	6218.53	6089.212	5841.987	5594.386	5238.057	4782.463	4315.964
06/05/16	3969.725	3703.612	3492.751	3331.551	3226.132	3126.03	3159.27	3390.653	3768.821	4193.194	4637.403	5055.643	5456.457	5835.337	6125.372	6325.734	6431.419	6445.37	6310.473	5983.417	5631.364	5202.313	4766.894	4347.67
06/06/16	4019.23	3751.613	3540.909	3389.893	3314.491	3233.854	3311.401	3577.622	3980.914	4418.614	4861.852	5242.871	5614.912	5976.987	6286.194	6517.044	6635.851	6651.335	6496.817	6157.573	5753.173	5319.84	4806.429	4314.678
06/07/16	3980.36	3691.516	3494.592	3388.86	3355.243	3385.531	3569.062	3801.385	4117.445	4470.39	4842.971	5173.361	5457.446	5761.799	6011.736	6212.602	6322.417	6306.101	6130.894	5892.933	5602.895	5242.786	4767.441	4309.457
06/08/16	3965.891	3700.694	3499.876	3381.963	3344.587	3375.552	3553.646	3782.575	4053.677	4361.604	4687.068	4956.015	5190.696	5457.272	5684.515	5890.836	6019.445	6040.543	5921.458	5698.489	5429.209	5063.032	4625.976	4258.001
06/09/16	3969.851	3749.409	3578.316	3468.099	3455.784	3491.529	3696.069	3946.362	4214.618	4512.978	4813.132	5091.422	5348.941	5626.038	5876.269	6081.018	6187.487	6161.477	6011.998	5881.65	5699.519	5393.891	4933.118	4494.498
06/10/16	4174.853	3927.463	3727.894	3620.134	3602.075	3621.165	3801.909	4045.667	4274.457	4536.568	4833.678	5075.79	5287.329	5532.586	5747.656	5924.232	6039.136	6049.608	5865.504	5679.176	5523.894	5224.465	4793.272	4353.409
06/11/16	4036.15	3811.996	3630.933	3512.779	3473.179	3464.297	3546.819	3698.113	3878.9	4144.368	4436.206	4701.043	4932.22	5147.128	5264.364	5340.717	5292.214	5198.079	4984.776	4910.62	4833.827	4648.38	4301.515	3931.817
06/12/16	3662.721	3465.068	3306.784	3202.767	3137.838	3058.602	3109.018	3336.895	3658.223	3979.899	4295.496	4573.358	4812.494	4985.126	5113.589	5180.333	5135.388	5162.847	5102.559	4938.788	4804.499	4556.313	4218.367	3866.038
06/13/16	3565.862	3332.31	3159.023	3060.307	3011.958	2953.88	3034.642	3246.261	3551.288	3880.487	4175.697	4405.722	4639.927	4873.196	5087.711	5261.231	5349.222	5370.767	5267.45	5067.714	4904.399	4627.23	4250.51	3882.198
06/14/16	3602.195	3397.863	3235.703	3136.08	3119.74	3146.397	3300.667	3501.52	3734.138	3964.061	4220.441	4421.114	4573.02	4759.564	4913.052	5061.608	5157.182	5192.312	5127.381	4988.395	4802.012	4520.063	4092.314	3708.064
06/15/16	3450.532	3262.207	3109.407	3028.216	3019.071	3059.18	3210.867	3388.096	3610.178	3856.707	4132.592	4362.363	4537.888	4741.407	4932.727	5108.242	5219.96	5284.504	5220.301	5068.751	4861.222	4565.568	4145.601	3759.615
06/16/16	3478.423	3272.963	3098.913	3031.71	3047.025	3092.443	3257.525	3467.395	3689.562	3932.981	4206.349	4429.737	4602.857	4821.335	5030.594	5205.695	5327.786	5392.887	5321.918	5169.656	5029.019	4757.932	4305.728	3878.692
06/17/16	3580.516	3374.836	3202.724	3117.999	3117.08	3152.882	3311.507	3505.726	3739.451	3990.974	4272.204	4500.86	4689.407	4930.499	5146.919	5330.069	5448.9	5493.599	5426.645	5259.25	5041.127	4727.607	4288.552	3870.564
06/18/16	3560.506	3322.895	3157.071	3057.19	3031.166	3018.063	3145.009	3363.67	3613.836	3909.66	4232.695	4543.336	4784.439	5044.995	5270.791	5486.895	5641.133	5686.107	5593.03	5367.657	5094.975	4711.039	4290.859	3882.465
06/19/16	3568.928	3345.042	3172.769	3062.762	2989.234	2905.721	2981.909	3211.262	3566.38	3999.318	4436.46	4833.743	5188.911	5519.64	5818.476	6052.973	6184.092	6245.406	6155.419	5889.069	5602.63	5246.5	4854.641	4462.344
06/20/16	4133.906	3878.486	3665.214	3538.9	3465.954	3401.898	3522.805	3834.209	4293.625	4808.324	5353.23	5824.889	6260.265	6665.878	6966.589	7181.824	7330.47	7389.877	7261.534	6968.713	6679.389	6289.268	5817.424	5385.346
06/21/16	4999.052	4674.596	4432.427	4247.619	4169.793	4161.158	4326.638	4606.042	4955.005	5346.632	5749.401	6087.771	6352.345	6655.783	6908.373	7102.576	7186.375	7134.017	6946.244	6762.822	6542.8	6210.523	5761.45	5318.605
06/22/16	4983.472	4683.106	4421.88	4245.138	4160.739	4146.099	4267.794	4519.519	4811.641	5139.015	5483.393	5758.447	6007.346	6279.181	6506.488	6697.516	6774.072	6783.436	6638.965	6449.657	6235.074	5906.933	5432.586	4979.948
06/23/16	4626.845	4327.559	4138.436	4017.662	3968.178	3972.488	4138.922	4368.39	4683.665	5047.121	5430.451	5764.152	6058.894	6352.213	6604.712	6810.062	6919.803	6905.646	6755.842	6524.944	6275.679	5921.878	5444.264	5000.92
06/24/16	4635.005	4326.498	4090.648	3942.442	3901.296	3900.917	4067.4	4391.145	4697.333	5057.922	5450.626	5761.414	5987.026	6244.988	6495.211	6693.11	6770.738	6664.195	6451.208	6266.228	6089.823	5764.628	5302.551	4856.888
06/25/16	4528.865	4257.382	4020.715	3854.852	3777.693	3740.622	3833.565	4105.843	4422.099	4766.57	5138.191	5443.66	5654.587	5899.321	6110.885	6281.064	6409.313	6415.288	6281.528	6057.574	5816.801	5477.353	5068.031	4662.857
06/26/16	4346.076	4097.247	3891.998	3741.793	3616.717	3489.002	3527.901	3812.525	4169.56	4557.556	4920.259	5243.865	5536.185	5818.869	6050.161	6233.698	6342.616	6348.876	6211.023	5960.339	5727.085	5390.803	4991.689	4644.063
06/27/16	4355.396	4118.801	3950.065	3851.865	3793.367	3737.341	3802.559	4093.198	4430.7	4796.416	5171.632	5464.045	5674.029	5858.58	6015.401	6174.183	6253.081	6251.516	6127.065	5972.339	5844.434	5604.973	5205.008	4817.554
06/28/16	4535.955	4329.679	4168.54	4072.215	4050.393	4102.606	4222.064	4388.789	4609.809	4918.703	5305.291	5642.981	5909.004	6209.949	6453.54	6625.677	6660.344	6611.796	6377.614	6161.722	5995.245	5729.689	5316.604	4918.076
06/29/16	4646.353	4405.131	4215.655	4102.454	4071.765	4134.115	4309.786	4590.342	4944.056	5317.764	5700.525	6000.787	6250.392	6511.584	6691.773	6862.753	6937.63	6944.391	6834.612	6657.575	6461.816	6133.698	5698.309	5288.349
06/30/16	4999.102	4756.392	4568.358	4438.32	4381.185	4378.457	4530.389	4764.256	5000.975	5259.068	5568.86	5792.644	5967.442	6163.295	6312.663	6386.328	6396.971	6418.865	6289.181	6132.578	5976.169	5659.532	5167.632	4699.292
07/01/16	4437.624	4213.457	4051.523	3951.399	3935.011	3979.639	4048.076	4138.864	4281.363	4456.852	4560.506	4594.222	4657.956	4760.975	4899.387	5030.853	5183.458	5297.067	5280.871	5249.053	5206.965	5044.528	4709.78	4357.605
07/02/16	4115.251	3923.83	3795.847	3724.141	3712.908	3723.685	3733.683	3850.298	4019.842	4207.54	4443.105	4662.371	4784	4949.307	5141.523	5300.476	5347.579	5152.177	4951.991	4895.724	4867.701	4686.933	4397.866	4087.396
07/03/16	3869.959	3699.848	3549.278	3468.973	3423.586	3366.104	3373.265	3541.222	3822.117	4143.558	4474.007	4749.545	4976.536	5231.917	5449.895	5632.185	5758.891	5783.523	5701.599	5487.963	5317.076	5016.837	4671.778	4364.483
07/04/16	4110.585	3877.932	3706.925	3579.307	3518.776	3447.441	3473.604	3675.547	4000.468	4365.223	4713.316	5027.551	5316.52	5590.828	5809.852	5976.894	6072.509	6069.021	5965.885	5712.423	5448.402	5113.602	4769.255	4430.278
07/05/16	4192.715	3961.298	3770.822	3644.294	3588.64	3549.154	3634.973	3896.423	4246.024	4651.487	5065.61	5424.801	5704.89	5990.827	6198.239	6365.806	6424.162	6416.19	6273.512	6008.307	5704.191	5377.513	5033.062	4668.131
07/06/16	4329.951	4053.181	3850.74	3722.73	3677.084	3693.273	3849.153	4124.163	4435.716	4785.523	5140.669	5442.879	5694.462	5969.962	6218.17	6403.164	6499.981	6520.116	6411.569	6201.583	5940.904	5591.646	5115.058	4686.058
07/07/16	4345.791	4077.627	3884.879	3765.721	3729.906	3750.058	3907.903	4154.829	4426.595	4727.291	5047.117	5292.435	5507.039	5773.463	6007.633	6218.247	6333.106	6363.887	6263.963	6073.546	5888.084	5580.472	5118.315	4694.938
07/08/16	4371.089	4097.542	3894.73	3764.224	3728.419	3740.887	3880.106	4110.854	4365.762	4665.905	4999.123	5266.528	5477.104	5725.002	5966.974	6172.447	6317.232	6366.61	6269.617	6083.859	5884.341	5556.199	5084.985	4632.978
07/09/16	4287.133	4030.001	3830.419	3671.639	3603.477	3570.022	3638.813	3882.547	4172.715	4485.882	4817.988	5123.718	5376.392	5644.532	5868.044	6082.81	6214.928	6245.861	6152.577	5963.736	5727.566	5383.897	4972.749	4556.11
07/10/16	4237.941	3991.159	3804.43	3657.241	3563.102	3455.929	3482.099	3734.215	4096.617	4482.308	4870.713	5224.353	5551.7	5869.347	6119.145	6301.447	6435.807	6469.722	6368.666	6100.627	5829.133	5479.67	5092.577	4717.011
07/11/16	4399.103	4133.237	3937.181	3799.124	3716.353	3651.417	3712.072	3957.908	4325.511	4714.406	5090.028	5422.628	5733.725	6027.968	6259.99	6422.462	6524.114	6511.253	6390.744	6109.699	5826.853	5468.47	5016.602	4600.344
07/12/16	4266.161	4036.441	3839.2	3724.439	3676.507	3689.467	3794.323	4024.021	4328.419	4650.533	4981.874	5251.014	5481.755	5756.577	6000.257	6202.846	6315.189	6319.983	6193.789	5947.975	5658.81	5290.542	4788.006	4345.382
07/13/16	4018.298	3767.621	3574.525	3470.558	3454.059	3495.056	3647.731	3881.892	4178.261	4528.659	4880.786	5191.9	5467.794	5778.467	6068.532	6299.942	6436.767	6476.739	6376.889	6141.072	5887.114	5550.1	5081.823	4635.935
07/14/16	4298.689	4018.838	3806.977	3689.351	3660.951	3689.122	3831.598	4081.343	4379.568	4708.615	5073.788	5353.755	5621.101	5929.096	6211.504	6445.203	6584.314	6639.351	6549.48	6350.021	6105.808	5738.371	5243.808	4805.834

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07/15/16	4484.883	4238.442	4032.458	3925.516	3895.211	3926.479	4072.419	4331.65	4621.004	4943.902	5300.752	5600.432	5873.948	6172.241	6446.181	6683.766	6822.499	6851.824	6742.544	6513.793	6245.345	5843.979	5330.406	4855.8
07/16/16	4489.628	4218.782	4014.254	3883.84	3843.638	3838.742	3931.416	4206.233	4480.995	4808.421	5163.551	5493.048	5752.263	6060.026	6347.969	6557.932	6696.183	6721.03	6606.118	6381.331	6142.868	5763.495	5350.364	4980.939
07/17/16	4639.269	4358.859	4149.436	4013.626	3945.666	3854.052	3840.894	4096.95	4418.078	4759.286	5126.879	5419.01	5698.356	5957.818	6150.627	6312.423	6455.744	6479.074	6364.151	6113.053	5888.707	5588.687	5231.141	4920.465
07/18/16	4635.777	4374.678	4172.397	4027.873	3953.202	3922.813	3958.801	4246.438	4606.934	4959.962	5283.964	5534.77	5745.509	5834.812	5791.595	5870.084	6006.822	6055.102	5895.178	5755.099	5625.953	5400.564	5034.436	4687.081
07/19/16	4415.804	4207.49	4061.244	3991.49	3959.647	4052.562	4129.278	4310.325	4548.911	4822.784	5153.736	5426.4	5658.996	5931.996	6138.26	6299.262	6410.966	6417.443	6162.271	5918.693	5737.474	5462.191	5056.14	4701.144
07/20/16	4464.587	4241.428	4089.01	3998.186	3993.83	4078.75	4225.053	4478.437	4749.372	5026.676	5365.691	5643.397	5873.467	6136.88	6340.44	6480.444	6567.81	6562.803	6394.32	6199.984	6014.484	5730.984	5327.417	4953.541
07/21/16	4675.38	4421.489	4210.537	4093.586	4081.882	4149.064	4279.377	4445.672	4740.362	5046.99	5391.013	5681.011	5896.203	6141.091	6338.012	6516.357	6573.502	6441.48	6192.165	6035.23	5895.717	5639.877	5213.756	4839.271
07/22/16	4541.166	4321.151	4169.232	4075.308	4073.828	4119.853	4247.722	4542.697	4848.902	5226.072	5632.116	5982.75	6259.966	6563.235	6833.174	7001.387	7073.564	7066.006	6926.958	6745.258	6532.643	6166.002	5644.437	5205.126
07/23/16	4883.126	4640.017	4467.967	4370.232	4358.057	4415.48	4409.73	4545.392	4864.718	5227.51	5576.676	5905.791	6191.651	6503.886	6770.311	6963.368	7010.969	6870.905	6548.442	6328.515	6153.747	5854.194	5454.628	5039.459
07/24/16	4704.853	4428.919	4207.017	4056.334	3977.937	3943.89	3950.254	4199.971	4574.773	4974.281	5379.496	5724.441	6015.78	6303.505	6555.904	6755.628	6865.061	6877.511	6748.635	6499.597	6281.946	5980.335	5596.227	5226.149
07/25/16	4925.924	4650.879	4425.4	4270.398	4181.211	4156.763	4189.584	4420.91	4712.655	5042.028	5365.228	5614.513	5864.314	6144.754	6393.145	6588.521	6686.728	6716.744	6575.997	6342.665	6128.673	5844.179	5445.856	5087.055
07/26/16	4809.882	4556.097	4357.315	4229.729	4193.904	4242.096	4347.504	4579.299	4856.82	5162.809	5488.704	5777.809	6005.428	6267.557	6484.573	6606.297	6690.001	6637.629	6393.913	6167.189	5976.17	5674.477	5231.087	4851.697
07/27/16	4593.216	4395.681	4226.584	4133.062	4115.793	4219.518	4354.799	4556.383	4836.513	5222.765	5615.26	5934.674	6191.716	6473.302	6707.032	6900.32	7019.713	7054.111	6952.735	6772.849	6555.534	6183.293	5701.044	5317.511
07/28/16	5021.812	4782.047	4587.981	4450.773	4396.686	4430.16	4552.735	4810.715	5093.28	5429.816	5790.708	6100.048	6348.886	6685.476	6962.103	7146.144	7234.405	7240.635	7089.478	6872.402	6601.652	6210.026	5723.373	5301.466
07/29/16	4992.365	4745.3	4534.314	4419.371	4399.645	4478.086	4572.98	4762.239	4940.169	5242.949	5633.273	5981.042	6276.666	6617.474	6876.772	7074.238	7131.336	7116.181	6974.331	6754.009	6492.377	6111.752	5649.134	5231.78
07/30/16	4904.191	4677.407	4528.074	4442.266	4447.394	4468.056	4482.454	4658.228	4877.541	5168.387	5509.535	5815.409	6057.869	6350.715	6622.082	6810.323	6858.674	6839.926	6719.155	6395.311	5895.549	5321.405	4886.285	4472.613
07/31/16	4180.347	4009.627	3880.128	3771.838	3735.871	3714.161	3664.759	3817.58	4161.434	4491.48	4816.949	5079.731	5323.586	5578.638	5784.732	5945.911	6028.073	6033.333	5905.76	5707.459	5542.701	5296.381	4981.661	4676.445
08/01/16	4410.21	4198.681	4028.067	3931.888	3875.284	3868.388	3882.857	4038.93	4306.5	4562.349	4901.035	5203.493	5485.366	5737.677	5959.925	6143.315	6213.526	6216.158	5978.243	5737.356	5480.62	5199.327	4807.802	4424.225
08/02/16	4163.344	4012.936	3893.46	3842.918	3867.182	3972.08	4081.632	4235.939	4388.435	4586.727	4822.772	5033.603	5248.591	5504.283	5735.84	5908.971	5996.531	6003.791	5857.39	5788.542	5658.205	5430.146	5047.043	4682.211
08/03/16	4432.102	4238.169	4105.013	4050.676	4061.271	4202.967	4324.804	4492.279	4699.178	4935.841	5208.866	5381.905	5518.378	5705.043	5848.921	5852.949	5651.846	5337.596	5073.403	5039.183	4913.712	4753.109	4439.047	4155.317
08/04/16	3961.573	3806.305	3710.691	3687.359	3747.019	3893.186	4082.398	4321.983	4550.224	4760.729	5021.151	5249.266	5413.702	5620.581	5535.299	5355.154	5331.318	5345.106	5278.126	5290.723	5232.719	5061.376	4697.999	4374.007
08/05/16	4168.916	4002.128	3879.671	3832.524	3877.411	4005.417	4147.914	4265.206	4446.745	4654.382	4908.006	5124.609	5317.549	5584.554	5832.925	6000.074	5942.347	5690.887	5473.067	5452.092	5360.873	5158.559	4800.04	4457.822
08/06/16	4190.832	4008.793	3895.259	3878.164	3915.929	3998.615	4073.154	4143.476	4148.678	4143.437	4195.815	4256.596	4413.44	4682.007	4981.145	5196.488	5286.873	5287.23	5194.972	5174.814	5080.802	4862.808	4544.251	4229.192
08/07/16	3969.611	3783.264	3649.033	3560.798	3510.716	3475.919	3489.36	3731.856	4090.054	4528.73	4920.834	5258.499	5547.395	5819.783	6043.131	6196.282	6283.762	6290.236	6170.712	5920.798	5660.413	5336.556	4950.065	4593.591
08/08/16	4326.303	4118.454	3937.421	3821.26	3764.964	3750.536	3782.842	4048.399	4433.541	4856.535	5266.806	5603.574	5917.616	6177.873	6417.061	6606.888	6701.282	6692.939	6559.017	6306.712	6024.141	5664.745	5231.467	4808.298
08/09/16	4460.089	4193.86	4001.798	3897.449	3886.05	3972.438	4110.195	4318.162	4605.671	4939.834	5343.707	5652.711	5862.64	6093.566	6329.651	6517.516	6621.601	6614.148	6481.829	6263.837	6003.972	5723.659	5300.182	4878.247
08/10/16	4583.583	4362.999	4211.499	4153.746	4162.977	4275.72	4455.684	4676.52	4871.957	5102.634	5365.114	5521.657	5347.657	5293.089	5452.613	5613.737	5765.613	5856.955	5776.183	5729.096	5550.529	5256.596	4846.18	4479.999
08/11/16	4215.001	4029.901	3919.97	3885.271	3926.054	4066.964	4261.298	4429.267	4598.97	4799.121	5072.21	5284.283	5469.387	5669.879	5854.344	6014.765	6098.196	6081.611	5965.406	5904.731	5708.556	5283.413	4779.383	4374.505
08/12/16	4123.048	3942.557	3827.763	3775.741	3807.937	3942.315	4104.193	4228.365	4328.658	4449.753	4651.543	4812.856	4986.034	5226.363	5475.444	5704.365	5871.627	5954.666	5836.366	5766.877	5591.149	5312.69	4880.403	4487.555
08/13/16	4196.816	4018.332	3896.952	3824.233	3828.465	3887.118	3993.176	4163.285	4354.052	4637.405	4942.645	5226.462	5448.772	5722.272	5969.371	6115.639	6046.339	6030.941	5939.583	5792.363	5582.311	5290.077	4896.369	4522.376
08/14/16	4242.976	4018.335	3842.023	3731.7	3664.926	3612.52	3582.159	3792.263	4129.645	4519.227	4916.894	5266.338	5578.207	5868.423	6109.73	6289.782	6408.143	6433.237	6284.921	6022.21	5711.043	5385.762	5047.135	4676.738
08/15/16	4382.042	4132.118	3979.373	3885.155	3841.813	3807.732	3821.528	4046.675	4382.96	4735.998	5077.923	5368.832	5659.443	5939.622	6170.719	6378.397	6541.195	6609.956	6478.02	6251.245	5988.398	5641.451	5178.544	4753.661
08/16/16	4448.707	4215.037	4062.055	4006.138	4035.503	4155.004	4309.341	4515.048	4772.337	5106.509	5436.447	5746.336	5988.481	6267.437	6518.757	6725.932	6841.102	6845.206	6611.8	6454.748	6179.599	5795.603	5271.359	4811.079
08/17/16	4482.189	4242.776	4077.426	4011.061	4016.428	4131.143	4294.282	4466.957	4729.407	5049.09	5435.677	5740.516	6050.819	6351.12	6584.953	6792.362	6890.965	6725.308	6372.463	6224.479	6025.046	5719.681	5222.305	4859.7
08/18/16	4578.905	4358.496	4203.861	4142.224	4157.57	4267.46	4427.03	4611.735	4799.745	4983.406	5285.731	5577.376	5816.266	6069.133	6265.974	6416.854	6495.803	6486.444	6283.639	6177.007	5952.502	5606.286	5147.33	4774.063
08/19/16	4491.715	4317.528	4177.95	4098.682	4087.539	4163.699	4289.056	4292.968	4351.89	4422.137	4654.779	4968.173	5224.479	5499.818	5754.595	5971.806	6123.408	6151.634	5964.339	5841.247	5605.752	5282.876	4849.07	4440.005
08/20/16	4150.313	3954.575	3783.809	3681.289	3696.224	3750.737	3794.118	3916.175	4091.26	4320.696	4584.564	4846.785	5060.334	5294.921	5540.762	5729.628	5845.43	5862.147	5657.123	5529.983	5341.46	5048.477	4753.855	4416.583
08/21/16	4126.897	3910.175	3733.199	3628.508	3571.003	3518.778	3479.213	3590.265	3836.413	4129.849	4453.993	4733.075	4977.356	5203.501	5371.544	5494.061	5597.326	5564.498	5095.059	4805.779	4578.473	4387.987	4162.77	3901.512
08/22/16	3722.07	3574.27	3462.225	3417.529	3421.528	3444.057	3448.562	3567.403	3841.128	4154.598	4473.837	4741.54	4977.578	5240.402	5433.062	5619.384	5680.079	5680.531	5512.508	5385.048	5175.483	4892.79	4524.816	4171.399
08/23/16	3930.441	3741.722	3611.301	3536.266	3546.11	3664.017	3817.047	3976.149	4151.508	4355.577	4615.881	4889.214	5081.545	5287.571	5453.365	5344.937	5112.035	5073.306	5043.826	5091	4952.688	4721.815	4390.947	4086.105
08/24/16	3869.478	3665.964	3533.916	3460.257	3477.907	3589.575	3726.382	3814.636	3920.456	4006.042	4130.412	4260.412	4364.13	4539.726	4749.309	4982.421	5122.885	5188.148	5094.184	5100.892	4940.643	4699.811	4337.119	4019.357
08/25/16	3783.615	3604.468	3486.286	3419.553	3439.795	3558.017	3712.899	3831.505	4004.983	4243.191	4531.693	4770.341	4981.88	5248.8	5483.366	5671.66	5710.982	5608.33	5226.982	5179.629	5009.321	4749.268	4339.769	4013.104
08/26/16	3779.135	3582.233	3461.696	3395.222	3433.429	3558.043	3742.798	3885.729	4048.88	4255.547	4516.035	4787.529	5017.955	5275.697	5422.161	5556.68	5682.538	5693.664	5534.224	5487.837	5281.958	4989.584	4590.901	4226.021
08/27/16	3979.103	3773.923	3665.254	3579.058	3553.821	3630.232	3718.781	3749.007	3825.763	4013.653	4238.396	4393.225	4504.751	4684.62	4850.502	5005.503	5121.468	5154.98	5050.642	5013.945	4831.632	4599.824	4307.87	3967.218
08/28/16	3730.171	3551.371	3414.895	3331.684	3300.77	3257.723	3217.536	3277.13	3490.699	3774.801	4024.003	4231.164	4419.229	4623.278	4809.538	4936.099	5010.658	5036.431	4909.807	4756.186	4525.207	4259.065	3982.472	3695.136
08/29/16	3506.936	3330.869	3218.459	3170.6	3161.3	3184.65	3198.468	3349.702	3641.606	3981.38	4296.956	4590.241	4859.378	5101.811	5315.801	5501.766	5603.159	5643.758	5520.039	5358.191	5071.009	4738.49	4329.897	3983.039
08/30/16	3720.537	3565.601	3459.795	3401.92	3402.834	3525.025	3681.468	3850.919	4079.417	4380.428	4702.771	4997.302	5226.858	5498.207	5745.744	5955.511	6054.33	6098.887	5924.161	5801.402	5488.48	5106.835	4621.093	4243.558
08/31/16	3949.206	3726.21	3567.682	3486.312	3503.68	3636.688	3806.409	3981.402	4247.013	4579.671	4908.324	5225.16	5477.908	5766.499	6008.193	6191.726	6239.562	6144.367	5923.484	5818.268	5540.77	5204.726	4762.845	4369.963
09/01/16	4173.048	3971.533	3852.966	3784.571	3834.996	4004.141	4173.456	4366.455	4621.521	4849.304	5168.203	5413.212	5600.249	5856.599	6096.429	6293.102	6428.063	6424.233	6227.174	6111.479	5836.776	5525.894	5108.939	4710.561

Arizona Public Service Company
2016 Total Hourly Retail Load
Through September 30, 2016

DT	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24
09/02/16	4442.499	4224.078	4067.452	3998.036	4013.282	4180.527	4325.413	4445.746	4611.154	4803.052	5078.21	5327.375	5485.116	5699.48	5921.146	6098.023	6184.547	6149.945	5958.515	5891.048	5674.274	5364.314	4973.849	4594.852
09/03/16	4220.09	4056.861	3913.459	3815.534	3805.209	3891.739	3960.144	4097.536	4293.727	4576.395	4848.079	5115.003	5318.757	5546.739	5738.993	5895.597	5972.839	5954.502	5769.708	5636.306	5348.884	5058.118	4724.398	4415.866
09/04/16	4153.29	3918.656	3730.364	3576.81	3477.906	3441.063	3378.929	3510.04	3806.066	4166.877	4524.503	4833.662	5090.482	5319.531	5490.845	5603.8	5660.052	5634.857	5434.784	5216.665	4882.312	4592.769	4277.122	3940.554
09/05/16	3669.986	3446.663	3279.346	3164.064	3084.847	3064.29	3009.298	3096.483	3347.271	3655.033	3963.083	4229.466	4475.458	4708.847	4916.836	5074.943	5169.387	5208.745	5062.149	4882.232	4605.144	4348.165	4019.691	3712.943
09/06/16	3481.695	3282.515	3143.668	3073.829	3057.569	3093.821	3088.715	3182.943	3448.337	3783.492	4134.863	4451.507	4703.119	4968.92	5199.063	5415.438	5525.669	5586.162	5423.321	5271.6	4984.024	4703.972	4320.387	3978.166
09/07/16	3731.634	3544.175	3408.882	3349.321	3354.511	3521.19	3681.78	3823.299	4026.139	4249.857	4474.441	4659.636	4901.069	5186.894	5379.965	5541.811	5592.674	5558.438	5453.003	5467.9	5287.72	5088.156	4761.624	4417.413
09/08/16	4162.828	3974.723	3843.624	3785.98	3824.87	4005.945	4180.564	4176.546	4163.781	4194.681	4246.331	4295.76	4366.866	4457.378	4565.922	4695.485	4749.269	4806.779	4835.656	4919.709	4785.794	4602.174	4277.515	3961.755
09/09/16	3736.702	3578.615	3494.562	3453.294	3483.913	3655.2	3815.716	3912.578	4031.772	4230.436	4452.714	4631.749	4827.684	5057.542	5241.074	5394.511	5510.153	5525.293	5393.139	5352.813	5117.974	4877.997	4487.802	4098.466
09/10/16	3822.208	3629.169	3491.778	3412.737	3412.62	3525.317	3627.622	3701.886	3880.769	4140.837	4442.904	4730.465	4978.92	5266.645	5511.374	5676.5	5764.357	5751.603	5552.237	5428.386	5168.211	4868.573	4498.166	4122.384
09/11/16	3837.471	3624.109	3473.044	3363.033	3309.735	3311.594	3261.265	3392.219	3713.982	4097.453	4499.449	4842.066	5152.726	5434.17	5663.696	5799.186	5847.293	5825.626	5605.013	5369.898	5039.165	4734.352	4401.692	4077.997
09/12/16	3823.669	3622.692	3484.044	3409.064	3373.714	3416.832	3421.714	3573.13	3924.075	4318.651	4695.649	5020.941	5292.256	5577.641	5783.238	5898.135	5950.425	5913.321	5726.817	5566.35	5261.637	4973.404	4529.191	4147.389
09/13/16	3900.182	3737.485	3634.071	3611.565	3666.467	3846.235	3989.738	4054.434	4241.7	4461.573	4658.679	4862.309	5017.695	5225.781	5399.943	5531.005	5580.7	5544.727	5405.067	5371.167	5131.612	4838.447	4476.692	4113.422
09/14/16	3884.293	3677.757	3525.399	3468.447	3495.016	3652.59	3826.69	3939.016	4083.795	4246.229	4438.395	4567.855	4677.764	4814.15	4953.821	5017.779	5012.046	5006.425	4966.181	5032.189	4840.592	4576.573	4211.843	3868.124
09/15/16	3601.791	3412.173	3258.754	3188.19	3217.87	3378.556	3536.824	3635.518	3796.684	4002.807	4259.699	4458.293	4612.64	4808.243	4958.03	5084.822	5138.225	5120.345	4987.738	4909.399	4638.828	4356.632	3959.993	3596.303
09/16/16	3340.68	3156.712	3029.794	2969.836	2990.601	3152.019	3286.166	3326.275	3426.821	3639.678	3870.504	4092.6	4297.018	4523.197	4699.457	4847.421	4927.535	4924.696	4802.494	4718.714	4433.643	4138.035	3763.372	3414.45
09/17/16	3178.65	3016.13	2895.542	2849.79	2874.879	3002.469	3100.355	3096.909	3196.806	3380.107	3605.509	3850.84	4096.355	4304.905	4526.529	4735.46	4844.124	4835.696	4681.314	4543.751	4279.408	4018.209	3733.079	3425.221
09/18/16	3194.184	3037.416	2919.303	2850.949	2816.739	2840.871	2826.436	2899.163	3104.59	3368.421	3660.647	3952.986	4240.459	4529.496	4791.558	4992.602	5108.763	5111.844	4897.994	4651.637	4358.597	4090.362	3825.237	3550.738
09/19/16	3339.909	3166.248	3035.556	2975.984	2971.773	3030.761	3051.08	3141.858	3395.587	3728.914	4086.284	4416.131	4755.201	5097.755	5417.433	5643.089	5738.639	5661.012	5454.328	5195.501	4837.751	4520.543	4122.015	3770.436
09/20/16	3526.663	3353.493	3242.421	3204.491	3244.203	3420.57	3566.984	3654.033	3806.603	4033.925	4308.391	4504.1	4687.562	4922.519	5079.962	5059.528	4985.655	4920.153	4949.404	5000.712	4840.282	4656.184	4327.721	4022.174
09/21/16	3810.598	3663.18	3558.645	3521.609	3545.154	3722.15	3908.392	3954.228	3986.398	4022.432	4114.877	4156.917	4215.56	4270.666	4328.76	4416.902	4439.547	4499.472	4577.672	4672.301	4532.323	4379.959	4074.953	3793.611
09/22/16	3595.093	3454.117	3341.007	3318.425	3369.942	3559.294	3755.759	3817.961	3884.649	4085.901	4348.349	4555.401	4764.089	5015.155	5225.067	5369.845	5391.617	5365.713	5286.285	5267.673	5043.262	4801.791	4439.001	4083.516
09/23/16	3838.953	3664.31	3505.366	3430.33	3428.893	3560.397	3697.502	3750.599	3893.935	3998.091	4029.875	4007.83	4019.199	4147.475	4218.547	4170.581	4111.46	4207.438	4241.262	4288.636	4147.486	3949.833	3662.504	3387.349
09/24/16	3219.348	3112.594	3018.263	2938.965	2933.967	3030.343	3097.688	3054.181	3059.17	3153.889	3278.601	3401.05	3491.799	3599.116	3720.443	3815.816	3887.26	3897.054	3851.62	3853.563	3692.625	3510.968	3294.539	3057.775
09/25/16	2888.389	2775.267	2699.081	2658.276	2658.642	2661.529	2662.05	2693.779	2820.086	2979.962	3173.041	3334.956	3511.486	3694.852	3888.699	4011.593	4090.58	4107.312	4044.152	3969.594	3798.385	3632.566	3417.221	3218.055
09/26/16	3070.058	2945.462	2865.187	2850.208	2869.533	2938.466	2976.94	3085.536	3316.356	3557.437	3808.999	4015.403	4232.535	4424.697	4605.383	4765.374	4848.798	4837.627	4728.012	4602.757	4362.236	4111.123	3780.262	3477.465
09/27/16	3315.848	3208.75	3142.82	3129.925	3200.556	3385.428	3597.91	3661.848	3760.612	3927.739	4088.054	4173.657	4262.437	4365.559	4419.152	4405.078	4344.067	4316.305	4326.937	4339.503	4229.84	4038.064	3743.223	3461.034
09/28/16	3276.565	3140.357	3044.946	3011.472	3071.286	3282.609	3462.585	3509.523	3606.238	3739.991	3814.174	3825.548	3879.074	4033.703	4185.474	4289.064	4354.488	4391.064	4429.518	4443.828	4274.488	4085.608	3788.358	3502.247
09/29/16	3314.655	3176.116	3073.55	3057.304	3127.905	3328.367	3533.597	3613.464	3761.869	3898.484	4060.281	4215.232	4348.236	4551.873	4722.374	4884.044	4971.351	4997.801	4992.018	4916.72	4668.277	4400.695	4049.849	3771.688
09/30/16	3568.432	3419.979	3319.213	3298.158	3338.629	3511.74	3721.377	3745.73	3742.478	3778.809	3896.848	4005.818	4115.804	4299.909	4499.653	4668.544	4770.438	4798.744	4759.535	4713.328	4491.818	4251.248	3902.96	3589.068

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-18: Staff 5.31_Residential Solar Production 8760 in 2016_APSRC01216.xlsx

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
1-Jan-16	0	0	0	0	0	0	0	1	32	79	119	145	154	147	124	81	34	3	0	0	0	0	0	0
2-Jan-16	0	0	0	0	0	0	0	3	33	76	119	146	156	149	126	86	39	2	0	0	0	0	0	0
3-Jan-16	0	0	0	0	0	0	0	1	29	74	115	139	124	115	87	45	16	1	0	0	0	0	0	0
4-Jan-16	0	0	0	0	0	0	0	1	14	29	34	27	26	31	33	20	6	0	0	0	0	0	0	0
5-Jan-16	0	0	0	0	0	0	0	0	10	30	45	46	42	37	23	12	5	0	0	0	0	0	0	0
6-Jan-16	0	0	0	0	0	0	0	1	20	60	99	116	99	75	67	51	23	2	0	0	0	0	0	0
7-Jan-16	0	0	0	0	0	0	0	0	3	8	16	33	55	102	65	26	9	1	0	0	0	0	0	0
8-Jan-16	0	0	0	0	0	0	0	0	10	29	58	99	104	94	96	62	17	2	0	0	0	0	0	0
9-Jan-16	0	0	0	0	0	0	0	1	30	78	120	146	156	150	130	92	43	4	0	0	0	0	0	0
10-Jan-16	0	0	0	0	0	0	0	1	10	32	47	96	109	101	81	42	17	2	0	0	0	0	0	0
11-Jan-16	0	0	0	0	0	0	0	2	33	83	126	155	165	159	137	98	48	5	0	0	0	0	0	0
12-Jan-16	0	0	0	0	0	0	0	2	35	85	127	155	165	159	138	100	50	6	0	0	0	0	0	0
13-Jan-16	0	0	0	0	0	0	0	2	35	85	128	155	166	161	139	100	48	6	0	0	0	0	0	0
14-Jan-16	0	0	0	0	0	0	0	2	34	83	126	154	164	158	126	69	47	6	0	0	0	0	0	0
15-Jan-16	0	0	0	0	0	0	0	0	14	49	52	125	133	70	52	64	44	6	0	0	0	0	0	0
16-Jan-16	0	0	0	0	0	0	0	2	34	79	120	148	158	152	87	43	18	2	0	0	0	0	0	0
17-Jan-16	0	0	0	0	0	0	0	2	35	85	128	156	167	162	140	103	49	7	0	0	0	0	0	0
18-Jan-16	0	0	0	0	0	0	0	1	18	52	74	109	105	114	79	75	26	4	0	0	0	0	0	0
19-Jan-16	0	0	0	0	0	0	0	2	34	79	121	150	156	143	113	93	41	3	0	0	0	0	0	0
20-Jan-16	0	0	0	0	0	0	0	2	34	82	125	153	164	160	139	103	54	9	0	0	0	0	0	0
21-Jan-16	0	0	0	0	0	0	0	2	37	88	131	158	168	161	128	66	45	8	0	0	0	0	0	0
22-Jan-16	0	0	0	0	0	0	0	2	36	86	124	149	163	158	124	80	35	4	0	0	0	0	0	0
23-Jan-16	0	0	0	0	0	0	0	1	24	63	110	140	138	118	94	63	28	4	0	0	0	0	0	0
24-Jan-16	0	0	0	0	0	0	0	2	35	86	131	160	174	170	149	111	60	11	0	0	0	0	0	0
25-Jan-16	0	0	0	0	0	0	0	1	30	83	129	158	170	167	147	110	60	11	0	0	0	0	0	0
26-Jan-16	0	0	0	0	0	0	0	2	38	91	137	167	178	173	151	114	63	13	0	0	0	0	0	0
27-Jan-16	0	0	0	0	0	0	0	3	39	90	134	162	173	169	148	112	59	8	0	0	0	0	0	0
28-Jan-16	0	0	0	0	0	0	0	2	31	83	128	158	168	165	148	112	60	13	0	0	0	0	0	0
29-Jan-16	0	0	0	0	0	0	0	3	40	88	131	149	142	133	107	90	56	13	0	0	0	0	0	0
30-Jan-16	0	0	0	0	0	0	0	3	37	88	132	160	155	139	123	110	62	14	0	0	0	0	0	0
31-Jan-16	0	0	0	0	0	0	0	3	39	89	132	161	159	129	92	70	35	9	0	0	0	0	0	0
1-Feb-16	0	0	0	0	0	0	0	1	13	24	38	74	52	43	37	27	15	3	0	0	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
2-Feb-16	0	0	0	0	0	0	0	4	42	95	140	170	184	182	163	126	73	18	0	0	0	0	0	0
3-Feb-16	0	0	0	0	0	0	0	4	41	91	133	160	171	168	150	115	68	17	0	0	0	0	0	0
4-Feb-16	0	0	0	0	0	0	0	5	44	85	124	168	181	181	162	125	74	19	0	0	0	0	0	0
5-Feb-16	0	0	0	0	0	0	0	4	44	99	145	175	187	185	164	126	75	19	0	0	0	0	0	0
6-Feb-16	0	0	0	0	0	0	0	5	47	100	146	175	187	182	161	124	74	20	0	0	0	0	0	0
7-Feb-16	0	0	0	0	0	0	0	5	47	100	144	172	183	179	159	124	74	20	0	0	0	0	0	0
8-Feb-16	0	0	0	0	0	0	0	5	47	100	145	173	184	179	159	124	74	21	0	0	0	0	0	0
9-Feb-16	0	0	0	0	0	0	0	5	47	100	144	172	183	179	160	125	75	21	0	0	0	0	0	0
10-Feb-16	0	0	0	0	0	0	0	6	48	100	144	171	178	172	143	101	70	15	0	0	0	0	0	0
11-Feb-16	0	0	0	0	0	0	0	6	49	101	145	173	184	180	160	126	77	23	0	0	0	0	0	0
12-Feb-16	0	0	0	0	0	0	0	6	49	101	144	172	182	178	159	124	76	23	0	0	0	0	0	0
13-Feb-16	0	0	0	0	0	0	0	7	51	102	145	172	183	181	161	125	79	24	0	0	0	0	0	0
14-Feb-16	0	0	0	0	0	0	0	7	51	103	145	173	186	182	162	103	42	19	0	0	0	0	0	0
15-Feb-16	0	0	0	0	0	0	0	7	50	103	146	173	183	179	161	127	79	24	0	0	0	0	0	0
16-Feb-16	0	0	0	0	0	0	0	8	52	104	147	174	185	181	162	128	80	26	0	0	0	0	0	0
17-Feb-16	0	0	0	0	0	0	0	8	54	106	149	177	188	185	166	130	81	26	0	0	0	0	0	0
18-Feb-16	0	0	0	0	0	0	0	11	25	55	74	87	117	130	127	99	67	24	0	0	0	0	0	0
19-Feb-16	0	0	0	0	0	0	0	3	18	36	73	93	93	115	124	109	72	27	1	0	0	0	0	0
20-Feb-16	0	0	0	0	0	0	0	9	55	107	150	177	189	184	165	131	82	28	1	0	0	0	0	0
21-Feb-16	0	0	0	0	0	0	0	10	56	109	152	179	191	188	169	134	85	29	1	0	0	0	0	0
22-Feb-16	0	0	0	0	0	0	0	10	57	110	154	182	194	192	173	138	88	31	1	0	0	0	0	0
23-Feb-16	0	0	0	0	0	0	0	12	62	117	161	178	192	189	173	137	87	25	0	0	0	0	0	0
24-Feb-16	0	0	0	0	0	0	0	12	62	117	162	190	200	195	175	139	89	32	1	0	0	0	0	0
25-Feb-16	0	0	0	0	0	0	0	12	61	115	158	185	196	191	172	137	87	32	1	0	0	0	0	0
26-Feb-16	0	0	0	0	0	0	0	13	61	114	157	183	193	189	170	135	86	31	1	0	0	0	0	0
27-Feb-16	0	0	0	0	0	0	0	12	58	112	140	182	193	189	170	136	88	25	1	0	0	0	0	0
28-Feb-16	0	0	0	0	0	0	0	14	63	115	158	184	193	187	170	115	64	19	1	0	0	0	0	0
29-Feb-16	0	0	0	0	0	0	0	14	56	102	145	179	192	188	169	136	88	33	1	0	0	0	0	0
1-Mar-16	0	0	0	0	0	0	0	16	62	101	154	179	185	170	143	115	77	33	2	0	0	0	0	0
2-Mar-16	0	0	0	0	0	0	0	17	61	105	148	181	173	181	164	136	87	33	2	0	0	0	0	0
3-Mar-16	0	0	0	0	0	0	0	14	61	115	129	145	154	177	165	109	57	19	1	0	0	0	0	0
4-Mar-16	0	0	0	0	0	0	0	17	65	120	161	187	196	190	165	126	73	28	1	0	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
5-Mar-16	0	0	0	0	0	0	0	20	60	110	118	148	158	129	110	61	44	19	1	0	0	0	0	0
6-Mar-16	0	0	0	0	0	0	0	6	40	72	120	161	131	114	128	112	78	27	2	0	0	0	0	0
7-Mar-16	0	0	0	0	0	0	0	19	68	119	154	161	155	156	148	119	65	25	1	0	0	0	0	0
8-Mar-16	0	0	0	0	0	0	0	15	69	125	170	197	205	200	181	146	94	35	2	0	0	0	0	0
9-Mar-16	0	0	0	0	0	0	0	22	74	128	171	196	206	202	183	146	94	39	2	0	0	0	0	0
10-Mar-16	0	0	0	0	0	0	0	23	75	129	171	196	205	200	181	145	97	41	2	0	0	0	0	0
11-Mar-16	0	0	0	0	0	0	1	24	60	83	130	138	141	168	135	87	48	25	5	0	0	0	0	0
12-Mar-16	0	0	0	0	0	0	0	23	74	128	172	200	212	208	188	152	100	42	3	0	0	0	0	0
13-Mar-16	0	0	0	0	0	0	0	25	76	129	172	199	210	205	186	144	84	24	2	0	0	0	0	0
14-Mar-16	0	0	0	0	0	0	1	24	74	128	171	187	195	201	182	147	96	41	3	0	0	0	0	0
15-Mar-16	0	0	0	0	0	0	1	26	77	131	172	196	203	195	176	141	89	36	3	0	0	0	0	0
16-Mar-16	0	0	0	0	0	0	1	27	80	134	174	198	207	203	183	149	100	44	4	0	0	0	0	0
17-Mar-16	0	0	0	0	0	0	1	28	81	134	175	199	208	203	185	151	101	44	4	0	0	0	0	0
18-Mar-16	0	0	0	0	0	0	1	29	82	135	175	199	208	203	185	150	100	44	4	0	0	0	0	0
19-Mar-16	0	0	0	0	0	0	1	29	82	136	176	200	208	203	184	149	99	43	4	0	0	0	0	0
20-Mar-16	0	0	0	0	0	0	1	30	82	134	169	199	209	203	183	148	93	46	4	0	0	0	0	0
21-Mar-16	0	0	0	0	0	0	2	32	74	135	173	195	203	198	179	144	99	39	4	0	0	0	0	0
22-Mar-16	0	0	0	0	0	0	2	32	84	138	184	211	220	208	192	151	101	39	5	0	0	0	0	0
23-Mar-16	0	0	0	0	0	0	2	34	89	143	183	205	212	207	187	153	104	47	5	0	0	0	0	0
24-Mar-16	0	0	0	0	0	0	2	36	91	146	186	210	218	212	193	157	106	48	6	0	0	0	0	0
25-Mar-16	0	0	0	0	0	0	3	36	90	144	185	209	217	212	193	157	106	47	6	0	0	0	0	0
26-Mar-16	0	0	0	0	0	0	3	36	90	144	184	208	217	213	194	159	108	50	7	0	0	0	0	0
27-Mar-16	0	0	0	0	0	0	3	38	93	147	188	210	218	212	193	158	107	49	7	0	0	0	0	0
28-Mar-16	0	0	0	0	0	0	2	36	91	144	183	199	150	99	97	141	80	32	3	0	0	0	0	0
29-Mar-16	0	0	0	0	0	0	1	15	55	92	130	186	213	203	190	161	108	50	7	0	0	0	0	0
30-Mar-16	0	0	0	0	0	0	3	38	95	149	188	206	211	204	183	152	104	50	6	0	0	0	0	0
31-Mar-16	0	0	0	0	0	0	3	34	95	150	190	210	212	203	177	142	99	46	5	0	0	0	0	0
1-Apr-16	0	0	0	0	0	0	5	42	97	151	190	212	217	211	190	155	106	50	7	0	0	0	0	0
2-Apr-16	0	0	0	0	0	0	5	43	98	152	191	214	221	214	194	159	109	52	8	0	0	0	0	0
3-Apr-16	0	0	0	0	0	0	5	44	99	151	189	211	218	212	192	158	108	52	8	0	0	0	0	0
4-Apr-16	0	0	0	0	0	0	6	44	97	149	187	209	216	211	192	157	106	49	9	0	0	0	0	0
5-Apr-16	0	0	0	0	0	0	5	41	84	128	161	197	195	179	171	149	96	43	6	0	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
6-Apr-16	0	0	0	0	0	0	7	44	99	151	185	207	209	191	160	147	88	35	6	0	0	0	0	0
7-Apr-16	0	0	0	0	0	0	3	20	33	89	95	118	162	113	64	42	30	12	2	0	0	0	0	0
8-Apr-16	0	0	0	0	0	0	5	32	72	119	153	186	185	147	127	104	66	32	4	0	0	0	0	0
9-Apr-16	0	0	0	0	0	0	7	44	95	141	163	184	197	205	195	157	97	49	8	0	0	0	0	0
10-Apr-16	0	0	0	0	0	0	10	37	55	55	70	106	92	48	58	78	77	41	6	0	0	0	0	0
11-Apr-16	0	0	0	0	0	0	9	51	108	158	188	205	208	200	182	155	104	43	8	0	0	0	0	0
12-Apr-16	0	0	0	0	0	0	9	52	108	162	199	215	204	199	187	154	111	56	11	0	0	0	0	0
13-Apr-16	0	0	0	0	0	0	10	53	110	163	199	219	224	219	200	166	116	58	9	0	0	0	0	0
14-Apr-16	0	0	0	0	0	0	11	54	110	160	196	215	219	217	191	165	114	57	12	0	0	0	0	0
15-Apr-16	0	0	0	0	0	0	11	53	110	164	201	223	228	225	211	176	123	60	12	0	0	0	0	0
16-Apr-16	0	0	0	0	0	0	12	57	116	170	208	226	231	224	203	167	112	54	13	0	0	0	0	0
17-Apr-16	0	0	0	0	0	0	12	58	118	173	211	230	235	228	208	172	121	61	13	0	0	0	0	0
18-Apr-16	0	0	0	0	0	0	13	59	119	172	207	227	234	229	209	174	122	63	13	0	0	0	0	0
19-Apr-16	0	0	0	0	0	0	14	60	118	169	205	224	230	224	202	152	95	51	14	0	0	0	0	0
20-Apr-16	0	0	0	0	0	0	14	60	117	169	204	223	228	223	204	169	119	61	14	0	0	0	0	0
21-Apr-16	0	0	0	0	0	0	14	59	118	162	192	211	219	215	197	162	113	56	12	0	0	0	0	0
22-Apr-16	0	0	0	0	0	0	16	59	115	167	203	222	230	225	205	169	120	62	14	0	0	0	0	0
23-Apr-16	0	0	0	0	0	0	15	60	117	172	209	231	238	232	212	176	124	65	16	0	0	0	0	0
24-Apr-16	0	0	0	0	0	0	17	64	123	175	210	230	237	232	211	175	124	64	14	0	0	0	0	0
25-Apr-16	0	0	0	0	0	0	16	60	120	176	215	234	237	226	210	172	119	58	14	0	0	0	0	0
26-Apr-16	0	0	0	0	0	0	15	63	123	175	211	228	233	229	209	174	122	64	16	0	0	0	0	0
27-Apr-16	0	0	0	0	0	0	17	63	113	154	199	213	219	227	209	169	109	60	14	0	0	0	0	0
28-Apr-16	0	0	0	0	0	0	15	60	115	167	211	229	235	228	203	160	113	58	12	0	0	0	0	0
29-Apr-16	0	0	0	0	0	0	11	42	107	171	207	221	209	206	175	130	93	51	16	0	0	0	0	0
30-Apr-16	0	0	0	0	0	0	16	58	112	139	129	151	176	111	81	44	19	13	9	0	0	0	0	0
1-May-16	0	0	0	0	0	0	11	42	91	157	193	210	205	196	176	144	105	59	16	0	0	0	0	0
2-May-16	0	0	0	0	0	0	19	66	124	176	210	227	227	221	201	166	118	62	16	0	0	0	0	0
3-May-16	0	0	0	0	0	1	20	67	125	175	210	229	234	226	206	171	122	65	17	0	0	0	0	0
4-May-16	0	0	0	0	0	1	20	67	124	176	212	231	236	229	209	173	123	65	17	0	0	0	0	0
5-May-16	0	0	0	0	0	1	21	68	126	176	208	219	221	228	214	177	126	65	17	0	0	0	0	0
6-May-16	0	0	0	0	0	0	20	68	128	176	206	215	213	158	174	99	83	49	5	0	0	0	0	0
7-May-16	0	0	0	0	0	1	21	68	128	177	204	205	199	191	175	147	95	57	21	0	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
8-May-16	0	0	0	0	0	0	21	65	124	178	209	215	175	201	183	141	96	53	17	0	0	0	0	0
9-May-16	0	0	0	0	0	1	23	71	129	180	214	233	239	233	212	177	5	3	1	0	0	0	0	0
10-May-16	0	0	0	0	0	1	23	71	130	179	214	233	240	234	213	179	129	70	21	1	0	0	0	0
11-May-16	0	0	0	0	0	2	24	66	115	165	206	229	235	228	207	173	125	69	20	1	0	0	0	0
12-May-16	0	0	0	0	0	1	24	69	123	173	210	230	235	227	207	174	126	69	21	1	0	0	0	0
13-May-16	0	0	0	0	0	1	24	72	130	178	212	230	234	227	207	171	125	72	24	1	0	0	0	0
14-May-16	0	0	0	0	0	2	29	64	119	162	180	209	212	209	198	158	115	60	25	1	0	0	0	0
15-May-16	0	0	0	0	0	2	24	73	131	182	218	238	244	238	217	182	131	72	23	1	0	0	0	0
16-May-16	0	0	0	0	0	2	24	72	131	180	215	231	234	228	211	178	129	71	22	1	0	0	0	0
17-May-16	0	0	0	0	0	1	19	66	127	176	207	220	223	219	198	140	83	37	10	0	0	0	0	0
18-May-16	0	0	0	0	0	1	10	30	73	89	130	198	223	209	162	139	108	53	12	1	0	0	0	0
19-May-16	0	0	0	0	0	2	25	73	131	180	213	230	234	226	206	173	127	71	22	1	0	0	0	0
20-May-16	0	0	0	0	0	2	25	73	133	183	218	238	241	232	214	179	131	73	23	1	0	0	0	0
21-May-16	0	0	0	0	0	2	26	76	137	189	224	244	249	242	221	185	136	77	25	1	0	0	0	0
22-May-16	0	0	0	0	0	2	26	76	136	187	223	243	248	241	221	186	136	76	25	1	0	0	0	0
23-May-16	0	0	0	0	0	2	27	77	136	187	222	240	246	239	219	185	135	76	25	1	0	0	0	0
24-May-16	0	0	0	0	0	2	27	75	135	187	223	242	248	242	223	187	136	77	26	1	0	0	0	0
25-May-16	0	0	0	0	0	3	28	76	134	185	220	241	247	240	219	184	135	76	25	1	0	0	0	0
26-May-16	0	0	0	0	0	2	27	75	134	185	220	239	244	236	217	182	132	75	26	2	0	0	0	0
27-May-16	0	0	0	0	0	2	27	75	133	181	214	232	238	231	211	177	130	74	26	2	0	0	0	0
28-May-16	0	0	0	0	0	2	27	75	133	182	215	234	239	232	212	178	131	74	26	2	0	0	0	0
29-May-16	0	0	0	0	0	3	28	76	134	184	219	241	247	239	219	185	136	78	27	2	0	0	0	0
30-May-16	0	0	0	0	0	3	29	78	136	186	220	239	245	238	218	184	135	77	27	2	0	0	0	0
31-May-16	0	0	0	0	0	3	28	76	133	181	213	232	238	230	210	177	131	78	32	3	0	0	0	0
1-Jun-16	0	0	0	0	0	2	26	72	129	178	211	230	236	230	211	179	131	75	27	2	0	0	0	0
2-Jun-16	0	0	0	0	0	3	27	72	130	179	212	229	235	229	211	179	131	75	29	2	0	0	0	0
3-Jun-16	0	0	0	0	0	3	27	74	130	176	208	227	233	226	208	176	130	75	27	2	0	0	0	0
4-Jun-16	0	0	0	0	0	3	27	73	128	175	206	223	229	225	207	175	128	73	27	2	0	0	0	0
5-Jun-16	0	0	0	0	0	2	27	73	129	175	208	225	231	225	206	175	130	75	28	2	0	0	0	0
6-Jun-16	0	0	0	0	0	4	28	72	129	177	211	229	235	230	212	180	132	72	29	3	0	0	0	0
7-Jun-16	0	0	0	0	0	3	27	74	131	179	212	232	238	232	212	179	132	77	28	3	0	0	0	0
8-Jun-16	0	0	0	0	0	3	26	71	125	172	205	224	228	221	202	169	126	73	34	3	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
9-Jun-16	0	0	0	0	0	2	25	70	125	172	207	228	234	228	209	176	129	75	28	2	0	0	0	0
10-Jun-16	0	0	0	0	0	2	22	55	91	169	196	199	193	180	150	134	75	42	16	1	0	0	0	0
11-Jun-16	0	0	0	0	0	2	26	70	125	172	206	224	221	189	179	93	109	73	27	3	0	0	0	0
12-Jun-16	0	0	0	0	0	3	28	75	133	182	217	236	241	235	213	181	136	80	30	3	0	0	0	0
13-Jun-16	0	0	0	0	0	3	27	74	132	181	218	240	247	243	224	190	141	83	32	3	0	0	0	0
14-Jun-16	0	0	0	0	0	3	28	75	134	184	219	239	247	242	223	190	141	83	32	3	0	0	0	0
15-Jun-16	0	0	0	0	0	3	28	77	136	186	221	242	249	243	224	190	142	83	32	3	0	0	0	0
16-Jun-16	0	0	0	0	0	3	28	75	134	183	218	238	245	241	222	189	141	84	32	3	0	0	0	0
17-Jun-16	0	0	0	0	0	3	28	76	134	183	217	237	244	238	220	188	141	84	32	3	0	0	0	0
18-Jun-16	0	0	0	0	0	3	28	76	134	182	210	225	222	220	209	177	136	79	29	3	0	0	0	0
19-Jun-16	0	0	0	0	0	3	26	72	128	175	207	225	231	225	207	176	132	77	30	3	0	0	0	0
20-Jun-16	0	0	0	0	0	3	27	70	125	173	208	229	234	226	205	171	125	67	25	2	0	0	0	0
21-Jun-16	0	0	0	0	0	2	24	67	122	168	199	220	229	223	205	174	127	74	26	3	0	0	0	0
22-Jun-16	0	0	0	0	0	2	22	65	122	172	207	227	234	230	212	180	133	78	30	3	0	0	0	0
23-Jun-16	0	0	0	0	0	2	25	68	120	168	204	224	231	222	206	173	129	74	30	5	0	0	0	0
24-Jun-16	0	0	0	0	0	2	23	67	124	172	208	230	237	228	209	180	136	81	31	3	0	0	0	0
25-Jun-16	0	0	0	0	0	2	25	70	125	174	208	227	233	227	208	178	132	78	31	4	0	0	0	0
26-Jun-16	0	0	0	0	0	2	23	67	117	157	193	187	189	184	193	155	110	60	27	2	0	0	0	0
27-Jun-16	0	0	0	0	0	2	15	37	77	129	162	173	196	198	184	159	96	54	16	1	0	0	0	0
28-Jun-16	0	0	0	0	0	2	25	65	121	170	204	221	224	212	193	165	122	73	30	4	0	0	0	0
29-Jun-16	0	0	0	0	0	2	26	70	120	163	193	209	213	183	176	144	109	73	28	3	0	0	0	0
30-Jun-16	0	0	0	0	0	0	11	42	81	95	76	93	126	124	112	113	118	79	37	5	0	0	0	0
1-Jul-16	0	0	0	0	0	0	14	60	113	151	193	229	228	223	202	150	78	27	14	5	0	0	0	0
2-Jul-16	0	0	0	0	0	1	17	62	124	177	214	233	237	230	213	180	135	80	31	3	0	0	0	0
3-Jul-16	0	0	0	0	0	2	24	69	126	174	208	227	233	228	207	175	137	83	32	3	0	0	0	0
4-Jul-16	0	0	0	0	0	2	24	69	127	177	211	231	238	234	217	186	140	84	33	4	0	0	0	0
5-Jul-16	0	0	0	0	0	2	24	69	127	177	210	230	235	236	218	188	142	85	33	4	0	0	0	0
6-Jul-16	0	0	0	0	0	2	24	70	128	178	214	236	243	238	219	187	140	84	32	3	0	0	0	0
7-Jul-16	0	0	0	0	0	2	24	70	128	179	215	236	243	237	219	187	140	84	32	3	0	0	0	0
8-Jul-16	0	0	0	0	0	2	24	70	129	180	216	237	245	240	222	190	142	85	33	3	0	0	0	0
9-Jul-16	0	0	0	0	0	2	23	69	127	178	214	234	239	235	219	187	141	83	32	3	0	0	0	0
10-Jul-16	0	0	0	0	0	1	23	68	127	178	214	236	245	242	225	193	146	87	34	4	0	0	0	0

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Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
11-Jul-16	0	0	0	0	0	1	23	70	129	182	219	240	248	244	226	193	146	88	34	4	0	0	0	0
12-Jul-16	0	0	0	0	0	1	23	70	129	181	217	238	245	240	223	192	144	86	33	3	0	0	0	0
13-Jul-16	0	0	0	0	0	1	23	69	127	178	215	236	242	236	219	187	140	83	32	3	0	0	0	0
14-Jul-16	0	0	0	0	0	1	21	66	125	176	213	233	241	237	219	186	140	83	32	3	0	0	0	0
15-Jul-16	0	0	0	0	0	1	21	66	124	176	212	233	241	236	218	186	139	82	31	3	0	0	0	0
16-Jul-16	0	0	0	0	0	1	22	66	119	172	209	231	239	232	210	178	135	80	30	3	0	0	0	0
17-Jul-16	0	0	0	0	0	1	20	60	109	133	138	177	183	147	110	152	121	66	20	2	0	0	0	0
18-Jul-16	0	0	0	0	0	1	16	51	90	148	187	220	228	211	188	171	128	77	22	2	0	0	0	0
19-Jul-16	0	0	0	0	0	1	22	59	98	148	189	217	230	224	203	173	130	81	34	3	0	0	0	0
20-Jul-16	0	0	0	0	0	1	16	56	102	142	186	219	224	215	198	164	93	44	18	2	0	0	0	0
21-Jul-16	0	0	0	0	0	1	19	63	119	170	205	224	229	224	207	172	126	77	33	4	0	0	0	0
22-Jul-16	0	0	0	0	0	0	12	55	118	162	184	222	227	218	204	174	117	54	19	2	0	0	0	0
23-Jul-16	0	0	0	0	0	1	21	61	116	171	206	228	237	231	212	180	133	78	28	2	0	0	0	0
24-Jul-16	0	0	0	0	0	1	19	62	120	173	207	232	240	233	212	170	130	75	23	2	0	0	0	0
25-Jul-16	0	0	0	0	0	0	18	61	117	167	206	228	234	227	203	169	122	60	16	1	0	0	0	0
26-Jul-16	0	0	0	0	0	0	13	54	111	164	202	221	226	220	202	176	130	73	27	2	0	0	0	0
27-Jul-16	0	0	0	0	0	0	17	59	116	168	206	227	235	230	205	174	129	76	28	1	0	0	0	0
28-Jul-16	0	0	0	0	0	0	17	55	97	154	205	227	232	228	209	172	124	72	26	2	0	0	0	0
29-Jul-16	0	0	0	0	0	1	21	63	117	168	205	229	236	230	211	175	126	73	26	2	0	0	0	0
30-Jul-16	0	0	0	0	0	0	14	59	115	160	200	223	236	233	213	178	130	75	26	1	0	0	0	0
31-Jul-16	0	0	0	0	0	0	10	45	92	147	207	232	238	230	209	181	129	73	25	2	0	0	0	0
1-Aug-16	0	0	0	0	0	0	12	46	96	140	168	224	230	230	210	172	128	75	27	0	0	0	0	0
2-Aug-16	0	0	0	0	0	0	11	49	101	153	190	206	208	194	164	102	56	26	4	0	0	0	0	0
3-Aug-16	0	0	0	0	0	0	12	53	97	143	190	212	214	185	116	113	114	76	27	1	0	0	0	0
4-Aug-16	0	0	0	0	0	0	10	43	92	150	206	221	228	218	194	148	77	51	26	2	0	0	0	0
5-Aug-16	0	0	0	0	0	0	8	25	39	44	56	111	214	233	205	142	96	52	18	1	0	0	0	0
6-Aug-16	0	0	0	0	0	0	15	60	120	174	213	233	241	233	210	179	131	74	23	1	0	0	0	0
7-Aug-16	0	0	0	0	0	0	15	60	120	175	213	234	240	233	213	180	131	75	24	1	0	0	0	0
8-Aug-16	0	0	0	0	0	0	15	60	121	175	213	236	243	239	221	187	138	77	24	1	0	0	0	0
9-Aug-16	0	0	0	0	0	0	16	59	114	165	190	185	133	219	218	175	129	70	21	0	0	0	0	0
10-Aug-16	0	0	0	0	0	0	11	50	107	154	195	216	222	214	196	163	110	62	16	0	0	0	0	0
11-Aug-16	0	0	0	0	0	0	12	44	74	122	161	205	236	235	216	182	134	74	15	0	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
12-Aug-16	0	0	0	0	0	0	14	59	119	174	214	237	245	238	213	145	110	72	21	0	0	0	0	0
13-Aug-16	0	0	0	0	0	0	14	60	120	174	212	235	243	237	217	181	132	72	20	0	0	0	0	0
14-Aug-16	0	0	0	0	0	0	14	60	121	179	219	241	248	240	218	183	132	72	20	0	0	0	0	0
15-Aug-16	0	0	0	0	0	0	14	59	119	174	213	235	239	229	208	177	121	61	15	0	0	0	0	0
16-Aug-16	0	0	0	0	0	0	11	56	114	165	205	229	233	227	202	167	113	54	12	0	0	0	0	0
17-Aug-16	0	0	0	0	0	0	11	46	81	124	166	203	219	216	196	162	117	56	10	0	0	0	0	0
18-Aug-16	0	0	0	0	0	0	4	30	60	109	193	223	234	233	213	173	121	66	16	0	0	0	0	0
19-Aug-16	0	0	0	0	0	0	10	55	116	166	205	232	244	241	218	180	126	67	18	0	0	0	0	0
20-Aug-16	0	0	0	0	0	0	12	47	92	145	180	210	236	234	209	172	118	44	5	0	0	0	0	0
21-Aug-16	0	0	0	0	0	0	8	45	103	161	203	227	239	231	210	177	120	61	16	0	0	0	0	0
22-Aug-16	0	0	0	0	0	0	11	57	118	175	212	229	220	204	148	66	72	47	15	0	0	0	0	0
23-Aug-16	0	0	0	0	0	0	8	49	61	97	149	156	164	197	212	182	126	65	14	0	0	0	0	0
24-Aug-16	0	0	0	0	0	0	9	55	118	174	214	237	245	235	211	166	108	54	12	0	0	0	0	0
25-Aug-16	0	0	0	0	0	0	11	56	115	169	210	229	231	223	199	170	115	55	12	0	0	0	0	0
26-Aug-16	0	0	0	0	0	0	5	42	100	147	164	163	202	208	207	171	119	62	13	0	0	0	0	0
27-Aug-16	0	0	0	0	0	0	6	42	94	154	200	243	254	243	217	179	126	64	12	0	0	0	0	0
28-Aug-16	0	0	0	0	0	0	11	57	120	178	218	241	247	240	219	180	125	63	12	0	0	0	0	0
29-Aug-16	0	0	0	0	0	0	11	58	120	178	217	240	247	239	215	175	122	61	12	0	0	0	0	0
30-Aug-16	0	0	0	0	0	0	10	53	111	166	205	226	230	223	198	153	98	43	10	0	0	0	0	0
31-Aug-16	0	0	0	0	0	0	9	53	113	170	210	231	236	228	205	167	114	54	9	0	0	0	0	0
1-Sep-16	0	0	0	0	0	0	5	35	68	105	152	162	174	195	184	149	98	44	7	0	0	0	0	0
2-Sep-16	0	0	0	0	0	0	10	54	112	169	207	227	231	220	201	168	116	55	8	0	0	0	0	0
3-Sep-16	0	0	0	0	0	0	9	54	117	176	218	240	245	236	213	177	122	59	9	0	0	0	0	0
4-Sep-16	0	0	0	0	0	0	10	59	125	186	229	254	262	254	230	188	128	60	9	0	0	0	0	0
5-Sep-16	0	0	0	0	0	0	10	59	124	184	226	250	258	249	226	184	124	58	8	0	0	0	0	0
6-Sep-16	0	0	0	0	0	0	9	57	120	179	219	241	247	235	184	147	89	40	5	0	0	0	0	0
7-Sep-16	0	0	0	0	0	0	1	10	22	45	75	122	124	129	140	106	67	28	4	0	0	0	0	0
8-Sep-16	0	0	0	0	0	0	6	44	101	152	193	232	246	240	218	176	118	53	6	0	0	0	0	0
9-Sep-16	0	0	0	0	0	0	8	54	117	175	216	240	248	240	215	173	116	51	6	0	0	0	0	0
10-Sep-16	0	0	0	0	0	0	9	52	113	172	214	237	242	233	209	168	111	49	5	0	0	0	0	0
11-Sep-16	0	0	0	0	0	0	7	54	116	174	216	241	246	237	213	171	112	49	5	0	0	0	0	0
12-Sep-16	0	0	0	0	0	0	4	46	98	148	187	226	245	238	212	170	108	45	4	0	0	0	0	0

2016 Residential Solar Production (MW)

Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
13-Sep-16	0	0	0	0	0	0	8	46	89	126	155	174	159	171	154	117	90	33	5	0	0	0	0	0
14-Sep-16	0	0	0	0	0	0	7	52	114	171	213	239	249	242	218	175	114	48	4	0	0	0	0	0
15-Sep-16	0	0	0	0	0	0	7	56	120	180	222	245	253	245	221	178	116	48	4	0	0	0	0	0
16-Sep-16	0	0	0	0	0	0	7	55	120	181	222	245	251	241	215	169	106	43	3	0	0	0	0	0
17-Sep-16	0	0	0	0	0	0	6	53	117	177	221	244	249	239	213	170	109	44	3	0	0	0	0	0
18-Sep-16	0	0	0	0	0	0	6	53	117	176	217	240	245	236	210	166	107	42	2	0	0	0	0	0
19-Sep-16	0	0	0	0	0	0	5	46	114	171	198	185	190	191	123	60	32	9	0	0	0	0	0	0
20-Sep-16	0	0	0	0	0	0	2	16	27	55	67	83	74	92	87	86	52	24	2	0	0	0	0	0
21-Sep-16	0	0	0	0	0	0	4	26	65	132	186	195	220	221	187	141	90	32	1	0	0	0	0	0
22-Sep-16	0	0	0	0	0	0	5	43	77	82	88	111	142	148	93	71	87	36	1	0	0	0	0	0
23-Sep-16	0	0	0	0	0	0	6	50	103	162	208	225	228	241	226	177	110	39	1	0	0	0	0	0
24-Sep-16	0	0	0	0	0	0	5	52	119	182	225	250	256	246	217	170	105	37	1	0	0	0	0	0
25-Sep-16	0	0	0	0	0	0	5	51	118	181	226	248	252	240	211	163	100	34	1	0	0	0	0	0
26-Sep-16	0	0	0	0	0	0	3	27	76	125	143	157	200	168	124	77	39	10	0	0	0	0	0	0
27-Sep-16	0	0	0	0	0	0	4	42	94	128	118	129	155	209	194	141	88	27	1	0	0	0	0	0
28-Sep-16	0	0	0	0	0	0	2	38	100	151	188	201	205	193	173	136	87	31	1	0	0	0	0	0
29-Sep-16	0	0	0	0	0	0	0	10	24	59	113	127	169	215	179	148	91	29	0	0	0	0	0	0
30-Sep-16	0	0	0	0	0	0	4	45	108	166	205	227	231	215	172	104	56	20	0	0	0	0	0	0

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-19: SEIA 1.10_2015 Substation Transformer Data_APSRC01727.xlsx

Tag Name
AA:12KV:XFMR11 A:MW:MvMoment
AA:12KV:XFMR3 A:MW:MvMoment
ABX:69KV:XFMR4 A:MW:MvMoment
AD:12KV:XFMR11 A:MW:MvMoment
AD:12KV:XFMR19 A:MW:MvMoment
AF:69KV:XFMR5 A:MW:MvMoment
AFX:230KV:XFMR3 A:MW:MvMoment
AFX:230KV:XFMR4 A:MW:MvMoment
AG:12KV:XFMR2 A:MW:MvMoment
AL:12KV:XFMR2 A:MW:MvMoment
ALHX:161KV:XFMR1 A:MW:MvMoment
AN:12KV:XFMR19 A:MW:MvMoment
ANX:230KV:XFMR1 A:MW:MvMoment
ANX:230KV:XFMR2 A:MW:MvMoment
ANX:230KV:XFMR3 A:MW:MvMoment
ANX:230KV:XFMR4 A:MW:MvMoment
APX:115KV:XFMR1 A:MW:MvMoment
APX:115KV:XFMR2 A:MW:MvMoment
AR:12KV:XFMR11 A:MW:MvMoment
AR:12KV:XFMR3 A:MW:MvMoment
ARC:12KV:XFMR3 A:MW:MvMoment
ARDX:230KV:XFMR2 A:MW:MvMoment
ARDX:230KV:XFMR7 A:MW:MvMoment
ARKX:161KV:XFMR1 A:MW:MvMoment
ARRX:345KV:XFMR1 A:MW:MvMoment
ARRX:345KV:XFMR5 A:MW:MvMoment
AT:12KV:XFMR51 A:MW:MvMoment
AT:12KV:XFMR52 A:MW:MvMoment
AVSX:115KV:XFMR2 A:CMW:MvMoment
AVX:92KV:XFMR1 A:MW:MvMoment
AVX:92KV:XFMR2 A:MW:MvMoment
AVX:92KV:XFMR3 A:MW:MvMoment
AVX:92KV:XFMR4 A:MW:MvMoment
AW:12KV:XFMR11 A:MW:MvMoment
AW:12KV:XFMR3 A:MW:MvMoment
AXX:230KV:XFMR0 A:MW:MvMoment
AXX:230KV:XFMR1 A:MW:MvMoment
AXX:230KV:XFMR2 A:MW:MvMoment
AY:12KV:XFMR3 A:MW:MvMoment
AZ:12KV:XFMR11 A:MW:MvMoment
BB:12KV:XFMR11 A:MW:MvMoment
BDX:230KV:XFMR1 A:MW:MvMoment
BDX:230KV:XFMR2 A:MW:MvMoment
BDX:230KV:XFMR3 A:MW:MvMoment
BE:12KV:XFMR2 A:MW:MvMoment
BF:12KV:XFMR11 A:MW:MvMoment
BF:12KV:XFMR3 A:MW:MvMoment
BGD:12KV:XFMR3 A:MW:MvMoment
BIX:345KV:XFMR A:MW:MvMoment
BJ:12KV:XFMR11 A:MW:MvMoment
BK:12KV:XFMR3 A:MW:MvMoment
BK:69KV:XFMR2 A:MW:MvMoment
BK:69KV:XFMR6 A:MW:MvMoment
BLL:12KV:XFMR11 A:MW:MvMoment
BLL:12KV:XFMR19 A:MW:MvMoment
BLWX:230KV:XFMR5 A:MW:MvMoment
BMT:12KV:XFMR11 A:MW:MvMoment
BMT:12KV:XFMR3 A:MW:MvMoment
BMX:69KV:XFMR1 A:MW:MvMoment
BMX:69KV:XFMR2 A:MW:MvMoment
BMX:69KV:XFMR3 A:MW:MvMoment
BMX:69KV:XFMR4 A:MW:MvMoment
BNX:230KV:XFMR1A A:MW:MvMoment
BNX:230KV:XFMR1B A:MW:MvMoment
BNX:230KV:XFMR4 A:MW:MvMoment
BNX:230KV:XFMR5 A:MW:MvMoment
BP:12KV:XFMR1 A:MW:MvMoment

Tag Name
BP:69KV:XFMR2 A:MW:MvMoment
BP:69KV:XFMR3 A:CMW:MvMoment
BP:69KV:XFMR3 A:MW:MvMoment
BQ:12KV:XFMR3 A:MW:MvMoment
BU:12KV:XFMR11 A:MW:MvMoment
BU:12KV:XFMR19 A:MW:MvMoment
BU:12KV:XFMR27 A:MW:MvMoment
BU:12KV:XFMR35 A:MW:MvMoment
BV:12KV:XFMR11 A:MW:MvMoment
BV:12KV:XFMR3 A:MW:MvMoment
BY:12KV:XFMR2 A:MW:MvMoment
BZ:12KV:XFMR11 A:MW:MvMoment
BZ:12KV:XFMR2 A:MW:MvMoment
BZX:345KV:XFMR2 A:MW:MvMoment
BZX:345KV:XFMR3 A:MW:MvMoment
CA:12KV:XFMR3 A:MW:MvMoment
CAX:138KV:XFMR1 A:MW:MvMoment
CB:12KV:XFMR11 A:MW:MvMoment
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CB:12KV:XFMR27 A:MW:MvMoment
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CCR:12KV:XFMR11 A:MW:MvMoment
CCR:12KV:XFMR3 A:MW:MvMoment
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CCVX:92KV:XFMR2 A:MW:MvMoment
CCVX:92KV:XFMR3 A:MW:MvMoment
CCVX:92KV:XFMR4 A:MW:MvMoment
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CD:12KV:XFMR3 A:MW:MvMoment
CDS:12KV:XFMR3 A:MW:MvMoment
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CGTEMP:230KV:XFMR2 A:MW:MvMoment
CGTEMP:69KV:XFMR2 A:MW:MvMoment
CGX:115KV:XFMR1A A:MW:MvMoment
CH:230KV:XFMR7 A:MW:MvMoment
CH:345KV:XFMR3 A:MW:MvMoment
CH:345KV:XFMR6 A:MW:MvMoment
CH:69KV:XFMR1 A:MW:MvMoment
CH:69KV:XFMR2 A:MW:MvMoment
CH:69KV:XFMR8 A:MW:MvMoment
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CJ:12KV:XFMR19 A:MW:MvMoment
CKX:230KV:XFMR1 A:MW:MvMoment
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CLNT:12KV:XFMR11 A:MW:MvMoment
CLNT:12KV:XFMR3 A:MW:MvMoment

Tag Name
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CLT:12KV:XFMR3 A:MW:MvMoment
CLW:12KV:XFMR11 A:MW:MvMoment
CLX:115KV:XFMR3 A:MW:MvMoment
CLX:115KV:XFMR4 A:MW:MvMoment
CLX:230KV:XFMR3 A:MW:MvMoment
CLX:230KV:XFMR4 A:MW:MvMoment
CMNX:230KV:XFMR1 A:MW:MvMoment
CN:12KV:XFMR3 A:MW:MvMoment
CNX:500KV:XFMR9A A:MW:MvMoment
CNX:500KV:XFMR9B A:MW:MvMoment
COX:345KV:XFMR1 A:MW:MvMoment
CP:12KV:XFMR11 A:MW:MvMoment
CP:12KV:XFMR3 A:MW:MvMoment
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CPL:12KV:XFMR3 A:MW:MvMoment
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CRGX:345KV:XFMR1 A:MW:MvMoment
CRGX:345KV:XFMR2 A:MW:MvMoment
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CRL:12KV:XFMR3 A:MW:MvMoment
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CU:12KV:XFMR11 A:MW:MvMoment
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CX:69KV:XFMR14 A:MW:MvMoment
CX:69KV:XFMR6 A:MW:MvMoment
CY:12KV:XFMR11 A:MW:MvMoment
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CYX:500KV:XFMR2 A:MW:MvMoment
CYX:500KV:XFMR3 A:MW:MvMoment
DAX:230KV:XFMR7 A:MW:MvMoment
DAX:230KV:XFMR8 A:MW:MvMoment
DBN:230KV:XFMR8 A:MW:MvMoment
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DDX:230KV:XFMR2 A:MW:MvMoment
DE:12KV:XFMR11 A:MW:MvMoment

Tag Name
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DG:12KV:XFMR11 A:MW:MvMoment
DG:12KV:XFMR3 A:MW:MvMoment
DGS:69KV:XFMR2 A:MW:MvMoment
DL:12KV:XFMR2 A:MW:MvMoment
DM:12KV:XFMR11 A:MW:MvMoment
DM:12KV:XFMR3 A:MW:MvMoment
DMX:138KV:XFMR5 A:MW:MvMoment
DMX:138KV:XFMR6 A:MW:MvMoment
DMX:138KV:XFMR7 A:MW:MvMoment
DNP:12KV:XFMR2 A:MW:MvMoment
DR:12KV:XFMR3 A:MW:MvMoment
DRKX:4KV:XFMR11 A:MW:MvMoment
DRKX:4KV:XFMR19 A:MW:MvMoment
DS:12KV:XFMR11 A:MW:MvMoment
DS:12KV:XFMR3 A:MW:MvMoment
DSX:69KV:XFMR2 A:MW:MvMoment
DT:12KV:XFMR51 A:MW:MvMoment
DU:12KV:XFMR11 A:MW:MvMoment
DU:12KV:XFMR3 A:MW:MvMoment
DUX:230KV:XFMR1B A:MW:MvMoment
DV:12KV:XFMR11 A:MW:MvMoment
DV:12KV:XFMR19 A:MW:MvMoment
DV:12KV:XFMR27 A:MW:MvMoment
DV:69KV:XFMR10 A:MW:MvMoment
DV:69KV:XFMR14 A:MW:MvMoment
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DVY:12KV:XFMR11 A:MW:MvMoment
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DY:12KV:XFMR27 A:MW:MvMoment
DZ:12KV:XFMR11 A:MW:MvMoment
DZ:12KV:XFMR3 A:MW:MvMoment
EA:12KV:XFMR3 A:MW:MvMoment
EC:12KV:XFMR11 A:MW:MvMoment
EC:12KV:XFMR3 A:MW:MvMoment
ECOX:230KV:XFMR62 A:MW:MvMoment
ECOX:230KV:XFMR83 A:MW:MvMoment
ECSX:230KV:XFMR3 A:MW:MvMoment
ECSX:230KV:XFMR4 A:MW:MvMoment
ECX:161KV:XFMR1 A:MW:MvMoment
ECX:230KV:XFMR4 A:MW:MvMoment
ECX:92KV:XFMR2 A:MW:MvMoment
EG:12KV:XFMR3 A:MW:MvMoment
EGX:230KV:XFMR1 A:MW:MvMoment
EGX:230KV:XFMR2 A:MW:MvMoment
EGX:69KV:XFMR3A A:MW:MvMoment
EGX:69KV:XFMR4A A:MW:MvMoment
EIX:230KV:XFMR60 A:MW:MvMoment
ELLX:230KV:XFMR1 A:MW:MvMoment
ELLX:230KV:XFMR2 A:MW:MvMoment
ELLX:230KV:XFMR3 A:MW:MvMoment
ELLX:230KV:XFMR4 A:MW:MvMoment
ELN:12KV:XFMR11 A:MW:MvMoment
ELN:12KV:XFMR3 A:MW:MvMoment
EN:12KV:XFMR11 A:MW:MvMoment
EN:12KV:XFMR3 A:MW:MvMoment
ENX:138KV:XFMR1 A:MW:MvMoment
EO:12KV:XFMR11 A:MW:MvMoment

Tag Name
EPX:138KV:XFMR1 A:MW:MvMoment
EPX:138KV:XFMR2 A:MW:MvMoment
EPX:138KV:XFMR3 A:MW:MvMoment
EPX:138KV:XFMR4 A:MW:MvMoment
EQX:230KV:XFMR1 A:MW:MvMoment
ES:12KV:XFMR11 A:MW:MvMoment
ES:12KV:XFMR19 A:MW:MvMoment
ES:69KV:XFMR12 A:MW:MvMoment
ES:69KV:XFMR4 A:MW:MvMoment
ESX:230KV:XFMR70 A:MW:MvMoment
ESX:230KV:XFMR71 A:MW:MvMoment
ESX:230KV:XFMR72 A:MW:MvMoment
ET:12KV:XFMR11 A:MW:MvMoment
FA:12KV:XFMR11 A:MW:MvMoment
FC:230KV:XFMR4 A:MW:MvMoment
FC:230KV:XFMR8 A:MW:MvMoment
FC:345KV:XFMR4 A:MW:MvMoment
FC:345KV:XFMR8 A:MW:MvMoment
FC:69KV:XFMR2 A:MW:MvMoment
FC:69KV:XFMRGS A:MW:MvMoment
FE:12KV:XFMR3 A:MW:MvMoment
FH:12KV:XFMR11 A:MW:MvMoment
FH:12KV:XFMR19 A:MW:MvMoment
FKX:230KV:XFMR1 A:MW:MvMoment
FL:12KV:XFMR51 A:MW:MvMoment
FL:12KV:XFMR52 A:MW:MvMoment
FLR:12KV:XFMR3 A:MW:MvMoment
FP:12KV:XFMR11 A:MW:MvMoment
FP:12KV:XFMR3 A:MW:MvMoment
FSX:230KV:XFMR5 A:MW:MvMoment
GB:12KV:XFMR11 A:MW:MvMoment
GB:12KV:XFMR19 A:MW:MvMoment
GB:69KV:XFMR12 A:MW:MvMoment
GB:69KV:XFMR8 A:MW:MvMoment
GBS:12KV:XFMR11 A:MW:MvMoment
GC:12KV:XFMR2 A:MW:MvMoment
GEX:230KV:XFMR1 A:MW:MvMoment
GEX:230KV:XFMR2 A:MW:MvMoment
GF:12KV:XFMR51 A:MW:MvMoment
GF:12KV:XFMR52 A:MW:MvMoment
GF:12KV:XFMR53 A:MW:MvMoment
GF:12KV:XFMR54 A:MW:MvMoment
GFX:230KV:XFMR1 A:MW:MvMoment
GGX:230KV:XFMR A:MW:MvMoment
GIX:161KV:XFMR1 A:MW:MvMoment
GJX:345KV:XFMR A:MW:MvMoment
GL:12KV:XFMR15 A:MW:MvMoment
GL:12KV:XFMR3 A:MW:MvMoment
GLFX:230KV:XFMR1 A:MW:MvMoment
GLFX:230KV:XFMR2 A:MW:MvMoment
GN:12KV:XFMR11 A:MW:MvMoment
GP:12KV:XFMR3 A:MW:MvMoment
GR:12KV:XFMR11 A:MW:MvMoment
GR:12KV:XFMR3 A:MW:MvMoment
GRF:12KV:XFMR3 A:MW:MvMoment
GRW:12KV:XFMR3 A:MW:MvMoment
GTX:230KV:XFMR2 A:MW:MvMoment
GV:12KV:XFMR43 A:MW:MvMoment
GV:69KV:XFMR11 A:MW:MvMoment
GW:12KV:XFMR11 A:MW:MvMoment
GW:12KV:XFMR19 A:MW:MvMoment
GW:12KV:XFMR3 A:MW:MvMoment
GWX:230KV:XFMR1 A:MW:MvMoment
GWX:230KV:XFMR2 A:MW:MvMoment
GWX:230KV:XFMR4 A:MW:MvMoment
GY:12KV:XFMR19 A:MW:MvMoment
HA:6.9KV:XFMR4 A:MW:MvMoment

Tag Name
HC:21KV:XFMR3 A:MW:MvMoment
HCX:230KV:XFMR A:MW:MvMoment
HCX:230KV:XFMR2 A:MW:MvMoment
HD:12KV:XFMR1 A:MW:MvMoment
HDX:345KV:XFMR1 A:MW:MvMoment
HDX:345KV:XFMR2 A:MW:MvMoment
HE:12KV:XFMR11 A:MW:MvMoment
HE:12KV:XFMR3 A:MW:MvMoment
HEX:345KV:XFMR1 A:MW:MvMoment
HEX:345KV:XFMR2 A:MW:MvMoment
HF:12KV:XFMR3 A:MW:MvMoment
HG:12KV:XFMR11 A:MW:MvMoment
HG:12KV:XFMR3 A:MW:MvMoment
HGLX:92KV:XFMR1 A:MW:MvMoment
HGX:161KV:XFMR10 A:MW:MvMoment
HGX:161KV:XFMR7 A:MW:MvMoment
HH:12KV:XFMR11 A:MW:MvMoment
HH:12KV:XFMR3 A:MW:MvMoment
HKM:12KV:XFMR3 A:MW:MvMoment
HKX:230KV:XFMR1 A:MW:MvMoment
HKX:230KV:XFMR2 A:MW:MvMoment
HN:12KV:XFMR3 A:MW:MvMoment
HQ:12KV:XFMR2 A:MW:MvMoment
HQX:500KV:XFMR1 A:MW:MvMoment
HQX:500KV:XFMR2 A:MW:MvMoment
HQX:500KV:XFMR3 A:MW:MvMoment
HR:12KV:XFMR11 A:MW:MvMoment
HR:12KV:XFMR19 A:MW:MvMoment
HR:12KV:XFMR27 A:MW:MvMoment
HRX:230KV:XFMR2 A:MW:MvMoment
HRX:230KV:XFMR3 A:MW:MvMoment
HRX:230KV:XFMRCT A:MW:MvMoment
HU:12KV:XFMR11 A:MW:MvMoment
HUX:345KV:XFMR1 A:MW:MvMoment
HUX:345KV:XFMR2 A:MW:MvMoment
HW:12KV:XFMR11 A:MW:MvMoment
HW:12KV:XFMR3 A:MW:MvMoment
IB:12KV:XFMR11 A:MW:MvMoment
IB:12KV:XFMR3 A:MW:MvMoment
IEX:500KV:XFMR1 A:MW:MvMoment
IEX:500KV:XFMR2 A:MW:MvMoment
IMX:230KV:XFMR4 A:MW:MvMoment
IMX:230KV:XFMR6 A:MW:MvMoment
IN:12KV:XFMR51 A:MW:MvMoment
IN:12KV:XFMR52 A:MW:MvMoment
IN:12KV:XFMR53 A:MW:MvMoment
INX:345KV:XFMRK A:MW:MvMoment
INX:345KV:XFMRL A:MW:MvMoment
IV:12KV:XFMR11 A:MW:MvMoment
IV:12KV:XFMR3 A:MW:MvMoment
IVX:500KV:XFMR80 A:MW:MvMoment
IVX:500KV:XFMR81 A:MW:MvMoment
IVX:500KV:XFMR82 A:MW:MvMoment
JHX:230KV:XFMR1 A:MW:MvMoment
JHX:230KV:XFMR2 A:MW:MvMoment
JIX:345KV:XFMR A:MW:MvMoment
JOX:230KV:XFMR3 A:MW:MvMoment
JOX:230KV:XFMR4 A:MW:MvMoment
JS:12KV:XFMR12 A:MW:MvMoment
JS:12KV:XFMR20 A:MW:MvMoment
JS:12KV:XFMR28 A:MW:MvMoment
JV:12KV:XFMR11 A:MW:MvMoment
JV:12KV:XFMR3 A:MW:MvMoment
JX:12KV:XFMR11 A:MW:MvMoment
KAX:69KV:XFMR1 A:MW:MvMoment
KAX:69KV:XFMR2 A:MW:MvMoment
KC:21KV:XFMR1 A:MW:MvMoment

Tag Name
KJ:12KV:XFMR11 A:MW:MvMoment
KNX:69KV:XFMR2 A:MW:MvMoment
KOX:69KV:XFMR1 A:MW:MvMoment
KYX:230KV:XFMR2 A:MW:MvMoment
KYX:230KV:XFMR3 A:MW:MvMoment
KYX:230KV:XFMR4 A:MW:MvMoment
KYX:230KV:XFMR6 A:MW:MvMoment
KYX:230KV:XFMR7 A:MW:MvMoment
KYX:230KV:XFMR8 A:MW:MvMoment
LA:69KV:XFMR1 A:MW:MvMoment
LA:69KV:XFMR2 A:MW:MvMoment
LAX:345KV:XFMR1 A:MW:MvMoment
LCX:115KV:XFMR1 A:MW:MvMoment
LCX:115KV:XFMR2 A:MW:MvMoment
LDX:138KV:XFMR1 A:MW:MvMoment
LDX:138KV:XFMR2 A:MW:MvMoment
LFN:12KV:XFMR11 A:MW:MvMoment
LFN:12KV:XFMR3 A:MW:MvMoment
LG:12KV:XFMR11 A:MW:MvMoment
LG:12KV:XFMR3 A:MW:MvMoment
LH:12KV:XFMR11 A:MW:MvMoment
LH:12KV:XFMR3 A:MW:MvMoment
LIX:69KV:XFMR3 A:MW:MvMoment
LK:12KV:XFMR11 A:MW:MvMoment
LK:12KV:XFMR3 A:MW:MvMoment
LL:12KV:XFMR11 A:MW:MvMoment
LL:12KV:XFMR19 A:MW:MvMoment
LL:12KV:XFMR43 A:MW:MvMoment
LL:12KV:XFMR51 A:MW:MvMoment
LN:12KV:XFMR35 A:MW:MvMoment
LN:12KV:XFMR43 A:MW:MvMoment
LNX:12KV:XFMR1 A:MW:MvMoment
LP:12KV:XFMR11 A:MW:MvMoment
LP:69KV:XFMR1 A:MW:MvMoment
LP:69KV:XFMR7 A:MW:MvMoment
LR:12KV:XFMR11 A:MW:MvMoment
LR:12KV:XFMR3 A:MW:MvMoment
LRX:138KV:XFMR1 A:MW:MvMoment
LSS:230KV:XFMR10 A:MW:MvMoment
LTX:230KV:XFMR10 A:MW:MvMoment
LV:12KV:XFMR11 A:MW:MvMoment
LV:12KV:XFMR19 A:MW:MvMoment
LX:12KV:XFMR1 A:MW:MvMoment
LY:12KV:XFMR11 A:MW:MvMoment
LY:12KV:XFMR3 A:MW:MvMoment
MA:12KV:XFMR11 A:MW:MvMoment
MA:12KV:XFMR3 A:MW:MvMoment
MAX:12KV:XFMR1 A:MW:MvMoment
MAX:13.8KV:XFMR1 A:MW:MvMoment
MC:12KV:XFMR11 A:MW:MvMoment
MC:12KV:XFMR3 A:MW:MvMoment
MCM:12KV:XFMR11 A:MW:MvMoment
MCM:12KV:XFMR3 A:MW:MvMoment
MCR:12KV:XFMR11 A:MW:MvMoment
MCR:12KV:XFMR3 A:MW:MvMoment
MCSX:69KV:XFMR1 A:MW:MvMoment
MCSX:69KV:XFMR2 A:MW:MvMoment
MCX:230KV:XFMRHI A:MW:MvMoment
MCX:230KV:XFMRJ A:MW:MvMoment
MD:12KV:XFMR11 A:MW:MvMoment
MD:12KV:XFMR19 A:MW:MvMoment
ME:12KV:XFMR11 A:MW:MvMoment
ME:12KV:XFMR19 A:MW:MvMoment
ME:12KV:XFMR3 A:MW:MvMoment
ME:69KV:XFMR9 A:MW:MvMoment
MG:12KV:XFMR11 A:MW:MvMoment
MGN:69KV:XFMR3 A:MW:MvMoment

Tag Name
MGNX:230KV:XFMR5 A:MW:MvMoment
MGX:500KV:XFMR80 A:MW:MvMoment
MGX:500KV:XFMR81 A:MW:MvMoment
MKX:345KV:XFMR2 A:MW:MvMoment
ML:12KV:XFMR11 A:MW:MvMoment
ML:12KV:XFMR3 A:MW:MvMoment
MM:12KV:XFMR51 A:MW:MvMoment
MM:12KV:XFMR53 A:MW:MvMoment
MMX:230KV:XFMR5A A:MW:MvMoment
MMX:230KV:XFMR6A A:MW:MvMoment
MMX:230KV:XFMR7A A:MW:MvMoment
MQ:12KV:XFMR3 A:MW:MvMoment
MR:12KV:XFMR12 A:MW:MvMoment
MR:12KV:XFMR20 A:MW:MvMoment
MRG:230KV:XFMR6 A:MW:MvMoment
MRGX:230KV:XFMR1 A:MW:MvMoment
MRGX:230KV:XFMR3 A:MW:MvMoment
MRGX:230KV:XFMR4 A:MW:MvMoment
MRL:12KV:XFMR3 A:MW:MvMoment
MT:12KV:XFMR2 A:MW:MvMoment
MTRX:345KV:XFMR1 A:MW:MvMoment
MU:12KV:XFMR11 A:MW:MvMoment
MU:12KV:XFMR3L A:MW:MvMoment
MU:69KV:XFMR3M A:MW:MvMoment
MVX:138KV:XFMR1 A:MW:MvMoment
MVX:138KV:XFMR2 A:MW:MvMoment
MW:12KV:XFMR11 A:MW:MvMoment
MW:12KV:XFMR3 A:MW:MvMoment
MWYX:92KV:XFMR1 A:MW:MvMoment
MWYX:92KV:XFMR2 A:MW:MvMoment
NG:34.5KV:XFMR4 A:MW:MvMoment
NG:69KV:XFMR1 A:MW:MvMoment
NG:69KV:XFMR4 A:MW:MvMoment
NHX:138KV:XFMR1 A:MW:MvMoment
NHX:138KV:XFMR2 A:MW:MvMoment
NIX:92KV:XFMR1 A:MW:MvMoment
NMX:115KV:XFMR1 A:MW:MvMoment
NNX:230KV:XFMR1 A:MW:MvMoment
NR:12KV:XFMR11 A:MW:MvMoment
NRX:138KV:XFMR1 A:MW:MvMoment
NRX:138KV:XFMR2 A:MW:MvMoment
NSX:230KV:XFMR1 A:MW:MvMoment
NUX:230KV:XFMR3 A:MW:MvMoment
NWX:230KV:XFMR1 A:MW:MvMoment
NWX:230KV:XFMR3 A:MW:MvMoment
NWX:230KV:XFMR6 A:MW:MvMoment
NY:12KV:XFMR11 A:MW:MvMoment
NY:12KV:XFMR3 A:MW:MvMoment
OC:69KV:XFMR1 A:MW:MvMoment
OC:69KV:XFMR13 A:MW:MvMoment
OJOX:345KV:XFMR1 A:MW:MvMoment
OK:12KV:XFMR11 A:MW:MvMoment
OK:12KV:XFMR3 A:MW:MvMoment
OM:4KV:XFMR1 A:MW:MvMoment
OMX:230KV:XFMR1 A:MW:MvMoment
OMX:230KV:XFMR2 A:MW:MvMoment
OMX:230KV:XFMR3 A:MW:MvMoment
OMX:230KV:XFMR4 A:MW:MvMoment
OR:12KV:XFMR51 A:MW:MvMoment
OR:12KV:XFMR52 A:MW:MvMoment
OR:12KV:XFMR53 A:MW:MvMoment
OTX:230KV:XFMR70 A:MW:MvMoment
OTX:230KV:XFMR71 A:MW:MvMoment
PA:12KV:XFMR11 A:MW:MvMoment
PA:12KV:XFMR3 A:MW:MvMoment
PAL:12KV:XFMR3 A:MW:MvMoment
PAX:161KV:XFMR5 A:MW:MvMoment

Tag Name
PAX:161KV:XFMR6 A:MW:MvMoment
PAX:6.9KV:XFMR1 A:MW:MvMoment
PAX:6.9KV:XFMR2 A:MW:MvMoment
PAX:6.9KV:XFMR3 A:MW:MvMoment
PAX:6.9KV:XFMR4 A:MW:MvMoment
PAX:69KV:XFMR1 A:MW:MvMoment
PB:12KV:XFMR3 A:MW:MvMoment
PB:12KV:XFMR7 A:MW:MvMoment
PC:12KV:XFMR2 A:MW:MvMoment
PC:12KV:XFMR6 A:MW:MvMoment
PCK:12KV:XFMR3 A:MW:MvMoment
PCKX:230KV:XFMR1 A:CMW:MvMoment
PCKX:230KV:XFMR1 A:MW:MvMoment
PD:12KV:XFMR12 A:MW:MvMoment
PD:12KV:XFMR20 A:MW:MvMoment
PD:12KV:XFMR4 A:MW:MvMoment
PIX:345KV:XFMR2 A:MW:MvMoment
PIX:345KV:XFMR3 A:MW:MvMoment
PK:12KV:XFMR11 A:MW:MvMoment
PKT:12KV:XFMR3 A:MW:MvMoment
PKX:161KV:XFMR5 A:MW:MvMoment
PKX:92KV:XFMR1 A:MW:MvMoment
PKX:92KV:XFMR2 A:MW:MvMoment
PLK:12KV:XFMR11 A:MW:MvMoment
PLK:12KV:XFMR3 A:MW:MvMoment
PLX:500KV:XFMR5 A:MW:MvMoment
PM:12KV:XFMR2 A:MW:MvMoment
PM:12KV:XFMR5 A:MW:MvMoment
PMX:18KV:XFMR1 A:MW:MvMoment
PMX:18KV:XFMR2 A:MW:MvMoment
PMX:18KV:XFMR3 A:MW:MvMoment
PNR:12KV:XFMR11 A:MW:MvMoment
PNR:12KV:XFMR19 A:MW:MvMoment
POX:138KV:XFMR1 A:MW:MvMoment
PP:230KV:XFMR14 A:MW:MvMoment
PP:230KV:XFMR17 A:MW:MvMoment
PP:230KV:XFMR19 A:MW:MvMoment
PP:230KV:XFMR3 A:MW:MvMoment
PP:230KV:XFMR6 A:MW:MvMoment
PP:230KV:XFMR7 A:MW:MvMoment
PP:345KV:XFMR14 A:MW:MvMoment
PP:345KV:XFMR7 A:MW:MvMoment
PP:500KV:XFMR1 A:MW:MvMoment
PP:500KV:XFMR2 A:MW:MvMoment
PP:500KV:XFMR3 A:MW:MvMoment
PP:69KV:XFMR17 A:MW:MvMoment
PP:69KV:XFMR19 A:MW:MvMoment
PP:69KV:XFMR3 A:MW:MvMoment
PP:69KV:XFMR6 A:MW:MvMoment
PP2N:230KV:XFMR4 A:MW:MvMoment
PP5:230KV:XFMR1 A:MW:MvMoment
PP5:230KV:XFMR2 A:MW:MvMoment
PP5:230KV:XFMR3 A:MW:MvMoment
PPX:230KV:XFMR1 A:MW:MvMoment
PPX:230KV:XFMR2 A:MW:MvMoment
PPX:230KV:XFMR3 A:MW:MvMoment
PQX:230KV:XFMR60 A:MW:MvMoment
PQX:230KV:XFMR70 A:MW:MvMoment
PQX:230KV:XFMR71 A:MW:MvMoment
PR:21KV:XFMR3 A:MW:MvMoment
PR:69KV:XFMR1 A:MW:MvMoment
PR:69KV:XFMR6 A:MW:MvMoment
PTS:12KV:XFMR11 A:MW:MvMoment
PTX:230KV:XFMR1 A:MW:MvMoment
PU:12KV:XFMR3 A:MW:MvMoment
PV:12KV:XFMR21 A:MW:MvMoment
PV:12KV:XFMR25 A:MW:MvMoment

Tag Name
PV:69KV:XFMR3 A:MW:MvMoment
PWSX:500KV:XFMR1 A:MW:MvMoment
PWZX:345KV:XFMR1 A:MW:MvMoment
PY:12KV:XFMR3 A:MW:MvMoment
PYR:12KV:XFMR3 A:MW:MvMoment
PZ:21KV:XFMR21 A:MW:MvMoment
PZCX:230KV:XFMR3A A:MW:MvMoment
PZCX:230KV:XFMR3B A:MW:MvMoment
QS:12KV:XFMR11 A:MW:MvMoment
QS:12KV:XFMR3 A:MW:MvMoment
QU:12KV:XFMR19 A:MW:MvMoment
QU:12KV:XFMR27 A:MW:MvMoment
RB:12KV:XFMR2 A:MW:MvMoment
RBX:345KV:XFMR1 A:MW:MvMoment
RCH:69KV:XFMR2 A:MW:MvMoment
RCH:69KV:XFMR4 A:MW:MvMoment
RFX:345KV:XFMR4 A:MW:MvMoment
RH:12KV:XFMR11 A:MW:MvMoment
RH:12KV:XFMR3 A:MW:MvMoment
RIO:12KV:XFMR19 A:MW:MvMoment
RIO:12KV:XFMR27 A:MW:MvMoment
RIV:12KV:XFMR11 A:MW:MvMoment
RIV:12KV:XFMR3 A:MW:MvMoment
RIVX:230KV:XFMR1 A:MW:MvMoment
RIVX:230KV:XFMR2 A:MW:MvMoment
RIX:138KV:XFMR1 A:MW:MvMoment
RIX:138KV:XFMR2 A:MW:MvMoment
RIX:138KV:XFMR3 A:MW:MvMoment
RLX:138KV:XFMR1 A:MW:MvMoment
RM:12KV:XFMR3 A:MW:MvMoment
RMX:92KV:XFMR1 A:MW:MvMoment
ROX:138KV:XFMR1 A:MW:MvMoment
ROX:138KV:XFMR2 A:MW:MvMoment
ROX:138KV:XFMR4 A:MW:MvMoment
RQX:138KV:XFMR1 A:MW:MvMoment
RQX:138KV:XFMR2 A:MW:MvMoment
RR:12KV:XFMR19 A:MW:MvMoment
RR:12KV:XFMR3 A:MW:MvMoment
RSG:12KV:XFMR11 A:MW:MvMoment
RSG:12KV:XFMR3 A:MW:MvMoment
RT:12KV:XFMR11 A:MW:MvMoment
RT:12KV:XFMR3 A:MW:MvMoment
RTX:230KV:XFMR1 A:MW:MvMoment
RWYX:230KV:XFMR8T A:MW:MvMoment
RY:69KV:XFMR8 A:MW:MvMoment
SA:12KV:XFMR2 A:MW:MvMoment
SAR:12KV:XFMR11 A:MW:MvMoment
SAR:12KV:XFMR3 A:MW:MvMoment
SBDX:230KV:XFMR2 A:MW:MvMoment
SBDX:230KV:XFMR3 A:MW:MvMoment
SBDX:230KV:XFMR4 A:MW:MvMoment
SC:12KV:XFMR11 A:MW:MvMoment
SC:12KV:XFMR20 A:MW:MvMoment
SC:12KV:XFMR3 A:MW:MvMoment
SC:69KV:XFMR12 A:MW:MvMoment
SC:69KV:XFMR4 A:MW:MvMoment
SC:69KV:XFMR8 A:MW:MvMoment
SCRX:500KV:XFMR80 A:MW:MvMoment
SCRX:500KV:XFMR81 A:MW:MvMoment
SCX:69KV:XFMR4 A:MW:MvMoment
SDG:12KV:XFMR11 A:MW:MvMoment
SDG:12KV:XFMR3 A:MW:MvMoment
SDX:230KV:XFMR2 A:MW:MvMoment
SDX:230KV:XFMR3 A:MW:MvMoment
SDX:230KV:XFMR5 A:MW:MvMoment
SDX:230KV:XFMR6 A:MW:MvMoment
SE:12KV:XFMR11 A:MW:MvMoment

Tag Name
SE:12KV:XFMR3 A:MW:MvMoment
SF:12KV:XFMR11 A:MW:MvMoment
SF:12KV:XFMR3 A:MW:MvMoment
SFX:230KV:XFMR2 A:MW:MvMoment
SFX:230KV:XFMR3 A:MW:MvMoment
SG:115KV:XFMR1 A:MW:MvMoment
SG:115KV:XFMR10 A:MW:MvMoment
SG:115KV:XFMR14 A:MW:MvMoment
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SHA:12KV:XFMR3 A:MW:MvMoment
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SHRX:230KV:XFMR1 A:MW:MvMoment
SJX:345KV:XFMR2 A:MW:MvMoment
SKC:12KV:XFMR11 A:MW:MvMoment
SKC:12KV:XFMR3 A:MW:MvMoment
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SKX:115KV:XFMR2 A:MW:MvMoment
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WSP:12KV:XFMR11 A:MW:MvMoment
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WWX:345KV:XFMR7 A:MW:MvMoment
WXX:138KV:XFMR1 A:MW:MvMoment
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WXX:138KV:XFMR4 A:MW:MvMoment
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YU:69KV:XFMR1 A:MW:MvMoment

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-20: Docket no. E-01933A-15-0239 and E-01933A-0322 P 154

ORIGINAL

COMMISSIONERS
TOM FORESE – Chairman
BOB BURNS
DOUG LITTLE
ANDY TOBIN
BOYD W. DUNN

OPEN MEETING ITEM

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ARIZONA CORPORATION COMMISSION

AZ CORPORATION COMMISSION
DOCKET CONTROL
2017 JAN 24 P 3:33

DATE: JANUARY 24, 2017

DOCKET NO.: E-01933A-15-0239 AND E-01933A-15-0322

TO ALL PARTIES:

Enclosed please find the recommendation of Administrative Law Judge Jane L. Rodda. The recommendation has been filed in the form of an Opinion and Order on:

TUCSON ELECTRIC POWER COMPANY
(RATES)

Pursuant to A.A.C. R14-3-110(B), you may file exceptions to the recommendation of the Administrative Law Judge by filing an original and thirteen (13) copies of the exceptions with the Commission's Docket Control at the address listed below by **4:00** p.m. on or before:

FEBRUARY 2, 2017

The enclosed is NOT an order of the Commission, but a recommendation of the Administrative Law Judge to the Commissioners. Consideration of this matter has tentatively been scheduled for the Commission's Open Meeting to be held on:

FEBRUARY 7, 2017 FEBRUARY 8, 2017

For more information, you may contact Docket Control at (602) 542-3477 or the Hearing Division at (602) 542-4250. For information about the Open Meeting, contact the Executive Director's Office at (602) 542-3931.

TED VOGT
EXECUTIVE DIRECTOR

Arizona Corporation Commission
DOCKETED
JAN 24 2017
DOCKETED BY

This document is available in alternative formats by contacting Carolyn Buck, ADA Coordinator, voice phone number 602-542-3931, E-mail CDBuck@azcc.gov.

We find no harm created by adopting RUCO's proposal in Phase 1, and see some benefit to DG customers who desire to opt-in sooner rather than later in order to obtain some certainty in their compensation rate. Customer experience with the option may help inform any needed modifications in Phase 2 to improve the tariff. Our disinclination to adopt Vote Solar's proposed modifications to the interim tariff should not be read as disapproval of the proposals. The option will be examined again in Phase 2.

C. Meter Charge for DG Customers

1. TEP

TEP requests that the Commission approve an additional meter charge for new DG customers to cover the cost of a second meter that is required to serve them. TEP proposed a charge of $8.62 for residential DG customers and $9.13 for SGS customers based on its marginal cost study. TEP asserts that it is important to keep in mind that the charge would only apply to new solar DG, and the relevant cost should be what a new meter costs today. Thus, TEP argues that using the marginal cost study is appropriate rather than historical embedded costs because these are new customers who are imposing new incremental costs.[626] TEP contends that its proposed charges are conservative because they are for traditional meters rather than the more expensive bidirectional meters required for DG customers.

TEP argues that the second production meter for DG customers is necessary because the REST Rules require the Company to record PV production data for its customers and that complying with this obligation is a cost of providing service.[627] TEP states that the LFCR POA also requires production data for the LFCR calculations.[628] TEP asserts that while inverters may provide production data, they do not have billing quality accuracy, and produce data in various formats that are inconsistent with TEP's billing system.[629]

Moreover, TEP notes that the Commission recently approved an additional meter charge for new DG customers in the UNSE Rate Order. In Decision No. 75697 the Commission stated:

> The meter-related costs for the second meter required by DG customers is not being paid directly by DG customers and is currently being passed on

[626] Ex TEP-32 Jones RJ at 24.
[627] TEP Opening Brief at 39-40; A.A.C. R14-2-1812 (B)(1); Tr. at 883-884.
[628] Tr. at 2345 and 1473.
[629] TEP Opening Brief at 40; Tr. at 2347.

> to non-DG customers. It is appropriate for each DG customer to bear the cost of that second meter.

TEP argues that DG customers should bear the costs of the second meter because the meter costs would not be incurred but for the choice of DG customers to install DG systems.[630]

TEP argues that the DG production meters provide benefits to DG customers who can use them to monitor their systems. However, TEP asserts that in any event, costs should be assigned to cost causers and the test under this regulatory principle is not who benefits, but who causes the costs. TEP argues the second meters would not be installed except for the customer installing the solar system, and thus, that customer should bear the cost and it should not be shifted to other customers under the current practice.[631]

Mr. Koch opined that the charge should only be approved if a customer can opt out of the second meter, but TEP states because the second meter is required to comply with Commission rules and requirements, there can be no opting out.[632]

2. <u>RUCO</u>

RUCO proposed a $6 meter fee for new DG net metering customers. RUCO based its meter fee on the Company's marginal cost study (attributing $3.10 for the cost of the meter and $2.90 for administrative costs).[633] RUCO claims that the estimate is conservative because it does not take into account the incremental additional cost of an upgraded bidirectional meter unique to solar customers.[634] RUCO notes that the Commission adopted a meter fee for new DG customers in Phase 1 of the UNSE rate case, and believes that there is no reason to depart from the decision in that case.[635]

RUCO argues that this issue must be placed in context and considered in the light of the facts and circumstances of each particular case. RUCO notes that in the UNSE case, the meter charge was the result of a last minute proposal by UNSE at Open Meeting, and UNSE was not recommending a charge that covered all of its embedded costs, but was looking to establish a placeholder, or proxy for

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[630] TEP Opening Brief at 40.
[631] TEP Reply Brief at 22.
[632] *Id.*.
[633] Tr. at 1545.
[634] RCUO Opening Brief at 9.
[635] *Id. citing* Decision No. 75689 at 118; see also RUCO Reply Brief at 7-8. RUCO argues the meter fee is not an additional rate, but rather an additional charge on the rate for the class.

the production meter cost.[636] RUCO asserts that the meter cost was not thoroughly vetted in the UNSE case, and consequently a very conservative number was approved. RUCO argues that although embedded costs were used in determining the UNSE fee, the best data to determine new meter costs is a marginal cost study. RUCO asserts further that in the present case, we know the actual hard costs (administrative, meter reading, hardware) of the second meter from the marginal cost study, and it is appropriate to include them in the approved charge. RUCO argues that Phase 1 is intended "not to calculate the total embedded costs but to determine a proxy that moves the Company forward in starting to recover meter costs."[637] RUCO argues that its proposed $6 meter fee is fair and a reasonable proxy toward collecting the meter fees associated with rooftop solar. RUCO claims that at $6 interim meter cost is not unreasonable given that the capital cost alone for a bi-directional meter is $216 and installed cost of a production meter is $71, such that a $6 a month and it would take almost 4 years to off the combined install cost for these two meters (not including carrying costs).[638] RUCO claims that Mr. Huber's proposed administrative costs associated with installation of the second meter were only intended to be estimates, with the precise number to be determined in Phase 2.[639]

3. Vote Solar

Vote Solar urges the Commission not to require new DG solar customers to pay a second meter fee. Vote Solar notes that TEP's proposed meter fee ($8.62 for Residential customers and $9.13 per month for SGS customers) is over five times greater than the $1.58 per month approved for UNSE.[640] Vote Solar asserts that the Commission should defer the solar meter proposals until Phase 2 of this proceeding.

Pointing out that the Commission has deferred "issues related to changes in net metering and rate design for new DG customers" until Phase 2, Vote Solar argues that the proposed solar meter fee raises solar rate design issues because it implements a new fixed charge that would increase solar customers' monthly bills and alter the economics of rooftop solar, and because it would impact TEP's

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[636] RUCO Opening Brief at 10, citing Transcript of the 08/11/2016 Open Meeting at 523, attached to RUCO Opening Brief as Exhibit B. The Commission approved a meter charge for new DG of $1.58 for UNSE.
[637] RUCO Opening Brief at 11-12. *See also* RUCO Reply Brief at 8-9.
[638] RUCO Reply Brief at 9.
[639] RUCO Reply Brief at 10.
[640] Similarly, Vote Solar notes that RUCO's proposed fee of $6 is three times the UNSE approved charge.

fixed cost recovery from new solar customers. Vote Solar argues that approving a solar meter fee now would prevent the Commission from holistically and comprehensively deciding solar rate design issues in Phase 2.[641] Vote Solar contends that there is no critical distinction between "rate" and "charge" with respect to the proposed meter fee, and in any case, determining the appropriate "charge" that certain customers will pay is a "paradigmatic" rate design decision.[642]

Vote Solar also contends that there are critical differences between the UNSE rate case where a meter fee was approved in Phase 1, and the current proceeding which warrant deferring the meter fee proposals until Phase 2, including: (1) the meter fee proposals in this case are three to five times greater than the UNSE fee and would have a more significant impact on the rates of new solar customers; (2) the UNSE fee was approved after a full evidentiary hearing on solar rate design and net metering issues, but here the evidentiary hearing on these issues will not occur until Phase 2; and (3) the timing of the TEP and UNSE cases is substantially different as the time between Phases 1 and 2 in the TEP matter will likely be substantially less than in the UNSE case. Vote Solar asserts that deferring the meter fee proposals until Phase 2 would minimally burden TEP because the Commission may issue a Phase 2 decision within months of the Phase 1 Decision.[643]

Vote Solar claims TEP's and RUCO's meter fee proposals unreasonably inflate the incremental metering costs for solar customers because they inaccurately calculate the incremental capital costs associated with the meter and overestimate the incremental administrative costs.[644] Both TEP and RUCO set the capital cost component of the additional meter at $3.10 per month. TEP has stated that the $3.10 is not the actual cost of either a bidirectional meter or a production meter, but is a proxy figure that reflects the average cost of a standard meter.[645] TEP claims that the $3.10 is consistent with the UNSE meter methodology, and TEP and RUCO believe it is a "first step" toward adequate cost recovery because it is less than the actual capital costs for a bidirectional meter.[646] Vote Solar asserts

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[641] Vote Solar Opening Brief at 3.
[642] *Id.* at 4.
[643] Vote Solar Opening Brief at 4-5.
[644] Id. at 5-8. When a residential or small commercial customer installs rooftop solar, TEP must replace the customer's "AMR-based" meter with a bidirectional meter that measures the solar customer's consumption and exports to the grid. Ex TEP-32 Jones RJ at 24; RUCO-11 Huber Surr at 13. TEP also installs a production meter so that it can track its compliance with the REST Rules.
[645] Tr. at 1976-77 and 1979.
[646] Tr. at 1979, Ex TEP-32 Jones RJ at 24; Ex RUCO-11 Huber Surr at 13.

that the capital component of these meter fee proposals is flawed because it is not consistent with that UNSE meter fee which reflected the per-unit embedded costs for a standard meter, while the current proposals reflect the per-unit marginal costs for a standard meter. Vote Solar states that had TEP and RUCO used the embedded cost of a standard meter, the charge would be $1.64 per month, and if the Commission wishes to implement a fee that is consistent with the UNSE Decision, the entire meter fee for new residential solar customers would be $1.64 per month.[647]

In addition, Vote Solar asserts that the $3.10 proxy charge is actually not the marginal cost of a standard meter, but the marginal cost of a bidirectional meter.[648] Vote Solar argues that because solar customers already pay for the costs of a standard meter through the basic service charge, TEP's and RUCO's proposals are not merely conservative "first steps" toward recovering capital costs as claimed.

Vote Solar states that the second component of the proposed meter fee is a charge to recover the incremental administrative costs attributable to solar customers who participate in net metering.[649] Vote Solar claims both proposals overestimate administrative costs and are not supported by the record. Vote Solar states that TEP and RUCO did not calculate the actual incremental administrative costs TEP incurs when it installs a bidirectional meter, but merely assume that the administrative costs for solar customers are double the administrative costs for a non-solar customer.[650] Vote Solar asserts that it is illogical and counterintuitive that every type of administrative expense doubles when TEP installs a second meter for a solar customer. Vote Solar charges that neither TEP nor RUCO offer a plausible explanation why advertising expenses, salaries and other administrative costs double when a customer installs solar. Vote Solar states TEP has offered no evidence of the additional administrative costs it incurs when a customer signs up for solar and that the Company has stated that it "does not currently

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[647] *See* Final Schedules at G-6-1, and note that the labels for lines 26 and 28 are switched and the unit cost of "meter reading" should be $0.32, and the unit cost of the "meters" should be $1.64.

[648] Vote Solar Opening Brief at 6-7; Tr. at 1982-1987; Ex Vote Solar -2.

[649] Vote Solar Opening Brief at 7. TEP sets the administrative cost component at $5.52 per month and RUCO sets it a $2.90 per month. Tr. at 1981 and 1545.

[650] Vote Solar Opening Brief at 7.The Administrative Costs TEP includes in its proposed fee are those included in FERC accounts 902-905, 908-910 and 920-935, which include Meter Reading (Account 902), Customer Records and Collections (Account 903), Advertising (Account 909), and Salaries (Account 920). RUCO's proposal is the same except that it would include half of the administrative costs for Account 903 (Customer Records and Collections).

track these costs at this level of detail at this time."[651] Vote Solar cites A.A.C. R14-2-2305 which provides that TEP "shall have the burden of proof" on any new or additional charge for solar customers.

Vote Solar asserts that TEP's discussion about the costs of a "second meter" is fundamentally flawed because it doesn't reflect the actual costs that TEP incurs when a customer installs rooftop solar. Vote Solar notes that when a customer installs rooftop solar. TEP replaces the customer's standard "AMR-based" meter with a bidirectional meter and a production meter. Vote Solar states that TEP's proposal does not recover the actual incremental cost of either the bidirectional meter or the production meter, but would recover the costs of a generic second meter.[652] The proposed costs are for more than the actual incremental metering costs of the bidirectional meter, and Vote Solar argues that proxy charges and generic assumptions should not be allowed to inflate the fee.[653] In addition, Vote Solar argues that marginal costs should not be used to set the fee, as rates are set based on embedded costs, and because the fee would be unavoidable, marginal costs are not necessary to send a price signal.[654]

Vote Solar asserts that a meter fee should be limited to the actual incremental capital and labor costs for a bidirectional meter. Vote Solar states that a bidirectional meter benefits solar customers because it allows them to export energy to the grid, while a production meter solely benefits TEP because it allows the Company to track its REST compliance.[655] According to Vote Solar witness, Ms. Kobor, the total capital and labor incremental cost to install a bidirectional meter is $142.95 for a residential customer, and $23.74 for a small commercial customer. Thus, Vote Solar argues any meter fee approved in this case should reflect these costs, and new solar customers should have the option of either paying these one-time incremental costs up-front, or on a monthly basis. Ms. Kobor calculates the monthly fee for residential customers should be $2.05, and $0.34 per month for a small commercial customer.[656] Moreover, Vote Solar recommends that if the Commission approves a meter fee, it should

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[651] Ex Vote Solar-3 TEP Resp. to VS D.R. 11.03.
[652] Vote Solar Reply Brief at 3.
[653] Vote Solar notes that TEP and RUCO claim that their meter fees are conservative because they reflect the costs of a traditional meter, but that at the hearing, it was shown that the marginal cost study actually reflects the cost of a bidirectional meter. Vote Solar Reply Brief at 5; Tr. at 1987.
[654] Vote Solar Reply Brief at 3.
[655] See Tr. at 882-884 and 2144.
[656] Vote Solar Opening Brief at 10; Tr. at 2117-2118; Ex Vote Solar-6.

revisit the issue in Phase 2, and should direct TEP to determine the incremental embedded capital costs for a bidirectional meter and update the meter fee accordingly at that time.

4. EFCA

EFCA states that the meter fee that TEP is proposing for new DG customers is approximately 5 times the meter fee approved in the recent UNSE rate case. EFAC asserts that the fee is intended to cover the costs of the production meter, which EFCA claims provides no benefit to the DG customer and is installed solely for the benefit of the utility. EFCA asserts that REST compliance is a community benefit because the increased use of renewable energy benefits not just the DG customers, but TEP, its ratepayers, and all of Arizona.[657] As such, EFCA argues that the proposed meter fees should not be permitted because not only would the fees discourage the development of distributed generation, they would inappropriately impose new costs on the group of customers who provide the benefits of renewable energy.[658] Thus, EFCA argues that the fee should be borne by all customers and not just DG customers.[659]

EFCA notes that the production meter is used to track compliance with REST requirements, and the calculation of the LFCR. EFCA asserts that compliance with the REST serves everyone, not only DG customers. EFCA argues that DG customers have no duty to install DG whereas the Company has a duty to have DG installed, and so the production meter is clearly for the benefit of the utility and not needed by the DG customer. EFCA asserts that TEP's attempts to justify the need for the meter as a possible way to manage the distribution system are speculative. In addition, EFCA asserts using a marginal cost study to support the cost of the meters is inappropriate.[660]

EFCA asserts the fees would make a significant impact on the economics of DG, and cites Mr. Koch's testimony that the extra fees could add a year to the payback period of a system.[661] EFAC argues that the additional fixed charges harm the value of solar and make TEP's customers less likely to adopt it.

. . .

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[657] EFCA Reply Brief at 13.
[658] EFCA Reply Brief at 13.
[659] *Id.* at 14; EFCA Opening Brief at 10.
[660] EFCA Reply Brief at 13.
[661] Tr. at 1756. Mr. Koch's business installs DG systems.

1 **5. Koch**

2 Mr. Koch argues that unless solar customers can opt out of the requirement to install a solar
3 meter, they should not be charged a solar meter fee. He asserts that the solar customers do not need the
4 second meter for their own operations or maintenance for a piece of equipment that only benefits the
5 utility in meeting the REST requirements. He states that customers who wish to sell their RECs to the
6 utility or some other party could pay for the solar meter through the proceeds of the REC sale.[662] He
7 asserts that currently, solar customers already pay for the labor costs for the installation of these meters,
8 while TEP pays for the equipment and the ongoing meter reading services.

9 **6. Analysis and Resolution of DG Meter Fee.**

10 TEP and RUCO take the position that DG customers (not all ratepayers) should pay for the
11 costs of the production meter that is installed with a rooftop system. TEP and RUCO rely on a marginal
12 cost study to support the cost of the meter at $3.10 per month, and they both add costs for the
13 administrative expenses, with TEP proposing a total meter fee of $8.62 for residential DG customers
14 and $9.12 for small commercial DG customers, and RUCO proposing a $6 meter fee for residential
15 customers. Both TEP and RUCO claim the fee is justified because the Company would not incur the
16 expense of the production meter but for the customer's choice to install solar, and costs should be
17 assigned to the cost-causer—in this case the individual ratepayer who installs solar. They also argue
18 that the fee is consistent with the decision in the UNSE rate case to impose a meter fee of $1.58 for
19 new residential DG customers.[663]

20 We agree that an interim meter fee for new DG customers is appropriate until we can review
21 and approve a holistic rate design for DG customers in Phase 2. However, we also agree with Vote
22 Solar's position that the fee should not be based on the cost of the production meter, but on the
23 incremental cost of the bidirectional meter that is necessary for DG customers to receive credit for their
24 systems' production and to receive compensation for their excess production. The production meter
25 supports REST compliance (and LFCR calculations). The REST Rules are for the benefit of all
26 ratepayers, the Company, and society in general, and the cost of REST compliance should not be

27 [662] Koch Opening Brief at 3. Mr. Koch states that because most solar customers today are not selling their RECs to TEP or others, they do not have a need or financial incentive to install such a meter.

28 [663] Staff did not take a position on the imposition of a meter charge in Phase 1 of this proceeding.

imposed only on the group of customers who contribute to meeting renewable goals. The bidirectional meters, however, do benefit the DG customers who receive compensation for their production, and it is appropriate on an interim basis that new DG customers are responsible for the additional costs of serving them.

The evidence supports Ms. Kobor's calculation that the total incremental capital and labor cost to install a bidirectional meter is $142.95 for a residential customer and $23.74 for a small commercial customer, and that the appropriate monthly fee should be $2.05 for residential and $0.35 for small commercial. New DG customers subject to this charge should have the option of a one-time upfront fee or the monthly charge.

If we were to use the same methodology to set the DG meter charge in this case as we did in the UNSE case, the monthly charge would be $1.64 for residential customers. The record on the appropriate fee was more developed in this case than in the UNSE proceeding, and justifies a refinement of the methodology used in the earlier proceeding. We note that in both cases, the fee adopted in Phase 1 will be further evaluated in Phase 2, and may be further refined.

VII. Other Issues

A. Revisions to TEP Rules and Regulations

1. TEP

TEP has proposed revisions to its Rules and Regulations Tariff to: (1) modernize the Rules and Regulations; (2) update provisions to meet current operational needs; and (3) bring them closer to the Rules and Regulations of its sister company, UNSE, that were approved in Decision No. 75697 on August 18, 2016. During the course of this proceeding, both Staff and ACAA raised issues with the proposed revisions. TEP believes that it has resolved all of Staff's concerns, but some ACAA concerns remain.[664]

TEP does not agree with ACAA's request that Lifeline customers be held harmless from the modifications regarding deposits in Subsection 3.B.3.

[664] ACAA states that is pleased with TEP's commitment to streamline the weatherization program, to maintain the deferred payment plan length at 6 months, to maintain the Lifeline rates for master metered customers and to modify the termination notice to include customer assistance information. Although recognizing that the Commission cannot order the shareholders to increase their support for bill assistance programs, ACAA requests the Company to increase its annual bill assistance contribution from $150,000 to $200,000. SWEEP/WRA/ACAA Opening Brief at 24-25.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-21: APS response to VS 7.5_Meter Cost_APSRC01816.xlsx

VOTE SOLAR'S
SEVENTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
JANUARY 3, 2016

VS 7.5: Regarding Workbook A of the COSS tab "INPUT" cells B161:D186: For each row in the table please provide: [If there are multiple meters for a single type of customer please answer separately for each type of meter.]

a) Meter manufacturer and model number for each meter.

b) Capital cost of each meter.

c) Estimated labor hours to install each meter.

d) Labor rate to install each meter.

e) Total installed cost of each meter.

f) Any other costs not identified in sub questions (b)-(e) that are included in the values present in the table. Include an itemized lost of all costs with a description of what they represent.

Response: a.-f. Please see attached as APSRC01816 for the requested information.

Witness: Leland Snook

Rate Class	AMI Meter Cost	Manufacturer	Model	Meter Cost	Tax	Sub-Item Cost (labor cost)	Capital Cost of Meter	Meter Seal	Safety Socket	Mount	Misc. Material	Current Transformers	Potential Transformers	Test Switch	Total Installed Cost of each meter	Estimated Labor Rate*	Estimated Labor Hrs
RESIDENTIAL E-12	$ 134.53	Elster	R2SD - Residential	$ 96.00	$ 7.78	$ 27.67	$ 131.45	$ 3.09	$ -	$ -	$ -	$ -	$ -	$ -	$ 134.54	$ 36.40	0.76
RESIDENTIAL ET-1 & ET-2	$ 134.53	Elster	R2SD - Residential	$ 96.00	$ 7.78	$ 27.67	$ 131.45	$ 3.09	$ -	$ -	$ -	$ -	$ -	$ -	$ 134.54	$ 36.40	0.76
RESIDENTIAL ECT-1 & ECT-2	$ 134.53	Elster	R2SD - Residential	$ 96.00	$ 7.78	$ 27.67	$ 131.45	$ 3.09	$ -	$ -	$ -	$ -	$ -	$ -	$ 134.54	$ 36.40	0.76
RESIDENTIAL SOLAR - BI-DIRECTIONAL BILLING METER	*$ 431.44*	*Elster*	*A3RL - Residential*	*$ 296.58*	*$ 24.02*	*$ 107.25*	*$ 427.85*	*$ 3.59*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ 431.44*	*$ 93.26*	*1.15*
RESIDENTIAL SOLAR - PRODUCTION METER	*$ 134.53*	*Elster*	*R2S - Commercial*	*$ 96.00*	*$ 7.78*	*$ 27.67*	*$ 131.45*	*$ 3.09*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ 134.54*	*$ 36.40*	*0.76*
RESIDENTIAL SOLAR (ENERGY & DEMAND) - COMBINED	$ 565.97	Elster	R2S and A3RL	$ 392.58	$ 31.80	$ 134.92	$ 559.30	$ 6.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 565.98	$ 70.64	1.91
E-20 (Church Rate)	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
E-32 TOU (0-20 kW)	$ 152.30	Elster	R2SD - Commercial	$ 96.00	$ 7.78	$ 27.67	$ 131.45	$ 3.09	$ -	$ -	$ -	$ -	$ -	$ -	$ 134.54	$ 36.40	0.76
E-32 TOU (21-100 kW)	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
E-32 TOU (101-400 kW)	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
E-32 TOU (401+ kW)	$ 969.05	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 389.16	$ -	$ 53.26	$ 969.06	$ 93.30	2.375
School TOU	$ 969.05	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 389.16	$ -	$ 53.26	$ 969.06	$ 93.30	2.375
E-32 (0-20 kW)	$ 152.30	Elster	R2SD - Commercial	$ 96.00	$ 7.78	$ 27.67	$ 131.45	$ 3.09	$ -	$ -	$ -	$ -	$ -	$ -	$ 134.54	$ 36.40	0.76
E-32 (21-100 kW)	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
E-32 (101-400 kW)	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
E-32 (401+ kW)	$ 969.05	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 389.16	$ -	$ 53.26	$ 969.06	$ 93.30	2.375
E-34	$ 969.05	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 389.16	$ -	$ 53.26	$ 969.06	$ 93.30	2.375
E-35	$ 969.05	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 389.16	$ -	$ 53.26	$ 969.06	$ 93.30	2.375
E-221 (Water Pumping)	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
PRIMARY METER	$ 5,377.85	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 1,508.67	$ 1,773.52	$ 3.09	$ 151.36	$ 266.43	$ 75.00	$ 1,188.59	$ 1,866.60	$ 53.26	$ 5,377.85	$ 93.56	16.125
Irrigation Resale	$ 836.64	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 221.58	$ 486.43	$ 40.21	$ -	$ -	$ -	$ 256.75	$ -	$ 53.26	$ 836.65	$ 93.30	2.375
City of Wickenburg	$ 5,377.85	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 1,508.67	$ 1,773.52	$ 3.09	$ 151.36	$ 266.43	$ 75.00	$ 1,188.59	$ 1,866.60	$ 53.26	$ 5,377.85	$ 93.56	16.125
City of Williams 12 kV	$ 5,377.85	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 1,508.67	$ 1,773.52	$ 3.09	$ 151.36	$ 266.43	$ 75.00	$ 1,188.59	$ 1,866.60	$ 53.26	$ 5,377.85	$ 93.56	16.125
City of Williams 2.4 kV	$ 4,216.34	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 1,508.67	$ 1,773.52	$ 3.09	$ 151.36	$ 266.43	$ 75.00	$ 1,188.59	$ 705.09	$ 53.26	$ 4,216.34	$ 93.56	16.125
Mexico Accounts & BHP Minerals	$ 5,377.85	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 1,508.67	$ 1,773.52	$ 3.09	$ 151.36	$ 266.43	$ 75.00	$ 1,188.59	$ 1,866.60	$ 53.26	$ 5,377.85	$ 93.56	16.125
Tohono Odham Utility Authority	$ 5,377.85	Elster	A3TL - Commercial	$ 245.00	$ 19.85	$ 1,508.67	$ 1,773.52	$ 3.09	$ 151.36	$ 266.43	$ 75.00	$ 1,188.59	$ 1,866.60	$ 53.26	$ 5,377.85	$ 93.56	16.125

* Labor rate is loaded and blended due to different skills and craft involved

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-22: APS response to VS 1.7. Hourly data were provided in file "All Residential Rates NEM_APSRC01588.xlsx

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.7: Please provide a representative sample of hourly residential customer usage data over the test year that can be used to develop alternative rate designs for the residential class while maintaining revenue neutrality with the proposed rates. Please provide data in excel or csv format excluding any personal identifying information.

Response: Attached as APSRC01588 and APSRC01589 is the census rather than a sample of hourly solar and non-solar residential customer usage data for 2015. The solar attachment includes what APS delivered to the customer, what APS received from the customer and the customer's site consumption. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding.

Please note the attachments are too large to upload to the APS external SharePoint site, so the attachments will be provided through an alternate method. Special instructions to access the data will be sent separately to Vote Solar. Please contact APS for this information.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-23: See Table 3b, Arizona Public Service Company 2015 Demand Side Management Annual Progress Report, APSRC01805

0000168764

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March 1, 2016

Arizona Corporation Commission
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Docket Control
Arizona Corporation Commission
1200 W. Washington Street
Phoenix, AZ 85007

RE: Arizona Public Service Company's 2015 Demand Side Management (DSM) Progress Report; Docket No. E-00000U-16-0069.

Pursuant to the Electric Energy Efficiency Standard Rules (EERS) and A.A.C. R14-2-2409(A):

> By March 1 of each year, an affected utility shall submit . . . a DSM progress report providing information on each of the affected utility's Commission-approved DSM programs. . .

In addition, Decisions No. 73089, 74006, 74703, and 74813 require the DSM Progress Reports to include supplemental information. As a result, APS submits its 2015 DSM Annual Progress Report incompliance with EERS and the above-referenced decisions.

If you have any questions regarding this information, please contact Kerri A. Carnes at (602) 250-3341.

Sincerely,

Debra Dunn for

Kerri A. Carnes

KC/kr

cc: Barbara Keene
Brian Bozzo

ARIZONA PUBLIC SERVICE COMPANY

2015 DEMAND SIDE MANAGEMENT ANNUAL PROGRESS REPORT

March 1, 2016

aps

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I. Introduction

Arizona Public Service Company ("APS" or "Company") is filing this Demand Side Management Annual Progress Report ("Progress Report") for 2015 ("Reporting Period") in compliance with R14-2-2409(A) and the reporting requirements contained in Arizona Corporation Commission ("ACC" or "Commission") Decision Nos. 73089 (April 4, 2012), 74406 (March 19, 2014), 74703 (August 21, 2014), and 74813 (November 13, 2014). This report includes the following information for all APS Demand Side Management ("DSM") programs that were in place during the Reporting Period:

- APS's progress toward meeting the cumulative energy efficiency standard;
- An identification of Commission approved DSM Programs and measures by customer segment;
- A description of the findings from any research projects completed;
- A brief description of the programs;
- Program goals, objectives, and savings targets;
- Level of customer participation;
- Costs incurred disaggregated by type of cost, such as administrative costs, rebates, and monitoring costs;
- A description of the results of evaluation and monitoring activities;
- kW and kWh savings;
- Environmental benefits including reduced emissions and water savings;
- Incremental benefits and net benefits in dollars;
- Performance Incentive calculations;
- Problems encountered and proposed solutions;
- A description of modifications proposed for the following year;
- If applicable, program or program measure termination and proposed date of termination;
- Where applicable, reporting requirements included in Commission Decision No. 73089, 74406, 74703, and 74813. Due to the length of Decision No. 74703 reporting requirements, this information has been included in separate work papers; and
- Other significant information.

II. 2015 DSM Program Results

A. Compliance with Energy Efficiency ("EE") Requirements

For calendar year 2015, the Commission established a cumulative annual EE requirement of 9.50 percent of the utility's 2014 retail kilowatt-hour ("kWh") sales. A summary of APS's 2015 compliance with the Energy Efficiency Standard is shown in Table 1. In 2015, the Company achieved 102% of the Commission's annual EE goal. APS achieved the cumulative megawatt hour ("MWh") savings goal for 2015, achieving cumulative savings of 9.55% against a goal of 9.50%, while spending $2.8 million less than the overall budget approved for 2015 of $68.9 million.

Table 1

2015 DSM Savings Goal & Achievement

Goal Calculation	
2014 Retail Sales[1]	27,017,353
2015 Cumulative EE Standard	9.50%
2015 Goal (MWh)	2,566,649
Less Cumulative Savings from 2014 Applied to 2015[2]	2,026,753
2015 DSM Savings Goal	**539,896**

Results	
Contribution From Demand Response (10% of Goal)	53,990
Contribution From Energy Efficiency Programs	498,434
Total 2015 MWh Achieved	**552,424**
Over or (Under) 2015 Goal	12,528
% of 2015 Savings Goal Achieved	**102.3%**
2015 Annual Savings % of 2014 Retail Sales	**2.04%**
2015 Cumulative Savings as a % of 2014 Retail Sales	**9.55%**
3rd Party MER Verified Savings for 2015	**552,069**
Difference: 2015 MER Verified to 2015 APR	(355)

Note:

[1]Includes billed and unbilled sales, does not include line losses, excludes Freeport McMoran Mine

[2]Cumulative savings through 2014 are MER Verified MWh savings.

III. Program Results and Program Incentive Calculations

Program expenses are provided in Tables 2a through 3b and DSM program megawatt ("MW") and MWh savings are provided in Tables 4 and 5. Tables 6 and 7 provide net benefits and Table 8 shows the performance incentive calculation for 2015. Table 9 provides the environmental benefits associated with the lifetime energy savings resulting from DSM programs. Table 10 shows 2015 demand response ("DR") load reduction and savings values.

B Year to Date DSM Program Expenses

Table 2a

Demand Response Program Expenses 2015

Program	Rebates & Incentives	Measurement Evaluation and Research ("MER")	Metering	Program Implementation[1]	Program Marketing	Planning & Administration	Total Program Costs
HEI Pilot[2]	$0	$0	$0	$0	$0	$0	$0
Marketing & MER of Rate Options	$0	$0	$0	$0	$0	$0	$0
Peak Solutions	$0	$0	$0	$1,762,296	$0	$28,662	$1,790,958
Total	**$0**	**$0**	**$0**	**$1,762,296**	**$0**	**$28,662**	**$1,790,958**

Table 2b

Energy Efficiency Program Expenses 2015

Program	Rebates & Incentives	Training & Technical Assistance	Consumer Education	Program Implementation[1]	Program Marketing	Planning & Administration	Total Program Costs
Residential Programs							
Consumer Products	$4,621,674	$0	$0	$3,064,113	$163,538	$417,028	$8,266,353
Existing Homes HVAC	$5,297,417	$130,824	$121,466	$1,257,272	$110,777	$322,662	$7,240,418
Existing Homes - Home Performance	$1,325,377	$1,761	$4,751	$928,233	$61,866	$109,452	$2,431,440
New Construction	$4,124,379	$7,205	$452	$663,363	$163,739	$340,477	$5,299,615
Appliance Recycling	$288,630	$0	$0	$477,673	$185,138	$108,055	$1,059,496
Conservation Behavior	$0	$0	$0	$1,437,721	$0	$60,613	$1,498,334
Multi-Family	$879,280	$0	$0	$846,527	$32,033	$94,915	$1,852,755
Shade Tree	$424	$0	$0	$325	$0	$0	$749
Prepaid Energy Conservation[2]	$0	$0	$0	$7,866	$1,744	$47,832	$57,442
Limited Income	$2,092,653	$0	$22,541	$59,186	$23,959	$76,003	$2,274,342
Total	**$18,629,834**	**$139,790**	**$149,210**	**$8,742,279**	**$742,794**	**$1,577,037**	**$29,980,944**
Non-Residential Programs							
Large Existing Facilities	$13,666,171	$176,262	$8,125	$4,146,342	$826,794	$440,019	$19,263,713
New Construction	$2,540,830	$28,010	$1,310	$589,999	$10,161	$76,881	$3,247,191
Small Business	$1,473,246	$27,606	$2,432	$546,778	$111,043	$87,885	$2,248,990
Energy Information Services	$31,526	$0	$0	$5,141	$0	$218	$36,885
Schools[3]	$1,341,909	$13,786	$732	$838,925	$30,240	$56,522	$2,282,114
Total	**$19,053,682**	**$245,664**	**$12,599**	**$6,127,185**	**$978,238**	**$661,525**	**$27,078,893**
Codes & Standards	$0	$0	$0	$147,252	$0	$25,325	$172,577
Total EE Program Costs	**$37,683,516**	**$385,454**	**$161,809**	**$15,016,716**	**$1,721,032**	**$2,263,887**	**$57,232,414**
						Measurement, Evaluation & Research	$1,835,226
						Performance Incentive[4]	$5,275,737
						Total EE Program Expense	$64,343,377
						Total DSM Expense	**$66,134,335**

Notes:

[1]Includes the cost for the Implementation Contractor.

[2]The HEI Pilot incurred carry cost of 362,3673, and the Prepaid Energy Conservation Program incurred carrying cost of $241,338 in 2015

[3]Schools are permitted to receive funding from other Non-Residential programs. Refer to the Schools Program section for additional information regarding total funds allocated to school districts.

[4]Details of the Performance Incentive calculation are provided in Table 8.

Table 2c

2015 Energy Efficiency Program Implementation Costs - APS Compared to Contractor[1]

Program	APS Expense	Contractor Expense	Total Implementation Cost
Residential Programs			
Consumer Products	$244,291	$2,819,822	$3,064,113
Existing Homes HVAC	$12,899	$1,244,373	$1,257,272
Existing Homes - Home Performance	$2,475	$925,758	$928,233
New Construction	$359,467	$303,896	$663,363
Appliance Recycling	$7,178	$470,495	$477,673
Conservation Behavior	$32,718	$1,405,003	$1,437,721
Multi-Family	$34,578	$811,949	$846,527
Shade Tree	$0	$325	$325
Prepaid Energy Conservation	$304	$7,562	$7,866
Limited Income	$0	$59,186	$59,186
Residential Total	**$693,910**	**$8,048,369**	**$8,742,279**
Non-Residential Programs		$8,048,369	
Large Existing Facilities	$0	$4,146,342	$4,146,342
New Construction	$0	$589,999	$589,999
Small Business	$0	$546,778	$546,778
Energy Information Services	$0	$5,141	$5,141
Schools	$0	$838,925	$838,925
Non-Residential Total	**$0**	**$6,127,185**	**$6,127,185**
Codes & Standards	$104,928	$42,324	$147,252
EE Implementation Costs	**$798,838**	**$14,217,878**	**$15,016,716**

[1]Required by Commission Decision No. 73089.

Program-To-Date DSM Program Expenses

Table 3a

Program-To-Date Demand Response Program Expenses: January 2010 - December 2015

Program	Rebates & Incentives	Measurement Evaluation and Research	Metering	Program Implementation[1]	Program Marketing	Planning & Administration	Total Program Costs
HEI Pilot	$596,904	$242,929	$0	$706,433	$129,123	$569,131	$2,244,520
Marketing & MER of Rate Options	$0	$0	$37,756	$147,290	$168,016	$0	$353,062
Peak Solutions	$0	$0	$51,017	$13,065,354	$0	$292,142	$13,408,513
Total	**$596,904**	**$242,929**	**$88,773**	**$13,919,077**	**$297,139**	**$861,273**	**$16,006,095**

Table 3b

Program-To-Date: Energy Efficiency Program Expenses: January 2005 - December 2015

Program	Rebates & Incentives	Training & Technical Assistance	Consumer Education	Program Implementation[1]	Program Marketing	Planning & Administration	Total Program Costs
Residential Programs							
Consumer Products	$37,050,222	$4,633	$53,335	$19,188,031	$4,066,742	$2,407,194	$62,770,157
Existing Homes HVAC	$35,956,544	$1,205,894	$1,789,706	$9,443,873	$2,077,306	$1,556,029	$52,029,352
Existing Homes - Home Performance	$11,218,853	$127,461	$7,695	$6,744,756	$929,526	$514,015	$19,542,306
New Construction	$19,693,935	$775,036	$130,597	$3,259,915	$3,043,725	$1,520,844	$28,424,052
Appliance Recycling	$1,520,331	$0	$0	$3,721,457	$1,143,867	$356,276	$6,741,931
Conservation Behavior	$0	$0	$0	$4,637,641	$0	$337,151	$4,974,792
Multi-Family	$2,589,979	$5,511	$101	$3,552,367	$64,391	$427,959	$6,640,308
Shade Tree	$165,813	$0	$3,837	$725,169	$19,407	$57,191	$971,417
Prepaid Energy Conservation	$0	$0	$0	$7,866	$1,744	$47,832	$57,442
Limited Income	$18,005,223	$118,015	$57,764	$829,046	$122,969	$1,134,117	$20,267,134
Total	**$126,200,900**	**$2,236,550**	**$2,043,035**	**$52,110,121**	**$11,469,677**	**$8,358,608**	**$202,418,891**
Non-Residential Programs							
Large Existing Facilities	$83,936,973	$1,485,335	$307,947	$22,194,061	$4,532,725	$3,080,608	$115,537,649
New Construction	$16,860,886	$271,878	$60,026	$6,482,146	$1,278,871	$904,638	$25,858,445
Small Business	$11,716,276	$186,477	$31,986	$5,025,909	$950,847	$639,788	$18,551,283
Building Operator Training	$0	$56,897	$0	$22,043	$15,783	$7,480	$102,203
Energy Information Services	$206,752	$18,317	$1,753	$221,259	$12,686	$29,112	$489,879
Schools[2]	$11,520,706	$260,946	$28,922	$4,717,292	$823,064	$566,068	$17,916,998
Total	**$124,241,593**	**$2,279,850**	**$430,634**	**$38,662,710**	**$7,613,976**	**$5,227,694**	**$178,456,457**
Codes & Standards	$0	$0	$0	$359,723	$0	$84,585	$444,308
Total EE Program Costs	**$250,442,493**	**$4,516,400**	**$2,473,669**	**$91,132,554**	**$19,083,653**	**$13,670,887**	**$381,319,656**
						Measurement, Evaluation & Research	$16,634,195
						Performance Incentive[3]	$ 46,856,199
						Total EE Program Expense	**$444,810,050**
						Total DSM Expense	**$460,816,145**

Notes:

[1]Includes the cost for the Implementation Contractor.

[2]Schools are permitted to receive funding from other Non-Residential programs. Refer to the Schools Program section for additional information regarding total funds allocated to school districts.

[3]Details of the Performance Incentive calculation are provided in Table 8. The program-to-date performance incentive amount is a summation of the performance incentive amount as calculated during each previous reporting period beginning with the January through June 2005 Progress Report.

D. Year-to-Date DSM Electric Savings

Table 4

DSM Electric Savings 2015[1, 3, 5]

Program	Gross Peak MW Capacity Savings	Gross Annual MWH Savings	Gross Lifetime MWH Savings[2]	Capacity Savings[4]	Net Annual MWH Savings[4]	Net Lifetime MWH Savings[2, 4]
Residential Programs						
Consumer Products	11.6	110,744	970,205	11.6	110,744	970,205
Existing Homes HVAC	14.0	18,232	243,598	14.0	18,232	243,598
Existing Homes - Home Performance	2.6	3,947	61,418	2.6	3,947	61,418
New Construction	5.8	11,257	225,140	5.8	11,257	225,140
Appliance Recycling	1.2	8,374	50,243	1.2	8,374	50,243
Conservation Behavior	12.0	57,444	57,444	12.0	57,444	57,444
Multi-Family	1.6	9,623	115,668	1.6	9,623	115,668
Prepaid Energy Conservation	0.4	1,929	1,929	0.4	1,929	1,929
Limited Income	0.3	1,793	31,369	0.3	1,793	31,369
Total	**49.5**	**223,343**	**1,757,014**	**49.5**	**223,343**	**1,757,014**
Non-Residential Programs						
Large Existing Facilities	32.7	164,814	2,368,952	32.7	164,814	2,368,952
New Construction	7.7	33,426	472,719	7.7	33,426	472,719
Small Business	4.1	14,867	178,080	4.1	14,867	178,080
Energy Information Services	2.1	31	157	2.1	31	157
Schools	3.8	12,925	192,453	3.8	12,925	192,453
Total	**50.4**	**226,063**	**3,212,361**	**50.4**	**226,063**	**3,212,361**
Codes & Standards	11.9	45,915	476,139	11.9	45,915	476,139
System Savings	0.1	3,113	16,322	0.1	3,113	16,322
DR Contribution		53,990			53,990	
Total DSM Savings	**111.9**	**552,424**	**5,461,836**	**111.9**	**552,424**	**5,461,836**

Notes:

[1]Savings for 2008 and after are MER adjusted, per Decision No. 69663, and savings prior to 2008 are not MER adjusted.

[2]Refers to savings over the expected lifetime of all program measures.

[3]Savings are adjusted for line losses (energy 7.0%, demand 11.7%) and a capacity reserve factor of 15%.

[4]Based on 2010 MER net to gross ratio ("NTGR") analysis, APS is utilizing a NTGR of 1.0 for all DSM programs and measures.

workpapers.

E. Program-To-Date DSM Electric Savings

Table 5

Program-To-Date DSM Electric Savings: January 2005 - December 2015[1, 3]

Program	Gross Peak MW Capacity Savings	Gross Annual MWH Savings	Gross Lifetime MWH Savings[2]	Net Peak MW Capacity Savings[4]	Net Annual MWH Savings[4]	Net Lifetime MWH Savings[2, 4]
Residential Programs						
Consumer Products	153.9	1,349,181	8,627,460	135.5	1,203,088	7,794,051
Existing Homes HVAC	75.8	112,328	1,477,985	66.3	102,891	1,337,812
Existing Homes - Home Performance	19.2	33,265	463,825	19.0	32,860	459,368
New Construction	48.5	93,152	1,863,035	47.6	91,148	1,822,949
Appliance Recycling	10.0	66,195	397,166	9.2	60,756	364,532
Conservation Behavior	28.4	150,845	150,845	28.4	150,845	150,845
Multi-Family	4.0	35,884	352,653	4.0	35,884	352,653
Shade Tree	1.1	2,005	60,114	1.1	2,005	60,114
Prepaid Energy Conservation	0.4	1,929	1,929	0.4	1,929	1,929
Limited Income	2.2	14,576	264,128	2.2	14,576	264,128
Total	**343.5**	**1,859,360**	**13,659,140**	**313.7**	**1,695,982**	**12,608,381**
Non-Residential Programs						
Large Existing Facilities	175.1	1,158,693	15,645,653	169.8	1,112,478	15,011,697
New Construction	38.8	284,550	4,085,915	36.2	249,189	3,582,135
Small Business	27.8	130,851	1,773,586	27.1	126,705	1,716,275
Building Operator Training	0.2	1,001	12,447	0.1	701	8,713
Energy Information Services	8.6	2,892	42,204	8.6	2,892	42,204
Schools	22.8	116,787	1,651,856	21.9	111,499	1,571,727
Total	**273.3**	**1,694,774**	**23,211,661**	**263.7**	**1,603,464**	**21,932,751**
Codes & Standards	23.9	107,648	928,205	23.9	107,648	928,205
System Savings	0.1	3,113	16,322	0.1	3,113	16,322
DR Contribution		254,132			254,132	
Total DSM Savings	**640.8**	**3,919,027**	**37,815,328**	**601.4**	**3,664,339**	**35,485,659**

Notes:

[1]Savings for 2008 and after are MER adjusted, per Decision No. 69663, and savings prior to 2008 are not MER adjusted.

[2]Refers to savings over the expected lifetime of all program measures.

[3]Savings are adjusted for line losses (energy 7.0%, demand 11.7%) and a capacity reserve factor of 15%.

[4]Based on 2010 MER Net to Gross Ratio ("NTGR") analysis, APS is utilizing a NTGR of 1.0 for all DSM programs and measures.

Year-to-Date Energy Efficiency Societal Benefits

Table 6

Energy Efficiency Societal Benefits 2015

Program	Program Cost	Societal Benefits	Societal Cost	Net Benefits	Benefit/Cost Ratio
Residential Programs					
Consumer Products	$8,266,353	42,287,663	18,310,872	$23,976,791	2.31
Existing Homes HVAC	$7,240,418	$19,951,598	$9,879,333	$10,072,265	2.02
Existing Homes - Home Performance	$2,431,440	$5,356,516	$4,738,339	$618,177	1.13
New Construction	$5,299,615	$13,580,248	$10,203,494	$3,376,754	1.33
Appliance Recycling	$1,059,496	$1,321,243	$770,866	$550,377	1.71
Conservation Behavior	$1,498,334	$1,739,776	$1,498,334	$241,443	1.16
Multi-Family	$1,852,755	$5,904,394	$2,580,188	$3,324,206	2.29
Prepaid Energy Conservation	$57,442	$58,409	$57,442	$967	1.02
Limited Income[1, 2]	$2,274,342	$2,264,936	$2,264,936	$0	1.00
Total	**$29,980,195**	**$92,464,784**	**$50,303,804**	**$42,160,980**	**1.84**
Non-Residential Programs					
Large Existing Facilities	$19,263,713	$71,354,925	$50,284,798	$21,070,127	1.42
New Construction	$3,247,191	$17,436,828	$6,914,515	$10,522,313	2.52
Small Business	$2,248,990	$6,121,524	$3,669,339	$2,452,185	1.67
Energy Information Services	$36,884	$919,651	$80,604	$839,047	11.41
Schools	$2,282,114	$5,773,180	$5,614,935	$158,245	1.03
Total	**$27,078,892**	**$101,606,108**	**$66,564,191**	**$35,041,917**	**1.53**
Codes & Standards	$172,577	$20,303,192	$18,414,855	$1,888,337	
Measurement, Evaluation & Research	$1,835,226	$0	$1,835,226	-$1,835,226	
Performance Incentive	$5,275,737	$0	$5,275,737	-$5,275,737	
Total Energy Efficiency Societal Benefits	**$64,342,627**	**$214,374,084**	**$142,393,813**	**$71,980,271**	**1.51**

Notes:

[1]Program Costs include weatherization and bill assistance. Societal Costs do not include bill assistance because it does not contribute to electric savings.

[2]APS analysis is consistent with Decision No. 68647.

4. Program To Date EE Societal Benefits

Table 7

Program-To-Date Energy Efficiency Societal Benefits: January 2005 - December 2015

Program	Program Cost	Societal Benefits	Societal Cost	Net Benefits
Residential Programs				
Consumer Products	$62,770,157	$387,400,351	$105,022,332	$282,378,019
Existing Homes HVAC	$52,029,352	$106,951,066	$74,825,786	$32,125,280
Existing Homes - Home Performance	$19,542,306	$40,672,948	$32,296,553	$8,376,395
New Construction	$28,424,052	$113,857,763	$60,937,512	$52,920,252
Appliance Recycling	$6,741,931	$17,548,709	$5,222,843	$12,325,866
Conservation Behavior	$4,974,792	$5,128,929	$4,860,973	$267,957
Multi-Family	$6,640,309	$16,782,597	$8,713,949	$8,068,648
Shade Tree	$970,668	$4,512,595	$2,357,226	$2,155,369
Prepaid Energy Conservation	$57,442	$58,409	$57,442	$967
Limited Income[1,2]	$20,267,134	$18,231,022	$18,231,022	$0
Total	**$202,418,143**	**$711,144,390**	**$312,525,638**	**$398,618,752**
Non-Residential Programs				
Large Existing Facilities	$115,537,649	$624,966,341	$271,732,700	$353,233,641
New Construction	$25,858,445	$158,354,111	$52,994,956	$105,359,155
Small Business	$18,551,283	$91,664,696	$27,770,830	$63,893,866
Building Operator Training	$102,203	$424,302	$183,392	$240,910
Energy Information Services	$489,878	$3,259,171	$859,863	$2,399,308
Schools	$17,916,998	$75,817,042	$39,466,085	$36,350,957
Total	**$178,456,456**	**$954,485,663**	**$393,007,826**	**$561,477,837**
Codes & Standards	$444,308	$39,518,587	$30,534,694	$8,983,893
Measurement, Evaluation & Research	$16,634,195	$0	$16,634,195	-$16,634,195
Performance Incentive	$ 46,859,932	$0	$46,859,932	-$46,859,932
Total Energy Efficiency Societal Benefits	**$444,813,034**	**$1,705,148,640**	**$799,562,285**	**$905,586,355**

Notes:

[1]Program Costs include weatherization and bill assistance. Societal Costs do not include bill assistance because it does not contribute to electric savings.

[2]APS analysis is consistent with Decision No. 68647.

H. 2015 Performance Incentive Calculation

Table 8

2015 Performance Incentive

Achievement Relative to Performance Incentive Level	
Total MWh Saved in 2015	552,424
Less System Savings	3,113
Total MWh Saved less System Savings	**549,311**
Total MWh Saved less System Savings as % of 2015 Goal	**101.7%**

Achievement Relative to DSM Goal	Performance Incentive as % of Net Benefits	Performance Incentive Capped at No More Than $0.0125 per kWh saved
96% to 105%	7%	503,396,000 kWh x $0.0125
Net Benefits (Prior to PI and Codes & Standards)	$75,367,671	
Calculation of Performance Incentive	$5,275,737	$6,292,450
Performance Incentive Amount for 2015 (Minimum of % of Net Benefits or Capped amount at $0.0125 per kWh)	**$5,275,737**	

Notes:

[1]The Performance Incentive methodology/calculation was approved in Decision No. 69663 and was modified in Decision No. 71448 and Decision No. 74406.

I. Net Environmental Benefits

Table 9

2015 Net Environmental Benefits

Reporting Period	Water (Mil Gal)	SOx (Lbs)	NOx (Lbs)	CO2 (Mil Lbs)	PM10 (Lbs)
Year-to-Date: Jan - Dec	1,731	24,305	461,798	4,910	134,907
Program-to-Date: Since Jan 2005	11,249	157,911	3,000,312	31,902	876,496

Notes:

[1]The environmental reductions are based on the net energy savings of all program measures installed during the Reporting Period over their expected lifetimes.

[2]Some measures will result in customer water savings, which this calculation does not include. Only utility water savings are included in this calculation.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-24: APS response to AURA 1.1 "The most recent US Census data (2013) indicates that 86.8% of households in Arizona have a computer and 76.2% of households have high speed Internet access." (Also includes APS response to AURA 1.6 and 1.45)

ARIZONA UTILITY RATEPAYER ALLIANCE'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
SEPTEMBER 8, 2016

AURA 1.1: Reference: Derstine testimony, p. 3, lines 7-9. For each of the following statements, please state whether the statement applies specifically to APS's residential customers and provide the source documents and data supporting the statement:

a. "most households have an internet connection and a computer"

b. "about three-fourths of the population has a smart phone"

Response: a. Please see the attached documentation by Internet Live Stats.

As referenced by the Internet Live Stats, the U.S. has nearly 287 million Internet users, which equates to approximately 88.5% of the population. Please see Attachment APSRC01138 or the following link.

http://www.internetworldstats.com/unitedstates.htm

The most recent US Census data (2013) indicates that 86.8% of households in Arizona have a computer and 76.2% of households have high speed Internet access. Please see Attachment APSRC01143, or the following link.

http://www.census.gov/content/dam/Census/library/publications/2014/acs/acs-28.pdf

b. Comscore, a leading national research technology measurement company, reported in February 2016 that 198.9 million people in the U.S. owned smartphones, which equates to 79.3 percent penetration at the national level. Please see Attachment APSRC01137 or the following link.

http://www.comscore.com/Insights/Rankings/comScore-Reports-February-2016-US-Smartphone-Subscriber-Market-Share

Based on APS's most recent Brand Alignment Tracking Study conducted April-May 2016 with 1,176 APS residential customers, three-quarters (76%) own a smartphone.

Witness: Stacy Derstine

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-25: APS response to SEIA 1.36: "APS has not conducted any customer surveys or focus groups on the introduction of mandatory or more widespread residential time-of-use (TOU) rates."

SOLAR ENERGY INDUSTRY ASSOCIATION'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 2, 2016

SEIA 1.36: Please provide the results of any customer surveys or focus groups that APS has conducted on customer's opinions on the introduction of mandatory or more widespread residential time-of-use (TOU) rates.

Response: APS has not conducted any customer surveys or focus groups on the introduction of mandatory or more widespread residential time-of-use (TOU) rates.

Witness: Stacy Derstine

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-26: APS response to Staff 5.2: "Staff 5.2_Demand Service Plan Satisfaction_APSRC01334_COMP CONF.pdf"

ARIZONA CORPORATION COMMISSION STAFF'S
FIFTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
OCTOBER 4, 2016

Staff 5.2: **Background**: Has the Company performed any studies, investigations, analyses or reviews to evaluate customer attitudes? If so, please provide those studies, investigations, analyses or reviews beginning January 1, 2015 through the present.

Response: Please contact APS regarding this data request.

Witness: Stacy Derstine

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-27: APS response to EFCA 5.29_attachment-APSRC01598.xlsx

ENERGY FREEDOM COALITION OF AMERICA'S
FIFTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 3, 2016

EFCA 5.29: Please provide monthly customer de-enrollment for ECT-2 and ECT-1R from 2007 to present.

Response: Please see attachment APSRC01598.

Witness: Stacy Derstine

ECT-1R De-Enrollment

YEAR	MONTH	COUNT
2007	1	131
2007	2	132
2007	3	160
2007	4	117
2007	5	170
2007	6	196
2007	7	171
2007	8	177
2007	9	169
2007	10	180
2007	11	155
2007	12	147
2008	1	139
2008	2	138
2008	3	148
2008	4	193
2008	5	218
2008	6	180
2008	7	249
2008	8	271
2008	9	216
2008	10	234
2008	11	201
2008	12	215
2009	1	197
2009	2	189
2009	3	199
2009	4	195
2009	5	237
2009	6	314
2009	7	479
2009	8	452
2009	9	467
2009	10	498
2009	11	391
2009	12	417
2010	1	357
2010	2	338
2010	3	451
2010	4	392

2010	5	463
2010	6	483
2010	7	438
2010	8	401
2010	9	416
2010	10	369
2010	11	281
2010	12	338
2011	1	276
2011	2	314
2011	3	338
2011	4	392
2011	5	316
2011	6	405
2011	7	358
2011	8	316
2011	9	271
2011	10	308
2011	11	252
2011	12	287
2012	1	216
2012	2	206
2012	3	283
2012	4	243
2012	5	282
2012	6	286
2012	7	264
2012	8	220
2012	9	242
2012	10	210
2012	11	189
2012	12	206
2013	1	184
2013	2	190
2013	3	207
2013	4	219
2013	5	244
2013	6	251
2013	7	221
2013	8	178
2013	9	154

2013	10	178
2013	11	154
2013	12	127
2014	1	133
2014	2	127
2014	3	145
2014	4	150
2014	5	208
2014	6	158
2014	7	161
2014	8	152
2014	9	128
2014	10	141
2014	11	122
2014	12	143
2015	1	126
2015	2	128
2015	3	142
2015	4	150
2015	5	172
2015	6	156
2015	7	156
2015	8	158
2015	9	141
2015	10	146
2015	11	86
2015	12	131
2016	1	105
2016	2	97
2016	3	142
2016	4	162
2016	5	160
2016	6	174
2016	7	141
2016	8	124
2016	9	111
2016	10	124
2016	11	35

ECT-2 De-Enrollment

YEAR	MONTH	COUNT
2007	1	29
2007	2	17
2007	3	36
2007	4	31
2007	5	57
2007	6	68
2007	7	76
2007	8	106
2007	9	87
2007	10	111
2007	11	106
2007	12	85
2008	1	110
2008	2	101
2008	3	87
2008	4	148
2008	5	195
2008	6	205
2008	7	217
2008	8	219
2008	9	243
2008	10	288
2008	11	215
2008	12	227
2009	1	215
2009	2	229
2009	3	257
2009	4	262
2009	5	326
2009	6	378
2009	7	526
2009	8	512
2009	9	482
2009	10	511
2009	11	391
2009	12	495
2010	1	432
2010	2	459
2010	3	532
2010	4	531

2010	5	633
2010	6	705
2010	7	712
2010	8	653
2010	9	793
2010	10	710
2010	11	578
2010	12	697
2011	1	542
2011	2	639
2011	3	731
2011	4	784
2011	5	774
2011	6	1094
2011	7	965
2011	8	922
2011	9	907
2011	10	963
2011	11	903
2011	12	943
2012	1	830
2012	2	838
2012	3	1083
2012	4	884
2012	5	1245
2012	6	1347
2012	7	1156
2012	8	1233
2012	9	1159
2012	10	1137
2012	11	1116
2012	12	1030
2013	1	963
2013	2	934
2013	3	1139
2013	4	1075
2013	5	1378
2013	6	1532
2013	7	1461
2013	8	1586
2013	9	1241

2013	10	1405
2013	11	1284
2013	12	1064
2014	1	1088
2014	2	1131
2014	3	1290
2014	4	1380
2014	5	1631
2014	6	1433
2014	7	1597
2014	8	1517
2014	9	1272
2014	10	1352
2014	11	1245
2014	12	1312
2015	1	1157
2015	2	1143
2015	3	1243
2015	4	1355
2015	5	1707
2015	6	1774
2015	7	1697
2015	8	1471
2015	9	1444
2015	10	1609
2015	11	1046
2015	12	1288
2016	1	1169
2016	2	1082
2016	3	1407
2016	4	1674
2016	5	1523
2016	6	2010
2016	7	1730
2016	8	1554
2016	9	1506
2016	10	1361
2016	11	531

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-28: EFCA 5.25 "EFCA 5.25_residential customer by month_APSRC01563.xlsx"

Arizona Public Service Company
Residential Customers by Rate
FERC form 1 page 304 - 304.1 - 304.A

2007

Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
E-10	67,769	67,395	67,025	66,638	66,239	65,845	65,028	63,686	62,623	58,717	53,534	47,911	62,701
E-12	449,352	450,927	452,276	447,746	443,378	442,335	442,700	440,692	440,601	443,458	451,998	463,462	447,410
EC-1	18,462	18,387	18,316	18,246	18,159	18,077	17,859	17,367	17,083	16,362	15,386	14,352	17,338
ET-1	358,215	356,714	355,515	354,113	353,004	351,488	350,946	351,032	351,870	352,351	351,865	351,772	353,240
ET-2	17,302	19,289	21,617	24,289	26,478	28,928	31,845	34,276	36,206	37,705	39,241	40,677	29,821
ECT-1R	48,372	48,240	48,155	47,995	47,826	47,696	47,614	47,789	47,998	48,256	48,416	48,605	48,080
ECT-2	3,547	4,000	4,501	5,134	5,543	6,078	6,756	7,794	8,695	9,725	10,894	11,880	7,046
EPR-2	6	6	5	5	6	6	373	168	134	129	118	126	90
EPR-5	0	0	0	0	0	0	2	227	260	355	317	355	126
EPR-4	289	287	320	321	361	357	0	0	0	0	0	0	161
Total Residential	963,314	965,245	967,730	964,487	960,994	960,810	963,123	963,031	965,470	967,058	971,769	979,140	966,013

2008

Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
E-10	42,997	38,077	36,288	34,952	32,517	29,447	2,632	335	2	1	0	0	18,104
E-12	471,531	475,459	475,839	471,754	468,879	469,067	490,327	487,275	485,480	485,386	488,932	494,972	480,408
EC-1	13,367	12,073	11,169	10,649	9,932	8,548	5,477	242	1	0	0	0	5,955
ET-1	351,549	350,353	349,370	347,276	345,357	343,354	347,271	347,043	346,682	345,419	343,953	343,071	346,725
ET-2	41,801	42,829	44,627	47,691	50,126	53,224	56,512	59,263	61,773	63,534	65,057	66,596	54,419
ECT-1R	48,803	48,979	49,300	49,075	48,960	48,868	49,143	53,207	54,275	54,189	54,058	53,970	51,069
ECT-2	12,743	13,630	14,946	16,770	18,323	20,080	22,210	23,936	25,022	25,821	26,390	26,847	20,560
EPR-2	122	119	122	121	120	120	120	115	113	116	116	114	118
EPR-5	395	428	458	497	523	552	602	638	670	716	754	793	586
Total Residential	983,308	981,947	982,119	978,785	974,737	973,260	974,294	972,054	974,018	975,182	979,260	986,363	977,944

2009

Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
E-12	497,044	497,135	497,188	492,898	487,591	485,239	484,576	480,638	479,720	479,363	482,629	489,740	487,813
ET-1	342,172	340,531	339,488	336,755	333,711	331,248	329,754	328,327	327,311	326,047	324,567	323,916	331,986
ET-2	67,660	68,424	69,635	72,578	75,929	77,986	80,297	82,836	85,288	87,226	88,983	90,746	78,966
ECT-1R	53,829	53,749	53,545	53,099	52,658	52,361	52,160	52,053	51,950	51,766	51,605	51,421	52,516
ECT-2	27,188	27,503	27,868	28,804	29,943	30,623	31,327	32,179	32,918	33,449	33,819	34,154	30,815
EPR-2	116	122	122	124	129	126	124	125	126	120	110	112	121
EPR-5	820	891	992	1,091	1,154	1,198	1,325	1,308	1,252	1,093	1,017	952	1,091
EPR-6	0	0	0	0	0	0	7	116	251	561	797	1,035	231
Total Residential	988,829	988,355	988,838	985,349	981,115	978,781	979,570	977,582	978,816	979,625	983,527	992,076	983,539

2010

Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
E-12	457,509	457,619	458,239	453,059	447,842	445,743	444,974	441,036	439,123	439,334	442,504	448,312	447,941
ET-1	305,022	301,704	296,474	291,267	285,540	279,345	273,523	267,693	261,906	256,975	252,646	249,239	276,778
ET-2	86,087	89,950	95,413	100,504	105,714	111,078	116,961	122,719	128,243	133,068	136,607	140,507	113,904
ECT-2	33,138	33,769	34,453	35,254	36,236	37,218	38,284	39,602	40,581	41,445	42,040	42,559	37,882
ECT-1R	50,112	49,723	49,232	48,724	48,140	47,464	46,835	46,187	45,591	45,106	44,674	44,284	47,173
E-12 Low Income	34,617	35,060	35,414	35,756	35,792	36,101	36,242	36,747	36,939	37,192	37,481	38,113	36,288
ET-1 Low Income	16,231	16,222	16,061	15,887	15,619	15,419	15,133	15,018	14,675	14,432	14,251	14,137	15,257
ET-2 Low Income	5,803	6,119	6,507	6,971	7,364	7,862	8,478	9,383	10,299	10,855	11,333	11,735	8,559
ECT-2 Low Income	1,163	1,181	1,224	1,273	1,307	1,373	1,437	1,515	1,581	1,642	1,696	1,742	1,428
ECT-1R Low Income	1,049	1,070	1,047	1,033	1,007	988	979	986	979	964	934	937	998
ET-SP	10	46	68	81	90	94	107	136	146	165	175	178	108
EPR-2	111	111	110	109	103	102	102	98	95	95	95	93	102
EPR-5	927	890	872	863	851	834	4	0	0	0	0	0	437
EPR-6	1,302	1,598	1,902	2,152	2,442	2,767	3,863	4,007	4,172	4,353	4,470	4,585	3,134
Total Residential	993,081	995,062	997,016	992,933	988,047	986,388	986,922	985,127	984,330	985,626	988,906	996,421	989,989

2011

Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
E-12	450,163	451,282	450,605	446,175	441,716	439,878	438,466	435,144	434,495	432,504	434,995	441,995	441,452
ET-1	245,729	242,649	239,380	236,155	232,724	229,168	223,106	218,784	213,426	206,995	202,176	198,980	224,106
ET-2	143,490	146,011	149,547	152,840	156,310	159,389	163,812	169,091	175,175	180,560	184,834	189,388	164,204
ECT-2	43,181	43,631	44,257	44,908	45,510	46,168	48,197	50,586	52,609	54,655	56,072	57,355	48,927
ECT-1R	43,849	43,453	43,027	42,623	42,128	41,672	40,652	39,977	39,222	38,602	38,150	37,629	40,915
E-12 Low Income	38,254	38,407	38,674	38,487	38,428	38,373	38,249	38,293	38,299	38,269	38,400	38,715	38,404
ET-1 Low Income	13,935	13,748	13,628	13,347	13,136	12,872	12,486	12,152	11,817	11,252	10,960	10,771	12,509
ET-2 Low Income	12,027	12,184	12,519	12,661	12,926	13,170	13,537	14,115	14,974	15,832	16,503	16,928	13,948
ECT-2 Low Income	1,768	1,794	1,846	1,859	1,883	1,912	2,000	2,152	2,303	2,442	2,577	2,657	2,099
ECT-1R Low Income	931	913	909	894	883	863	829	810	784	769	752	748	840
ET-SP	184	190	193	209	214	223	273	311	329	360	385	404	273
EPR-2	91	88	90	88	85	85	86	83	83	81	81	81	85
EPR-6	4933	5219	5478	5709	5927	6219	6537	6800	7061	7362	7674	8035	6,413
Total Residential	998,535	999,569	1,000,153	995,955	991,870	989,992	988,230	988,298	990,577	989,683	993,559	1,003,686	994,175

2012

Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
E-12	444,289	443,395	443,252	438,570	432,866	431,152	429,755	427,934	427,126	427,311	431,233	437,010	434,491
ET-1	196,543	194,055	191,804	189,414	186,772	183,871	180,421	178,648	176,297	173,977	172,064	170,351	182,851
ET-2	192,116	193,851	197,190	200,078	202,540	205,286	208,387	212,860	216,032	218,221	220,038	222,247	207,404
ECT-2	58,318	58,985	59,785	60,539	61,347	62,277	63,584	65,564	66,856	67,646	68,145	68,563	63,467
ECT-1R	37,288	36,915	36,585	36,233	35,784	35,307	34,749	34,482	34,144	33,824	33,548	33,257	35,176
E-12 Low Income	38,812	38,912	38,868	38,767	38,639	38,514	37,906	37,998	37,825	37,741	37,769	38,237	38,332
ET-1 Low Income	10,577	10,467	10,284	10,121	9,949	9,727	9,442	9,296	9,084	8,901	8,788	8,731	9,614
ET-2 Low Income	17,130	17,260	17,374	17,575	17,786	17,912	18,016	18,749	19,400	19,669	19,890	20,243	18,417
ECT-2 Low Income	2,706	2,769	2,792	2,828	2,868	2,936	2,977	3,156	3,300	3,362	3,436	3,451	3,048
ECT-1R Low Income	741	729	714	708	688	673	641	633	625	617	595	581	662
ET-SP	415	433	451	460	496	527	551	573	594	617	636	648	533
EPR-2	84	83	82	84	84	85	82	82	86	85	84	86	84
EPR-6	8,520	8,873	9,297	9,748	10,140	10,592	10,943	11,595	12,141	12,675	13,300	13,936	10,980
ET-EV	0	4	5	10	10	13	14	17	18	24	32	31	15
Total Residential	1,007,539	1,006,731	1,008,483	1,005,135	999,969	998,872	997,468	1,001,587	1,003,528	1,004,670	1,009,558	1,017,372	1,005,074

Notes:

1. Rate riders such as EPR-2 net metering and EPR-6 net billing are shown separately and not included in parent rate schedule counts

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-29: APS Pre-Filed 1.29 "Prefiled 1.29_Electric MWH Sales_APSRC00604.xlsx"

CUSTOMERS & SALES
2013 Actuals by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Customers													
Residential	1,021,328	1,022,104	1,022,020	1,018,554	1,015,112	1,013,282	1,014,973	1,013,380	1,016,894	1,018,265	1,023,354	1,032,239	1,019,292
Commercial	122,938	123,043	123,158	123,026	123,131	123,294	123,376	123,317	123,490	123,534	123,644	123,873	123,319
Industrial	3,411	3,404	3,408	3,395	3,394	3,400	3,400	3,390	3,399	3,410	3,407	3,406	3,402
C&I A	126,230	126,329	126,448	126,303	126,407	126,576	126,658	126,589	126,771	126,826	126,933	127,161	126,603
C&I B	117	116	116	116	116	116	116	116	116	116	116	116	116
C&I C	2	2	2	2	2	2	2	2	2	2	2	2	2
Irrigation	294	294	295	294	299	303	304	303	302	300	298	298	299
Hwy lighting & other pub. authority	1,142	1,147	1,150	1,147	1,146	1,150	1,151	1,149	1,153	1,159	1,155	1,155	1,150
Sales for resale	53	53	54	50	55	48	54	54	51	55	46	55	52
Total	1,149,166	1,150,045	1,150,085	1,146,466	1,143,137	1,141,477	1,143,258	1,141,593	1,145,289	1,146,723	1,151,904	1,161,026	1,147,514
Retail Total	1,149,113	1,149,992	1,150,031	1,146,416	1,143,082	1,141,429	1,143,204	1,141,539	1,145,238	1,146,668	1,151,858	1,160,971	1,147,462
Billed MWH's													
Residential	1,083,088	915,075	807,552	749,568	943,051	1,321,412	1,698,858	1,624,163	1,537,272	964,664	729,782	910,014	13,284,499
Commercial	947,837	919,108	898,312	928,882	1,020,906	1,141,443	1,270,165	1,278,535	1,241,660	993,293	908,292	944,050	12,492,483
Industrial	174,572	168,350	170,658	177,114	191,336	181,398	181,798	192,034	203,023	182,187	181,157	189,446	2,193,073
C&I A	868,998	844,052	819,039	846,678	932,215	1,042,682	1,159,224	1,178,107	1,140,332	905,627	830,119	874,052	11,441,125
C&I B	212,637	200,549	201,256	212,741	232,053	242,588	246,747	245,524	258,581	221,717	213,599	209,199	2,697,191
C&I C	40,774	42,857	48,675	46,577	47,974	37,571	45,992	46,938	45,770	48,136	45,731	50,245	547,240
Irrigation	647	538	788	780	1,102	1,396	1,403	1,241	967	987	962	660	11,471
Hwy lighting & other pub. authority	12,871	12,906	11,964	11,901	11,898	11,772	11,745	12,123	12,008	12,002	12,152	12,265	145,607
Sales for resale--traditional	26,446	45,656	57,720	57,270	68,741	87,299	94,289	86,562	60,762	43,098	28,914	26,452	683,209
Sales for resale--nontraditional													0
Total	2,245,461	2,061,633	1,946,994	1,925,515	2,237,034	2,744,720	3,258,258	3,194,658	3,055,692	2,196,231	1,861,259	2,082,887	28,810,342
Retail Total	2,219,015	2,015,977	1,889,274	1,868,245	2,168,293	2,657,421	3,163,969	3,108,096	2,994,930	2,153,133	1,832,345	2,056,435	28,127,133
Net Unbilled MWH's													
Residential	35,501	(91,903)	(19,168)	38,188	95,124	196,432	95,332	8,978	(212,153)	(147,833)	(26,578)	33,677	5,597
Commercial	(34,556)	(51,561)	40,030	41,768	87,485	48,059	(18,715)	7,901	(130,292)	(24,555)	16,548	(25,458)	(43,346)
Industrial	393	(6,151)	4,920	5,656	11,715	95	(9,287)	(88)	(14,099)	1,499	7,029	(3,151)	(1,469)
Irrigation	(214)	(156)	11	341	438	244	(75)	(273)	(251)	154	(184)	(87)	(52)
Hwy lighting & other pub. authority	85	(1,095)	905	759	521	(492)	(532)	(219)	(1,325)	575	985	(425)	(258)
Sales for resale	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,209	(150,866)	26,698	86,712	195,283	244,338	66,723	16,299	(358,120)	(170,160)	(2,200)	4,556	(39,528)
Retail Total	1,209	(150,866)	26,698	86,712	195,283	244,338	66,723	16,299	(358,120)	(170,160)	(2,200)	4,556	(39,528)
Total MWH's													
Residential	1,118,589	823,172	788,384	787,756	1,038,175	1,517,844	1,794,190	1,633,141	1,325,119	816,831	703,204	943,691	13,290,096
Commercial	913,281	867,547	938,342	970,650	1,108,391	1,189,502	1,251,450	1,286,436	1,111,368	968,738	924,840	918,592	12,449,137
Industrial	174,965	162,199	175,578	182,770	203,051	181,493	172,511	191,946	188,924	183,686	188,186	186,295	2,191,604
Irrigation	433	382	799	1,121	1,540	1,640	1,328	968	716	1,141	778	573	11,419
Hwy lighting & other pub. authority	12,956	11,811	12,869	12,660	12,419	11,280	11,213	11,904	10,683	12,577	13,137	11,840	145,349
Sales for resale--traditional	26,446	45,656	57,720	57,270	68,741	87,299	94,289	86,562	60,762	43,098	28,914	26,452	683,209
Sales for resale--nontraditional	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,246,670	1,910,767	1,973,692	2,012,227	2,432,317	2,989,058	3,324,981	3,210,957	2,697,572	2,026,071	1,859,059	2,087,443	28,770,814
Retail Total	2,220,224	1,865,111	1,915,972	1,954,957	2,363,576	2,901,759	3,230,692	3,124,395	2,636,810	1,982,973	1,830,145	2,060,991	28,087,605

CUSTOMERS & SALES
2014 Actuals by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Customers													
Residential	1,035,860	1,035,901	1,036,278	1,033,108	1,028,904	1,027,743	1,028,952	1,028,385	1,032,827	1,034,113	1,037,876	1,044,791	1,033,728
Commercial	123,913	123,915	124,072	124,235	124,338	124,353	124,437	124,704	124,867	124,753	124,943	124,984	124,460
Industrial	3,415	3,410	3,412	3,427	3,430	3,432	3,422	3,417	3,435	3,435	3,450	3,462	3,429
C&I A	127,207	127,204	127,363	127,541	127,647	127,664	127,738	128,000	128,181	128,067	128,272	128,325	127,767
C&I B	119	119	119	119	119	119	119	119	119	119	119	119	119
C&I C	2	2	2	2	2	2	2	2	2	2	2	2	2
Irrigation	298	296	295	296	299	299	301	301	303	301	297	298	299
Hwy lighting & other pub. authority	1,158	1,157	1,160	1,160	1,159	1,162	1,162	1,161	1,165	1,171	1,171	1,172	1,163
Sales for resale	54	55	62	55	54	57	52	55	61	54	49	53	55
Total	1,164,698	1,164,734	1,165,279	1,162,281	1,158,184	1,157,046	1,158,326	1,158,023	1,162,658	1,163,827	1,167,786	1,174,760	1,163,134
Retail Total	1,164,644	1,164,679	1,165,217	1,162,226	1,158,130	1,156,989	1,158,274	1,157,968	1,162,597	1,163,773	1,167,737	1,174,707	1,163,079
Billed MWH's													
Residential	956,075	799,532	705,678	723,707	853,989	1,263,488	1,587,267	1,634,799	1,495,800	1,110,269	843,303	846,487	12,820,394
Commercial	922,121	880,334	888,196	887,025	968,081	1,108,896	1,221,417	1,257,917	1,235,868	1,077,094	964,694	941,954	12,353,597
Industrial	176,515	173,257	174,866	179,804	182,413	190,338	199,131	197,982	189,779	194,089	184,923	195,040	2,238,137
C&I A	848,604	805,566	807,616	815,963	880,468	1,017,238	1,118,335	1,162,272	1,117,377	980,584	881,973	869,924	11,305,920
C&I B	201,557	203,586	204,949	202,716	222,106	234,761	254,123	245,170	268,656	242,092	220,873	220,769	2,721,358
C&I C	48,475	44,439	50,497	48,150	47,920	47,235	48,090	48,457	39,614	48,507	46,771	46,301	564,456
Irrigation	659	620	765	967	1,286	1,388	1,463	1,182	1,007	791	824	540	11,492
Hwy lighting & other pub. authority	12,859	12,355	12,122	12,121	11,852	11,829	11,807	11,878	11,863	12,046	12,117	12,545	145,394
Sales for resale--traditional	50,044	47,154	46,966	67,898	85,199	76,797	91,730	48,876	45,566	57,082	45,941	50,937	714,190
Sales for resale--nontraditional													0
Total	2,118,273	1,913,252	1,828,593	1,871,522	2,102,820	2,652,736	3,112,815	3,152,634	2,979,883	2,451,371	2,051,802	2,047,503	28,283,204
Retail Total	2,068,229	1,866,098	1,781,627	1,803,624	2,017,621	2,575,939	3,021,085	3,103,758	2,934,317	2,394,289	2,005,861	1,996,566	27,569,014
Net Unbilled MWH's													
Residential	(9,960)	(79,378)	10,459	29,047	142,700	190,810	168,404	(76,797)	(144,227)	(150,347)	(120,487)	57,134	17,358
Commercial	(22,998)	(51,940)	52,321	58,408	122,032	37,362	32,637	(55,135)	(67,049)	(29,437)	(52,721)	(39,859)	(16,379)
Industrial	(3,531)	(6,287)	7,282	9,015	16,204	(3,494)	(4,104)	(5,151)	(6,330)	2,256	(1,628)	15,855	20,087
Irrigation	(376)	(41)	102	129	260	134	(43)	(68)	(235)	37	(178)	(174)	(453)
Hwy lighting & other pub. authority	(315)	(460)	621	470	1,123	(226)	(504)	(684)	(706)	707	(102)	(5,018)	(5,094)
Sales for resale	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	(37,180)	(138,106)	70,785	97,069	282,319	224,586	196,390	(137,835)	(218,547)	(176,784)	(175,116)	27,938	15,519
Retail Total	(37,180)	(138,106)	70,785	97,069	282,319	224,586	196,390	(137,835)	(218,547)	(176,784)	(175,116)	27,938	15,519
Total MWH's													
Residential	946,115	720,154	716,137	752,754	996,689	1,454,298	1,755,671	1,558,002	1,351,573	959,922	722,816	903,621	12,837,752
Commercial	899,123	828,394	940,517	945,433	1,090,113	1,146,258	1,254,054	1,202,782	1,168,819	1,047,657	911,973	902,095	12,337,218
Industrial	172,984	166,970	182,148	188,819	198,617	186,844	195,027	192,831	183,449	196,345	183,295	210,895	2,258,224
Irrigation	283	579	867	1,096	1,546	1,522	1,420	1,114	772	828	646	366	11,039
Hwy lighting & other pub. authority	12,544	11,895	12,743	12,591	12,975	11,603	11,303	11,194	11,157	12,753	12,015	7,527	140,300
Sales for resale--traditional	50,044	47,154	46,966	67,898	85,199	76,797	91,730	48,876	45,566	57,082	45,941	50,937	714,190
Sales for resale--nontraditional	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,081,093	1,775,146	1,899,378	1,968,591	2,385,139	2,877,322	3,309,205	3,014,799	2,761,336	2,274,587	1,876,686	2,075,441	28,298,723
Retail Total	2,031,049	1,727,992	1,852,412	1,900,693	2,299,940	2,800,525	3,217,475	2,965,923	2,715,770	2,217,505	1,830,745	2,024,504	27,584,533

CUSTOMERS & SALES
2015 Actuals by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Customers													
Residential	1,048,536	1,049,347	1,048,980	1,044,773	1,041,301	1,040,751	1,042,487	1,041,741	1,046,424	1,047,852	1,052,387	1,059,292	1,046,989
Commercial	125,094	125,268	125,327	125,418	125,507	125,478	125,668	125,653	125,792	125,842	125,938	125,957	125,579
Industrial	3,443	3,443	3,445	3,447	3,448	3,451	3,430	3,445	3,438	3,438	3,438	3,462	3,444
C&I A	128,416	128,590	128,651	128,744	128,834	128,808	128,977	128,977	129,109	129,159	129,255	129,298	128,902
C&I B	119	119	119	119	119	119	119	119	119	119	119	119	119
C&I C	2	2	2	2	2	2	2	2	2	2	2	2	2
Irrigation	297	297	297	297	300	303	305	305	302	300	300	300	300
Hwy lighting & other pub. authority	1,179	1,187	1,177	1,178	1,179	1,181	1,178	1,179	1,189	1,188	1,187	1,187	1,182
Sales for resale	44	45	47	50	49	49	46	45	48	50	48	44	47
Total	1,178,593	1,179,587	1,179,273	1,175,163	1,171,784	1,171,213	1,173,114	1,172,368	1,177,193	1,178,670	1,183,298	1,190,242	1,177,541
Retail Total	1,178,549	1,179,542	1,179,226	1,175,113	1,171,735	1,171,164	1,173,068	1,172,323	1,177,145	1,178,620	1,183,250	1,190,198	1,177,494
Billed MWH's													
Residential	1,001,199	770,246	726,391	761,249	813,174	1,130,424	1,649,192	1,659,235	1,669,101	1,213,023	821,979	927,064	13,142,277
Commercial	923,474	878,525	886,028	914,743	943,853	1,056,657	1,246,661	1,251,308	1,275,995	1,109,004	951,397	934,848	12,372,493
Industrial	174,263	176,601	184,001	179,377	186,086	192,374	200,576	201,168	203,648	198,105	192,873	183,091	2,272,163
C&I A	839,236	808,660	811,886	836,012	860,483	966,109	1,145,496	1,153,172	1,173,428	1,024,715	874,170	860,894	11,354,261
C&I B	212,518	203,912	209,649	211,319	221,476	237,648	254,230	251,575	264,303	234,779	225,078	211,682	2,738,169
C&I C	45,983	42,554	48,494	46,789	47,980	45,274	47,511	47,729	41,912	47,615	45,022	45,363	552,226
Irrigation	484	462	675	837	1,068	1,255	1,319	1,234	1,234	1,022	687	598	10,875
Hwy lighting & other pub. authority	12,460	12,937	12,269	12,129	12,173	12,059	8,772	17,913	12,905	12,428	11,938	13,052	151,035
Sales for resale--traditional	8,447	15,084	16,391	20,596	31,295	19,484	8,046	23,439	6,962	20,663	3,873	4,948	179,228
Sales for resale--nontraditional													0
Total	2,120,327	1,853,855	1,825,755	1,888,931	1,987,649	2,412,253	3,114,566	3,154,297	3,169,845	2,554,245	1,982,747	2,063,601	28,128,071
Retail Total	2,111,880	1,838,771	1,809,364	1,868,335	1,956,354	2,392,769	3,106,520	3,130,858	3,162,883	2,533,582	1,978,874	2,058,653	27,948,843
Net Unbilled MWH's													
Residential	(55,884)	(97,618)	73,119	3,414	78,170	356,396	18,217	110,752	(273,651)	(201,698)	(86,214)	92,474	17,477
Commercial	7,008	(66,921)	66,036	20,647	61,389	105,620	(10,036)	81,028	(120,119)	(92,337)	(52,502)	(8,153)	(8,340)
Industrial	(9,607)	364	577	6,718	7,493	5,874	(1,024)	2,234	(9,254)	(8,741)	6,468	(8,655)	(7,553)
Irrigation	14	49	67	192	723	(190)	(440)	27	(118)	(135)	(96)	(45)	48
Hwy lighting & other pub. authority	(20)	(79)	40	(8)	493	(384)	(114)	30	(11)	23	53	(7)	16
Sales for resale	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	(58,489)	(164,205)	139,839	30,963	148,268	467,316	6,603	194,071	(403,153)	(302,888)	(132,291)	75,614	1,648
Retail Total	(58,489)	(164,205)	139,839	30,963	148,268	467,316	6,603	194,071	(403,153)	(302,888)	(132,291)	75,614	1,648
Total MWH's													
Residential	945,315	672,628	799,510	764,663	891,344	1,486,820	1,667,409	1,769,987	1,395,450	1,011,325	735,765	1,019,538	13,159,754
Commercial	930,482	811,604	952,064	935,390	1,005,242	1,162,277	1,236,625	1,332,336	1,155,876	1,016,667	898,895	926,695	12,364,153
Industrial	164,656	176,965	184,578	186,095	193,579	198,248	199,552	203,402	194,394	189,364	199,341	174,436	2,264,610
Irrigation	498	511	742	1,029	1,791	1,065	879	1,261	1,116	887	591	553	10,923
Hwy lighting & other pub. authority	12,440	12,858	12,309	12,121	12,666	11,675	8,658	17,943	12,894	12,451	11,991	13,045	151,051
Sales for resale--traditional	8,447	15,084	16,391	20,596	31,295	19,484	8,046	23,439	6,962	20,663	3,873	4,948	179,228
Sales for resale--nontraditional	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,061,838	1,689,650	1,965,594	1,919,894	2,135,917	2,879,569	3,121,169	3,348,368	2,766,692	2,251,357	1,850,456	2,139,215	28,129,719
Retail Total	2,053,391	1,674,566	1,949,203	1,899,298	2,104,622	2,860,085	3,113,123	3,324,929	2,759,730	2,230,694	1,846,583	2,134,267	27,950,491

Average Customers
Annual Change and % Change

	Average Customers				Change	% Change	Change	% Change	Change	% Change
	2012	2013	2014	2015	2013		2014		2015	
Customers										
Residential	1,005,074	1,019,292	1,033,728	1,046,989	14,218	1.41%	14,436	1.42%	13,261	1.27%
Commercial (included in C&I)	122,360	123,319	124,460	125,579	959	0.78%	1,141	0.93%	1,119	0.89%
Industrial (included in C&I)	3,417	3,402	3,429	3,444	(15)	-0.44%	27	0.79%	15	0.44%
C&I A	125,659	126,603	127,767	128,902	944	0.75%	1,164	0.92%	1,135	0.88%
C&I B	116	116	119	119	0	0.00%	3	2.59%	0	0.00%
C&I C	2	2	2	2	0	0.00%	0	0.00%	0	0.00%
Irrigation	304	299	299	300	(5)	-1.64%	0	0.00%	1	0.33%
Hwy lighting & other pub. authority	1,141	1,150	1,163	1,182	9	0.79%	13	1.13%	19	1.61%
Total Retail	1,132,296	1,147,462	1,163,078	1,177,494	15,166	1.34%	15,616	1.36%	14,416	1.22%

		Projected	Projected	Projected	Change	% Change	Change	% Change	Change	% Change
	2015	2016	2017	2018	2016		2017		2018	
Residential	1,046,989	1,070,998	1,103,101	1,136,176	24,009	2.29%	32,103	3.00%	33,075	2.91%
Commercial	125,579									
Industrial	3,444									
C&I A	128,902	131,752	135,295	139,367	2,850	2.21%	3,543	2.69%	4,072	2.92%
C&I B	119	121	121	121	2	1.68%	0	0.00%	0	0.00%
C&I C	2	2	2	2	0	0.00%	0	0.00%	0	0.00%
Irrigation	300	291	287	284	(9)	-3.00%	(4)	-1.37%	(3)	-1.06%
Hwy lighting & other pub. authority	1,182	1,181	1,186	1,192	(1)	-0.08%	5	0.42%	6	0.50%
Total Retail	1,177,494	1,204,345	1,239,992	1,277,142	26,851	2.28%	35,647	2.96%	37,150	2.91%

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-30: APS Pre-Filed data response Prefiled 1.26_APS Demand Energy Relationship_APSRC00480.xls

Arizona Public Service Company
Line Loss Values Used in Allocation Factors
2015 Engineering Study
Demand / Energy Relationship Using Westinghouse Empirical Formula

System Component	Contribution Factor (% of Component Loading) Demand	Energy
A. Secondary & Service	1.9	1.3
B. Distribution Transformers	1.3	0.9
C. Primary Distribution	2.6	1.8
D. 69/12 kV Transformers	0.3	0.2

I. Calculation of Loss Factor in Empirical Formula

Loss Factor = $X(\text{Load Factor})^2 + (1-X)(\text{Load Factor})$

X =	0.7
Load Factor =	0.55
Loss Factor =	0.37675

II. Calculation of Annual Energy Consumption

Peak Load (kW) =	100
Load Factor =	0.55
Calendar Hours =	8,760
Annual Consumption =	481,800

III. Calculation of Energy Losses

Energy Losses = (Loss Factor)(Calendar Hours)(Peak Load)(Demand % Component Loading)

IV. Calculation of Energy % Component Loading

Energy % Component Loading = Annual Consumption/(Annual Consumption - Energy Losses)

A. Calculation of Annual Energy Losses (Secondary & Services)

Peak Load (kW) =	100
Loss Factor =	0.37675
Calendar Hours =	8,760
Demand % Component Loading =	1.9
Energy Losses =	6,271

AA. Calculation of Energy Contribution Factor

Energy % Component Loading = **1.3**

B. Calculation of Annual Energy Losses (Distribution Transformers)

Peak Load (kW) =	100
Loss Factor =	0.37675
Calendar Hours =	8,760
Demand % Component Loading =	1.3
Energy Losses =	4,290

BB. Calculation of Energy Contribution Factor

Energy % Component Loading = **0.9**

C. Calculation of Annual Energy Losses (Primary Distribution)

Peak Load (kW) =	100
Loss Factor =	0.37675
Calendar Hours =	8,760
Demand % Component Loading =	2.6
Energy Losses =	8,581

CC. Calculation of Energy Contribution Factor

Energy % Component Loading = **1.8**

D. Calculation of Annual Energy Losses (69/12kV Transformers)

Peak Load (kW) =	100
Loss Factor =	0.37675
Calendar Hours =	8,760
Demand % Component Loading =	0.3
Energy Losses =	990

DD. Calculation of Energy Contribution Factor

Energy % Component Loading = **0.2**

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-31: SEIA 2.4c_ECT2 solar, billing determinants_APSRC01833.pdf

SOLAR ENERGY INDUSTRY ASSOCATION'S
SECOND SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 30, 2016

SEIA 2.4: APS's bill savings analysis provided in response to Vote Solar 2.7 ("VS 2.7 Staff 5.28 solar rate offset – proposed rates_APSRC0167") 3 provides a bill savings analysis for residential customer load on the R1, R2, and R3 rates, before and after installing solar. Regarding this analysis, please explain:

a. Are the loads "after" solar representative of delivered load (imports) to the solar customers?

b. Are exports considered in this analysis?

c. Please provide the monthly exports, in kWh, for the representative solar customer modeled in this analysis, in each of the customer classes modeled (i.e. ET-1, ET-2, ET-12, ET-1R, ECT-2).

d. The average customer in the analysis is a 16,957 kWh per year customer "before solar" and an 11,810 kWh per year "after solar." Does this indicate that solar is serving 30% of the customer's onsite load?

e. What are the export bill credits for each class modeled in the analysis? Please provide the same analysis with an exemplary 10.9 cents per kWh export rate.

f. What are the volumetric bill savings, including export credits, stated as $ per unit of total kWh solar output, for the R-1, R-2, and R-3 typical solar customer? (see cells B6:D9 of the Summary tab).

g. The bills calculated in this analysis are "base bills." Please list the other rate adjustments that APS has not included in its analysis of bill savings.

h. What size solar system (in kW-AC) corresponds to the average customer modeled for each customer class in the analysis? This should include system sizes for ET-1, ET-2, ET-12, ET-1R, ECT-2, and the average for all residential customers (weighted by number of customers).

i. Did APS make an error by applying the summer on peak demand charge in all months of the year in the R3 bill savings calculations?

Witness: Chuck Miessner

j. Please provide the 8760 hourly loads that are the basis for this bill savings analysis for (i) delivered load from the utility to the customer, (ii) receipts of solar exports to the utility from the customer's PV system, and (iii) total customer site load before solar is installed, for each customer class modeled (ET-1, ET-2, ET-12, ET-1R, ECT-2).

k. Please describe how APS derived the 8760 loads provided in response to Part (j) from the raw 2015 billing data for residential customers.

Response:

a. The load after solar reflects the kWh billed by APS, which in the case of APS's proposal for instantaneous netting for new solar customers would constitute the delivered load.

b. No. However, a high level estimate of the solar offset from the proposed rates including the export energy valued at APS's revised proposed purchase rate, which conforms to Decision No. 75879 in the value and cost of solar matter is provided as attachment APSRC01813.

c. Per conversations with SEIA, APS will provide this information in a supplemental response on 1/10/2017.

d. Please see response to part c.

e. Please refer to part b. The attachment to EFCA 21.2 is in excel format with formula's intact and the offset rate as an input to allow easy analysis for different export rates.

f. Please refer to part b.

g. A list of adjustor rates and details in how they are calculated are provided in SFR Rates and Tariffs book 2 of 2, the adjustments tab. Current charges can be found in the Redline Rate Schedules tab. Please note that a significant portion of the revenue requirement that was recovered through adjustor rates were transferred to base rates in APS's proposal. In addition, because these rates and the associated revenue requirements may change in 2017, prior to the end of the rate case, the adjustor rate levels at that time are yet to be determined.

Witness: Chuck Miessner

Response Continued:

h. Please see response to part c.

i. Yes. The corrected solar offset rate for R-3 is $0.078 per kWh rather than the original number of $0.079. A revised workpaper is provided as attachment APSRC01814.

j. Please see response to part c.

k. Please see response to part c.

Supplemental Response:

c. Please see Attachments APSRC01831-01836. Due to the size of the files, Attachments APSRC01831-01835 will be provided in excel format only.

d. Yes. And this result is consistent with an average customer that sizes their solar system to 68% of their annual kWh usage and 44% of the generation instantaneously serves their load and 56% is exported to the grid. (i.e. 44% times 68% = 30%).

h. APS did not model a specific solar system size for the various rate classes – the analysis was instead performed with metered load information on the delivered load, received load and the, metered solar production.

j. Please see following attachments for hourly data and description of data fields:

Attachment	Month
APSRC01818	January 2015
APSRC01819	February 2015
APSRC01820	March 2015
APSRC01821	April 2015
APSRC01822	May 2015
APSRC01823	June 2015
APSRC01824	July 2015
APSRC01825	August 2015
APSRC01826	September 2015
APSRC01827	October 2015
APSRC01828	November 2015
APSRC01829	December 2015
APSRC01830	Field key

Supplemental Response Continued:

Please note that Attachments APSRC01818-01829 are too large to upload to the APS external SharePoint site, so the attachments will be provided through an alternate method. Special instructions to access the data will be sent separately to SEIA. Other parties please contact APS for this information.

k. The hourly load profiles used in this analysis were based on hourly delivered load (supplied by APS generation) and received load (exported from the solar generator to the grid) data from the bidirectional billing meter, and hourly solar production from a separate generation meter for the same house. The hourly information was summarized by time-of-use periods and season for each of the current rate classes.

The site load was derived from the following:

Site Load = Delivered + (Solar Production – Received)

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-32: Staff 5.37_Demand Rate Analysis_APSRC01217.xlsx

ARIZONA PUBLIC SERVICE COMPANY
Residential Demand Rate Analysis

Background:

Analysis performed in 2015

The purpose of the study was to assess the impact of a three-part demand rate on demand, energy, and monthly bills for residential customers.

The study isolated the demand chage impact by comparing the same customer before and after switching to a three-part rate.

Since the three-part rate was a time-of-use rate, APS compared customers moving from a two-part TOU rate with similar on-peak hours.

The study specifically compared the two-part Rate ET-2 with the three-part Rate ECT-2, both having on-peak hours of 12 noon to 7 pm weekdays.

Sampling Frame:

Phoenix Metro customers

Switched from ET-2 to ECT-2 in 2013

Had 12 months billing data in 2012 and 2014

Resided in same home for the three year period

Total sample size = 977 customers

Adjustments:

Load data was normalized for temperature and humidity for summer months.

Winter months were not adjusted because correlation factors between load and weather were very low.

ARIZONA PUBLIC SERVICE COMPANY

Residential Demand Rate Analysis

stratified by % kW change during summer months

The change in kW, kWh, and monthly bill resulting from switching from a two-part rate to a three-part rate

Summer Load Change (Weather Normalized - temp, humidity)

% Customers	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	% Total kWh	% On-Pk kWh	% Off-Pk kWh	% On-Pk kW	Summer Bill[1] $ Change	% Change
5%	(617)	(234)	(383)	(3.0)	-27%	-40%	-22%	-39%	$ (93.94)	-35%
10%	(444)	(134)	(310)	(1.8)	-19%	-24%	-17%	-24%	$ (66.07)	-25%
15%	(386)	(139)	(247)	(1.6)	-15%	-21%	-13%	-19%	$ (64.35)	-22%
20%	(364)	(117)	(246)	(1.3)	-14%	-17%	-13%	-16%	$ (62.67)	-21%
25%	(358)	(89)	(269)	(1.1)	-14%	-14%	-14%	-13%	$ (58.15)	-20%
30%	(196)	(76)	(120)	(0.9)	-8%	-11%	-7%	-11%	$ (45.61)	-16%
35%	(99)	(48)	(51)	(0.7)	-4%	-8%	-3%	-9%	$ (37.68)	-14%
40%	(162)	(66)	(96)	(0.7)	-6%	-9%	-5%	-8%	$ (45.06)	-14%
45%	(40)	(29)	(11)	(0.5)	-2%	-5%	-1%	-6%	$ (29.43)	-11%
50%	(78)	(41)	(38)	(0.4)	-3%	-6%	-2%	-4%	$ (30.38)	-10%
55%	(31)	(25)	(6)	(0.2)	-1%	-4%	0%	-2%	$ (29.28)	-10%
60%	7	(12)	19	(0.1)	0%	-2%	1%	-1%	$ (22.88)	-9%
65%	2	(4)	6	0.1	0%	-1%	0%	1%	$ (17.45)	-6%
70%	68	8	60	0.2	3%	1%	4%	3%	$ (14.64)	-5%
75%	3	7	(4)	0.3	0%	1%	0%	4%	$ (17.65)	-6%
80%	181	25	156	0.5	8%	4%	9%	6%	$ (7.49)	-3%
85%	200	45	155	0.7	8%	7%	8%	9%	$ (1.01)	0%
90%	144	52	92	0.9	6%	9%	5%	12%	$ (3.11)	-1%
95%	256	63	193	1.2	11%	10%	11%	16%	$ 7.82	3%
100%	519	166	353	2.1	25%	34%	22%	33%	$ 41.43	18%
Average	(70)	(32)	(37)	(0.31)	-2.9%	-5.2%	-2.1%	-3.9%	$ (29.88)	-11%

Winter Load Change (No Weather Normalization)

% Customers	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	% Total kWh	% On-Pk kWh	% Off-Pk kWh	% On-Pk kW	Winter Bill[1] $ Change	% Change
5%	(242)	(61)	(182)	(1.2)	-21%	-29%	-19%	-26%	$ (27.63)	-23%
10%	(159)	(45)	(115)	(0.9)	-12%	-18%	-11%	-18%	$ (25.31)	-19%
15%	(88)	(23)	(66)	(0.3)	-7%	-10%	-6%	-7%	$ (13.58)	-11%
20%	(140)	(32)	(108)	(0.5)	-10%	-13%	-10%	-10%	$ (18.44)	-14%
25%	(147)	(22)	(125)	(0.4)	-12%	-9%	-12%	-9%	$ (16.23)	-13%
30%	(52)	(5)	(46)	(0.3)	-4%	-2%	-5%	-6%	$ (10.51)	-8%
35%	(94)	(3)	(92)	(0.1)	-8%	-1%	-9%	-3%	$ (10.56)	-9%
40%	(63)	(9)	(54)	(0.3)	-4%	-3%	-5%	-5%	$ (13.28)	-9%
45%	(5)	1	(6)	(0.3)	0%	0%	-1%	-5%	$ (6.04)	-5%
50%	(22)	3	(24)	0.1	-2%	1%	-2%	2%	$ (7.40)	-6%
55%	(1)	11	(12)	(0.1)	0%	5%	-1%	-1%	$ (5.18)	-4%
60%	(18)	(0)	(17)	(0.2)	-2%	0%	-2%	-4%	$ (7.61)	-7%
65%	12	17	(5)	0.0	1%	8%	-1%	0%	$ (3.20)	-3%
70%	45	20	25	0.1	4%	10%	3%	2%	$ 0.77	1%
75%	23	16	7	0.1	2%	8%	1%	3%	$ (4.20)	-4%
80%	137	33	104	0.2	12%	16%	11%	4%	$ 5.20	4%
85%	53	26	27	0.2	4%	10%	2%	4%	$ (1.60)	-1%
90%	58	29	30	0.3	5%	14%	3%	6%	$ (0.26)	0%
95%	151	53	98	0.6	13%	26%	10%	13%	$ 9.10	8%
100%	231	68	163	0.8	19%	32%	17%	17%	$ 13.41	11%
Average	(16)	4	(20)	(0.11)	-1.3%	1.7%	-2.0%	-2.2%	$ (7.13)	-6%

Annual Load Change

% Customers	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	% Total kWh	% On-Pk kWh	% Off-Pk kWh	% On-Pk kW	Annual Bill[1] $ Change	% Change
5%	(430)	(147)	(282)	(2.1)	-25%	-37%	-21%	-34%	$ (60.78)	-32%
10%	(302)	(89)	(213)	(1.3)	-16%	-22%	-15%	-21%	$ (45.69)	-23%
15%	(237)	(81)	(156)	(1.0)	-12%	-18%	-11%	-14%	$ (38.96)	-18%
20%	(252)	(75)	(177)	(0.9)	-13%	-16%	-12%	-13%	$ (40.56)	-18%
25%	(252)	(55)	(197)	(0.8)	-13%	-12%	-14%	-11%	$ (37.19)	-18%
30%	(124)	(41)	(83)	(0.6)	-7%	-9%	-6%	-9%	$ (28.06)	-14%
35%	(97)	(26)	(71)	(0.4)	-5%	-6%	-5%	-7%	$ (24.12)	-12%
40%	(113)	(37)	(75)	(0.5)	-5%	-8%	-5%	-6%	$ (29.17)	-13%
45%	(23)	(14)	(8)	(0.4)	-1%	-3%	-1%	-6%	$ (17.73)	-9%
50%	(50)	(19)	(31)	(0.1)	-3%	-4%	-2%	-2%	$ (18.89)	-9%
55%	(16)	(7)	(9)	(0.1)	-1%	-2%	-1%	-2%	$ (17.23)	-8%
60%	(5)	(6)	1	(0.1)	0%	-2%	0%	-2%	$ (15.25)	-8%
65%	7	7	0	0.1	0%	2%	0%	1%	$ (10.33)	-5%
70%	56	14	43	0.1	3%	3%	3%	2%	$ (6.93)	-4%
75%	13	12	1	0.2	1%	3%	0%	4%	$ (10.92)	-6%
80%	159	29	130	0.3	9%	7%	10%	5%	$ (1.15)	-1%
85%	127	36	91	0.5	7%	8%	6%	7%	$ (1.30)	-1%
90%	101	40	61	0.6	6%	10%	4%	10%	$ (1.68)	-1%
95%	204	58	146	0.9	12%	14%	11%	15%	$ 8.46	4%
100%	375	117	258	1.5	23%	33%	20%	26%	$ 27.42	16%
Average	(43)	(14)	(29)	(0.21)	-2.4%	-3.4%	-2.0%	-3.3%	$ (18.50)	-9%

Notes:

1. Excluding adjustors and taxes.

ARIZONA PUBLIC SERVICE COMPANY

Residential Demand Rate Analysis

stratified by % kW change during summer months

Three-part Demand Rate (Time-of-use)

ECT-2 Load (calendar year 2014)

	Summer Monthly Avg (May-Oct)				Winter Monthly Avg (Nov-April)				Annual				Avg Monthly Load Factor		
% Customers	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	Summer	Winter	Annual
5%	1,700	345	1,355	4.7	937	149	788	3.5	1,319	247	1,071	4.1	49%	37%	43%
10%	1,898	432	1,465	5.8	1,162	199	963	4.1	1,530	316	1,214	4.9	45%	39%	42%
15%	2,156	526	1,630	7.0	1,209	206	1,003	4.7	1,683	366	1,316	5.9	42%	35%	38%
20%	2,272	566	1,705	7.3	1,222	221	1,001	4.9	1,747	394	1,353	6.1	42%	34%	38%
25%	2,195	572	1,623	7.2	1,098	217	881	4.7	1,647	394	1,252	6.0	41%	32%	37%
30%	2,252	587	1,665	7.4	1,173	234	939	4.9	1,713	410	1,302	6.1	41%	33%	37%
35%	2,254	581	1,673	7.1	1,137	215	921	4.8	1,695	398	1,297	6.0	43%	33%	38%
40%	2,563	637	1,926	8.1	1,379	254	1,124	5.4	1,971	446	1,525	6.7	43%	35%	39%
45%	2,329	602	1,727	7.5	1,211	217	994	4.8	1,770	410	1,360	6.2	42%	35%	38%
50%	2,454	638	1,816	8.3	1,304	255	1,049	5.4	1,879	447	1,433	6.9	40%	33%	37%
55%	2,421	620	1,801	7.7	1,248	233	1,015	5.0	1,834	426	1,408	6.4	42%	34%	38%
60%	2,240	571	1,668	7.1	1,081	196	885	4.2	1,660	384	1,277	5.7	43%	36%	39%
65%	2,410	624	1,786	8.2	1,234	236	998	5.0	1,822	430	1,392	6.6	40%	34%	37%
70%	2,388	631	1,757	8.0	1,182	224	958	5.0	1,785	428	1,357	6.5	40%	33%	37%
75%	2,428	616	1,812	8.0	1,201	231	970	4.8	1,815	424	1,391	6.4	41%	35%	38%
80%	2,540	646	1,894	8.1	1,301	240	1,061	5.1	1,920	443	1,478	6.6	42%	35%	39%
85%	2,685	693	1,992	8.9	1,419	274	1,145	5.7	2,052	484	1,568	7.3	41%	34%	38%
90%	2,515	649	1,866	8.3	1,228	235	993	4.9	1,871	442	1,430	6.6	41%	35%	38%
95%	2,569	671	1,897	8.7	1,312	260	1,052	5.4	1,940	466	1,475	7.1	40%	33%	37%
100%	2,606	654	1,952	8.5	1,424	282	1,142	5.7	2,015	468	1,547	7.1	42%	35%	38%
Average	2,344	593	1,751	7.6	1,223	229	994	4.9	1,783	411	1,372	6.3	42%	35%	38%

Two-part Energy Rate (Time-of-use)

ET-2 Load (calendar year 2012)

	Summer Monthly Avg (May-Oct)				Winter Monthly Avg (Nov-April)				Annual				Load Factor		
% Customers	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	Total kWh	On-Pk kWh	Off-Pk kWh	On-Pk kW	Summer	Winter	Annual
5%	2,317	579	1,738	7.7	1,179	210	969	4.7	1,748	394	1,354	6.2	41%	35%	38%
10%	2,342	566	1,776	7.6	1,321	244	1,078	5.0	1,832	405	1,427	6.3	42%	37%	39%
15%	2,542	665	1,877	8.6	1,297	229	1,068	5.1	1,920	447	1,473	6.8	40%	35%	38%
20%	2,635	683	1,952	8.6	1,362	254	1,108	5.5	1,999	469	1,530	7.1	41%	34%	38%
25%	2,553	661	1,892	8.3	1,245	238	1,007	5.2	1,899	450	1,449	6.7	42%	33%	38%
30%	2,448	663	1,785	8.4	1,225	239	986	5.2	1,837	451	1,385	6.8	40%	33%	36%
35%	2,353	630	1,724	7.9	1,231	218	1,013	4.9	1,792	424	1,368	6.4	41%	35%	38%
40%	2,725	703	2,023	8.7	1,442	263	1,179	5.7	2,084	483	1,601	7.2	42%	35%	39%
45%	2,369	632	1,737	8.0	1,217	217	1,000	5.1	1,793	424	1,369	6.5	40%	33%	37%
50%	2,533	679	1,854	8.7	1,326	252	1,074	5.3	1,929	466	1,464	7.0	40%	34%	37%
55%	2,452	645	1,808	7.9	1,249	222	1,026	5.1	1,851	434	1,417	6.5	42%	34%	38%
60%	2,232	583	1,650	7.2	1,099	196	902	4.3	1,666	390	1,276	5.8	42%	35%	39%
65%	2,409	629	1,780	8.1	1,221	218	1,003	5.0	1,815	423	1,392	6.6	40%	34%	37%
70%	2,320	623	1,697	7.8	1,137	204	933	4.9	1,729	414	1,315	6.3	40%	32%	36%
75%	2,426	609	1,816	7.7	1,178	215	963	4.6	1,802	412	1,390	6.2	43%	35%	39%
80%	2,359	621	1,738	7.7	1,164	207	957	4.9	1,761	414	1,348	6.3	42%	33%	37%
85%	2,485	648	1,837	8.2	1,366	248	1,118	5.5	1,925	448	1,477	6.9	41%	34%	38%
90%	2,371	597	1,774	7.4	1,170	206	964	4.6	1,770	402	1,369	6.0	44%	35%	39%
95%	2,312	608	1,704	7.5	1,161	207	954	4.8	1,736	408	1,329	6.1	42%	34%	38%
100%	2,087	488	1,600	6.4	1,193	214	979	4.9	1,640	351	1,290	5.6	45%	34%	39%
Average	2,414	626	1,788	7.9	1,239	225	1,014	5.0	1,826	425	1,401	6.5	41%	34%	38%

ARIZONA PUBLIC SERVICE COMPANY

Residential Demand Rate Analysis

stratified by % kW change during summer months

Three-part Demand Rate (Time-of-use)
ECT-2 Average Monthly Bill [1]

% Customers	Summer	Winter	Annual
5%	$ 171.15	$ 90.08	$ 130.61
10%	$ 198.22	$ 105.72	$ 151.97
15%	$ 230.36	$ 113.95	$ 172.16
20%	$ 241.06	$ 116.50	$ 178.78
25%	$ 236.56	$ 109.36	$ 172.96
30%	$ 242.96	$ 114.00	$ 178.48
35%	$ 238.98	$ 111.42	$ 175.20
40%	$ 267.80	$ 127.85	$ 197.82
45%	$ 248.55	$ 114.87	$ 181.71
50%	$ 266.28	$ 125.11	$ 195.69
55%	$ 256.19	$ 118.49	$ 187.34
60%	$ 237.77	$ 103.32	$ 170.54
65%	$ 262.34	$ 118.24	$ 190.29
70%	$ 258.80	$ 115.16	$ 186.98
75%	$ 259.67	$ 114.06	$ 186.86
80%	$ 267.91	$ 121.54	$ 194.72
85%	$ 287.12	$ 132.75	$ 209.93
90%	$ 268.61	$ 116.33	$ 192.47
95%	$ 277.96	$ 125.27	$ 201.62
100%	$ 275.72	$ 132.57	$ 204.14
Average	$ 249.70	$ 116.33	$ 183.01

Two-part Energy Rate (Time-of-use)
ET-2 Average Monthly Bill [1]

% Customers	Summer	Winter	Annual
5%	$ 265.09	$ 117.71	$ 191.40
10%	$ 264.30	$ 131.03	$ 197.66
15%	$ 294.71	$ 127.53	$ 211.12
20%	$ 303.73	$ 134.94	$ 219.34
25%	$ 294.71	$ 125.59	$ 210.15
30%	$ 288.58	$ 124.51	$ 206.54
35%	$ 276.66	$ 121.98	$ 199.32
40%	$ 312.86	$ 141.13	$ 226.99
45%	$ 277.98	$ 120.91	$ 199.44
50%	$ 296.66	$ 132.50	$ 214.58
55%	$ 285.47	$ 123.67	$ 204.57
60%	$ 260.65	$ 110.93	$ 185.79
65%	$ 279.79	$ 121.45	$ 200.62
70%	$ 273.44	$ 114.39	$ 193.91
75%	$ 277.31	$ 118.26	$ 197.79
80%	$ 275.40	$ 116.34	$ 195.87
85%	$ 288.13	$ 134.35	$ 211.24
90%	$ 271.72	$ 116.58	$ 194.15
95%	$ 270.15	$ 116.17	$ 193.16
100%	$ 234.29	$ 119.17	$ 176.73
Average	$ 279.58	$ 123.46	$ 201.52

Notes:

1. Excluding adjustors and taxes.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-33: Table developed from customers by zip code (EFCA 26.1_Zip Codes as of Jan 1 2017_APSRC01859.xlsx)

ZIP CODE	Number of Accounts
85003	4,011
85004	2,628
85006	8,632
85007	4,757
85008	5,256
85009	7,839
85012	3,261
85013	6,609
85014	11,222
85015	3,199
85016	4,489
85017	304
85018	267
85020	15,928
85021	4,845
85022	21,892
85023	13,639
85024	10,680
85027	16,228
85028	8,472
85029	16,142
85032	28,492
85034	1,861
85050	11,768
85051	2,161
85053	11,389
85054	4,550
85083	6,385
85085	9,364
85086	15,669
85087	3,360
85122	20,120
85123	4,669
85128	2,913
85131	2,623
85132	5,859
85135	203
85137	813
85139	58

ZIP CODE	Number of Accounts
85141	91
85145	723
85173	1,249
85191	105
85192	125
85193	872
85194	92
85224	461
85225	8,794
85233	3,405
85234	2,179
85250	2,487
85251	10,042
85253	7,843
85254	20,156
85255	20,962
85258	14,998
85259	8,986
85260	18,423
85262	6,125
85266	6,079
85281	13,689
85282	96
85296	1,018
85301	6,859
85304	3,507
85306	9,219
85307	1,846
85308	26,465
85310	6,960
85320	445
85321	1,036
85322	222
85323	4,157
85324	1,460
85325	810
85326	18,120
85328	232
85331	13,034

ZIP CODE	Number of Accounts
85332	1,189
85333	245
85334	451
85335	10,827
85336	158
85337	857
85338	17,788
85340	10,293
85341	13
85342	735
85343	80
85344	4,074
85345	12,055
85346	1,812
85348	1,180
85349	6,815
85350	5,237
85351	20,364
85354	2,561
85355	3,668
85357	254
85361	2,388
85362	614
85363	2,418
85364	26,645
85365	17,855
85367	12,829
85373	10,093
85374	20,595
85375	18,660
85377	2,011
85378	4,629
85379	14,439
85381	1,697
85382	16,692
85383	19,061
85387	5,415
85388	9,115
85390	3,511

ZIP CODE	Number of Accounts
85392	4,997
85395	12,456
85396	8,274
85501	5,639
85532	1
85539	1,753
85541	13,707
85544	3,549
85550	12
85553	1,059
85554	542
85602	48
85603	3,624
85607	6,116
85615	1,109
85618	17
85620	260
85626	389
85631	1,358
85638	825
85650	69
85901	5,828
85912	13
85928	1
85931	835
85937	2,639
85939	1,557
85942	79
86001	11,965
86002	1
86004	15,430
86005	7,942
86015	328
86016	13
86017	2,903
86018	676
86020	8
86023	1,161
86024	1,567

ZIP CODE	Number of Accounts
86025	1,815
86028	64
86029	82
86030	194
86032	548
86034	155
86038	344
86039	258
86042	537
86043	488
86045	2,588
86046	1,601
86047	3,298
86301	10,819
86303	11,246
86305	9,887
86314	15,459
86315	3,549
86320	723
86321	869
86322	5,074
86323	7,185
86324	2,021
86325	2,795
86326	10,361
86327	5,449
86329	122
86331	317
86332	886
86333	2,928
86334	2,042
86335	2,292
86336	7,779
86337	525
86338	283
86342	3
86343	262
86351	4,247

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-34: Based upon APS response to VS 3.12 - data in ASPRC01765 and ASPRC01755

VOTE SOLAR'S
THIRD SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 5, 2016

VS 3.12: Please provide:

a) The number of residential customers served from each of your distribution substations;

b) The number of residential customers per mile of each distribution feeder on your system; and,

c) For each distribution feeder, the average number of residential customers per secondary transformer.

Response:

a) Please see APSRC01764 as attached.

b) Please see APSRC01765 as attached.

c) Please see APSRC01766 as attached.

Witness: Jacob Tetlow

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-35: System marginal costs from APS System Lambda 2015 FERC 714

VOTE SOLAR'S
SIXTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 23, 2016

VS 6.9: Regarding APS's Response to VS 5.7: Please provide all hourly data in the referenced PDF in excel format.

Response: Please see Attachment APSRC01798 in excel format only.

Witness: James Wilde

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-36: Data from ArizonaGoesSolar.org for SRP, based on 3478 applications in 2013, 8100 applications in 2014, and 468 applications in 2015.

Arizona Public Service (APS)

Since 1954, we have led the advancement of solar energy in Arizona. We believe solar energy should, and will, play a growing role in Arizona's energy future. As technologies advance, we will continue to add solar-generated power to our energy mix, which will allow all our customers to share in the benefits of clean solar energy. We know how important solar is to our customers and to our state. That's why we will continue to invest in solar technology to power homes across Arizona.

APS currently has more than a gigawatt of solar, wind, biomass/biogas and geothermal generation installed – enough power to meet the energy needs of over 370,000 customers. This is the result of over 65,000 customer installations within various APS renewable energy programs. APS residential and non-residential customers have more than 5,000 open applications, representing over 48 MW of additional solar capacity that is currently under development.

For additional information on APS's renewable energy programs, visit **aps.com/gosolar (http://www.aps.com/gosolar)** .

> Learn more

Track participation in the 2016 incentive program (http://www.aps.com/en/residential/renewableenergy/renewableenergyincentives/Pages/remaining-budget.aspx) as well as remaining budget.

Renewable Energy

Portfolio (in Mw)*

	Reserved / Installed	Total
Residential MWdc	37.1 / 420.7	457.8
Non-Residential MWdc	11.7 / 267.4	279.1
Utility Scale MWac	NA / 843	843
APS Owned MWac	NA / 15	15

Non-Residential Incentives **Installations** **Reports** **Rate History**

Residential and Non-Residential APS Installations

Search Zip: GO

Export as CSV (/DesktopModules/XModPro/Feed.aspx?xfd=installs&pid=2&util_code=APS)

Sort Status

Reverse ☐ Sort

Details	Status	Technology	Incentive Program	System Size (kW)	Power Generation (kWh)	System Cost	Incentive Offered	Zip Code
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD		85023
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD		85027
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	13.97		TBD		85050
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	6.50	10,725	TBD		85050
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	7.80	12,870	TBD		85083
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD		85083
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD		85086
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD		85087-5997

[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD	85122
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD	85122
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	8.58	14,157	TBD	85122-1523
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD	85123
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD	85128
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	10.66	17,589	TBD	85128
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	2.08	3,432	TBD	85132
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	5.98	9,867	TBD	85254
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	8.50		TBD	85258
[+]	2 - Reserved	PV - Solar Panels	Residential UFI	9.24	15,246	TBD	85304
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD	85308
[+]	2 - Reserved	PV - Solar Panels	Residential UFI			TBD	85308

Please Note:

- Incentives identified under "Applied" status are estimates based on current levels of incentives at the time a customer submits their application and are subject to change at the time an application is reserved.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-37: US Census Current Population Survey

Current Population Survey (CPS)

Income Definitions

- Poverty Status - Alternative and Household Income - Alternative are currently available for 2005, 2006, 2007, 2008 and 2009. Note that 2009 data show poverty status and income based on the 2008 reference period; 2007 data show poverty status and income based on the 2007 reference period.
- For Poverty Status - Alternative, the income definition is applied to the family income.
- For Household Income - Alternative, the income definition is applied to the household income.
- The income format for Household Income - Alternative is the format selected in section 4: Customized Formatting.
- You may select the official income (Money Income), any of five alternatives, or you may customize your own definition from the 42 possible components of income.
- The 42 income components are (the number corresponds to the number shown in the table footnote when you customize your own income definition):
  1. Earnings (wages, salaries, and self-employment income)
  2. Interest income
  3. Dividend income
  4. Rents, royalties, estate, and trust income
  5. Non-government retirement pensions and annuities
  6. Non-government survivor pensions and annuities
  7. Non-government disability pensions and annuities
  8. Realized capital gains (losses)
  9. Social Security
  10. Unemployment compensation
  11. Workers' compensation
  12. Veterans' payments other than pensions
  13. Government retirement pensions and annuities
  14. Government survivor pensions and annuities
  15. Government disability pensions and annuities
  16. Public assistance (includes TANF and other cash welfare)
  17. Supplemental Security Income (SSI)
  18. Veterans' pensions
  19. Federal earned income credit
  20. Federal income taxes after refundable credits except EIC (deducted from income)
  21. State income taxes after all refundable credits (deducted from income)
  22. Payroll taxes (FICA and other mandatory deductions) (deducted from income)
  23. Property taxes on owner-occupied housing (deducted from income)
  24. Government educational assistance
  25. Non-government educational assistance
  26. Supplemental Nutrition Assistance Program (SNAP) - formerly known as Food Stamps
  27. Free and reduced-price school lunches
  28. Low-income energy assistance
  29. Public housing and rent subsidies
    1. Public housing and rent subsidies - AHS-based estimates (used in the R&D Series)
    2. Public housing and rent subsidies - FMR-based estimates (used for the NAS Series)
  30. Fungible value of Medicaid
  31. Child Support
  32. Alimony
  33. Regular contributions from persons not living in the household
  34. Money income not elsewhere classified
  35. Imputed return to home equity on owner-occupied housing
  36. Regular-price school lunches
  37. Employer contribution to health care plans
  38. Fungible value of medicare
  39. Medical expenses out-of-pocket (deducted from income)
  40. Work-related expenses
    1. Work-related expenses excluding child care (deducted from income)
    2. Work-related expenses including child care (deducted from income)
  41. Economic stimulus payments (2009 ASEC only)
  42. Economic recovery payments (2010 ASEC only)

The pre-defined income definitions are:

- Money Income (the official definition of income) **Consists of the following 23 income components:**
  - 1. Earnings (wages, salaries, and self-employment income)
  - 2. Interest income
  - 3. Dividend income
  - 4. Rents, royalties, estate, and trust income
  - 5. Non-government retirement pensions and annuities
  - 6. Non-government survivor pensions and annuities
  - 7. Non-government disability pensions and annuities
  - 8. Social Security
  - 10. Unemployment compensation

- 10. Unemployment compensation
- 11. Workers' compensation
- 12. Veterans' payments other than pensions
- 13. Government retirement pensions and annuities
- 14. Government survivor pensions and annuities
- 15. Government disability pensions and annuities
- 16. Public assistance (includes TANF and other cash welfare)
- 17. Supplemental Security Income (SSI)
- 18. Veterans' pensions
- 24. Government educational assistance
- 25. Non-government educational assistance
- 31. Child Support
- 32. Alimony
- 33. Regular contributions from persons not living in the household
- 34. Money income not elsewhere classified

- **Market Income Consists of the following 15 income components:**
  - 1. Earnings (wages, salaries, and self-employment income)
  - 2. Interest income
  - 3. Dividend income
  - 4. Rents, royalties, estate, and trust income
  - 5. Non-government retirement pensions and annuities
  - 6. Non-government survivor pensions and annuities
  - 7. Non-government disability pensions and annuities
  - 8. Realized capital gains (losses)
  - 25. Non-government educational assistance
  - 31. Child Support
  - 32. Alimony
  - 33. Regular contributions from persons not living in the household
  - 34. Money income not elsewhere classified
  - 35. Imputed return to home equity on owner-occupied housing
  - 40(a). Worldwide expenses excluding child care (deducted from income)

- **Post-Social Insurance Income Consists of 23 income components, all the Market Income components AND the following:**
  - 9. Social Security
  - 10. Unemployment compensation
  - 11. Workers' compensation
  - 12. Veterans' payments other than pensions
  - 13. Government retirement pensions and annuities
  - 14. Government survivor pensions and annuities
  - 15. Government disability pensions and annuities
  - 24. Government educational assistance

- **Disposable Income Consists of 34 income components, all the Post-Social Insurance Income components AND the following:**
  - 16. Public assistance (includes TANF and other cash welfare)

  - 17. Supplemental Security Income (SSI)
  - 18. Veterans' pensions
  - 19. Federal earned income credit
  - 20. Federal income taxes after refundable credits except EIC (deducted from income)
  - 21. State income taxes after all refundable credits (deducted from income)
  - 22. Payroll taxes (FICA and other mandatory deductions) (deducted from income)
  - 23. Property taxes on owner-occupied housing (deducted from income)
  - 26. Supplemental Nutritional Assistance Program (SNAP)
  - 27. Free and reduced-price school lunches
  - 29(a). Public housing and rental subsidies - AHS-based estimate
  - 36. Regular-price school lunches
  - 41. Economic stimulus payments (2009 ASEC only)
  - 42. Economic recovery payments (2010 ASEC only)

- NAS Income **Consists of Money Income (see the 23 components listed above) PLUS**
  - 8. Realized capital gains (losses)
  - 19. Federal earned income credit
  - 26. Supplemental Nutritional Assistance Program (SNAP)
  - 27. Free and reduced-price school lunches
  - 28. Low-income energy assistance
  - 29(b). Public housing and rental subsidies - FMR-based estimate
  - 36. Regular-price school lunches

- 41. Economic stimulus payments (2009 ASEC only)
- 42. Economic recovery payments (2010 ASEC only)
  MINUS
- 20. Federal income taxes after refundable credits except EIC (deducted from income)
- 21. State income taxes after all refundable credits (deducted from income)
- 22. Payroll taxes (FICA and other mandatory deductions) (deducted from income)
- 40(b). Work-related expenses including child care
- NAS Income minus Medical Out-of-Pocket Expenditures **Consists of all the components in NAS Income**
  - 39. Medical Expenses out of pocket

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-38: Pew Research Household Expenditures and Income Data

A chartbook from THE PEW CHARITABLE TRUSTS | Mar 2016

Household Expenditures and Income

Balancing family finances in today's economy

The Pew Charitable Trusts

Susan K. Urahn, *executive vice president*
Travis Plunkett, *senior director*

Program team

Erin Currier, *project director*
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Walter Lake, *senior research associate*
Sheida Elmi, *associate*
Sowmya Kypa, *research associate*

External reviewers

This report benefited from the insights and expertise of Jonathan Fisher, research associate in the University of California, Santa Cruz department of economics. Neither he nor his organization necessarily endorses the conclusions of this chartbook.

Acknowledgments

The financial security and mobility team thanks Pew staff members Hassan Burke, Samantha Chao, Rica Santos, Alan van der Hilst, Jonathan Moody, Sultana Ali, Jennifer V. Doctors, and David Merchant for providing valuable feedback on this report. We also thank all those involved for their thoughtful suggestions and production assistance. Many thanks also to other current and former colleagues who made this work possible.

For additional information, please visit:

economicmobility.org

Overview

Expenditures are a key but often overlooked element of family balance sheets. In measuring household financial security, significant attention is typically paid to income, but much less to whether those resources are sufficient to cover expenses. To begin addressing this gap in the policy discourse, this chartbook uses the Bureau of Labor Statistics' Consumer Expenditure Survey to explore household expenditures, examining changes in overall spending and across individual categories from 1996 to 2014.[1] It also details the differences in expenditures by income, with a particular focus on the degree to which households have slack in their budgets that could be devoted to savings and other wealth-building efforts.

This analysis focuses on the working-age population, which includes survey respondents or their spouses who are between the ages of 20 and 60. For the purpose of examining differences in spending by income, the sample was divided into thirds.

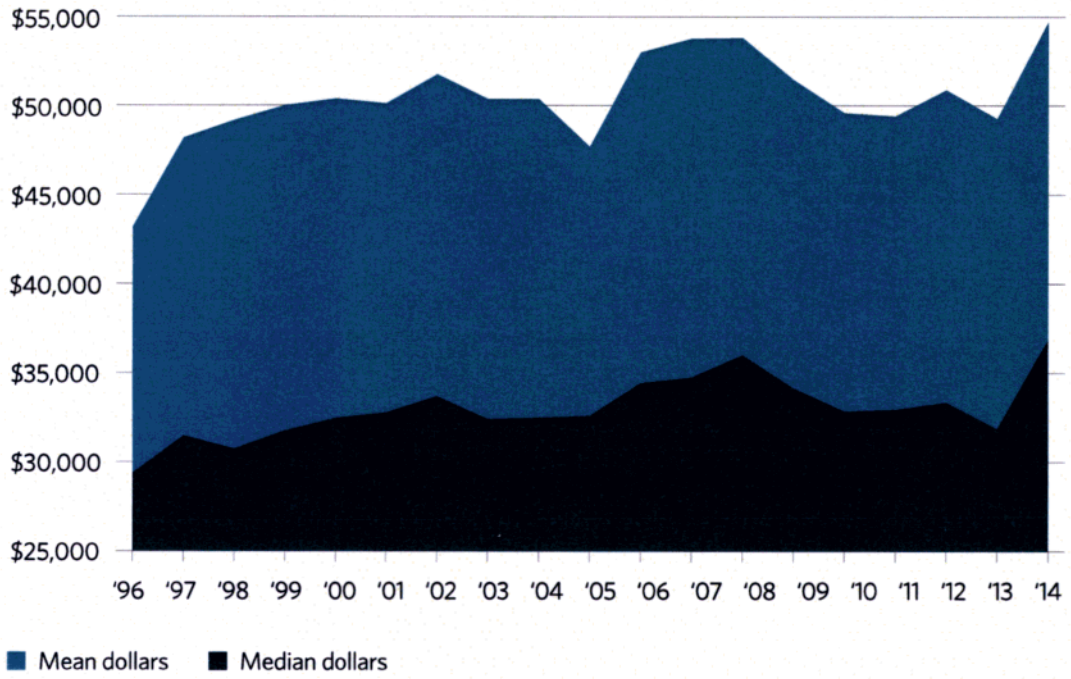
The analysis shows that both median income and expenditures contracted after the Great Recession, reflecting the economic turmoil of the country. By examining household spending, this research helps to shed light on family financial security over time, and especially in recent years. Key findings include:

- **Overall median household expenditures grew by about 25 percent between 1996 and 2014, returning to pre-recession levels.**[2] After declining during and after the Great Recession, expenditures increased between 2013 and 2014 in particular. In 2014, the typical American household spent $36,800.
- **Although expenditures recovered from the downturn, income did not.** As the recovery began, median household expenditures returned to pre-crisis levels, but median household income continued to contract. By 2014, median income had fallen by 13 percent from 2004 levels, while expenditures had increased by nearly 14 percent.
- **Low-income families spent a far greater share of their income on core needs, such as housing, transportation, and food, than did upper-income families.** Households in the lower third spent 40 percent of their income on housing, while renters in that third spent nearly half of their income on housing, as of 2014. Because their core spending absorbed so much of their income, households in the lower income tier spent considerably less than their middle- and upper-income counterparts on discretionary items, such as food away from home and entertainment.
- **Although all households had less slack in their budgets in 2014 than in 2004, lower-income households went into the red.** In 2004, typical households at the bottom had $1,500 of income left over after expenses. By 2014, this figure had decreased by $3,800, putting them $2,300 in the red. The lack of financial flexibility threatens low-income households' financial security in the short term and their economic mobility in the long term.

Figure 1

After a Long Recovery, Household Spending Increased by 25%, Returning to Pre-Recession Levels

Average and median household expenditures, 1996-2014



Households spent more in 2014 than they did in 1996, after adjusting for inflation; this holds whether the figures are based on averages (means) or medians. The typical household saw its expenditures grow by more than 25 percent, from $29,400 in 1996 to $36,800 in 2014. Mean expenditures grew 27 percent since 1996, rising from $43,200 to $54,800. Much of the growth occurred between 2012 and 2014, signaling a promising recovery from the Great Recession and the housing crisis.

Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 1996-2014

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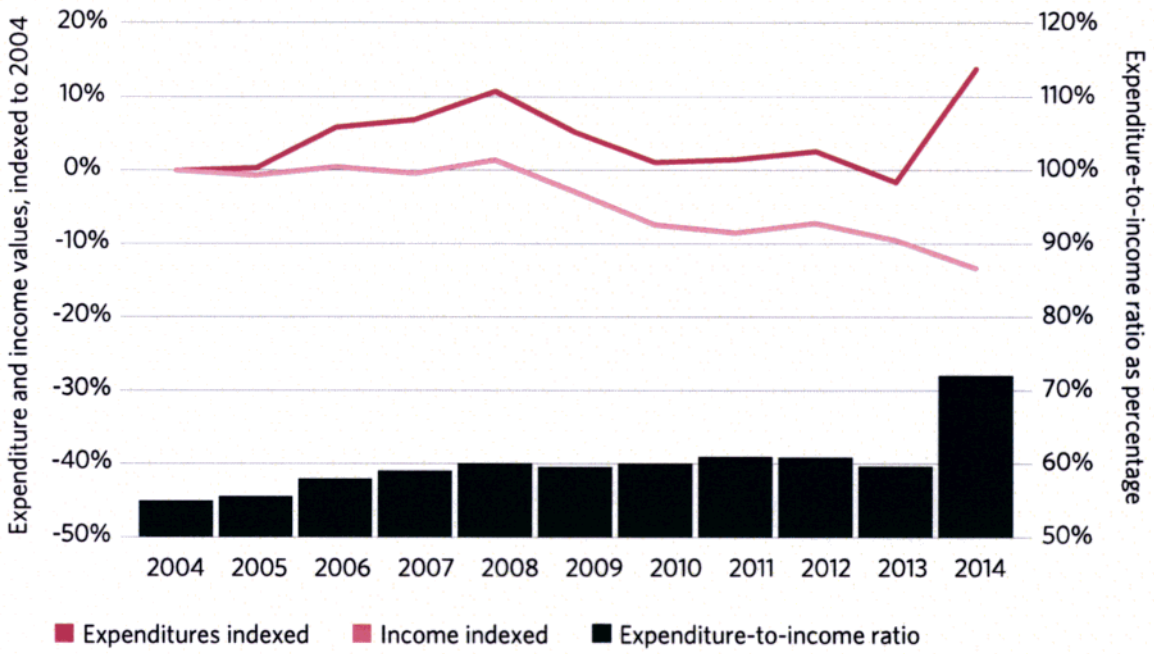
Figure 2

Expenditures Grew and Income Dropped Since the End of the Great Recession

Trends, 2004-14



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 2004-14

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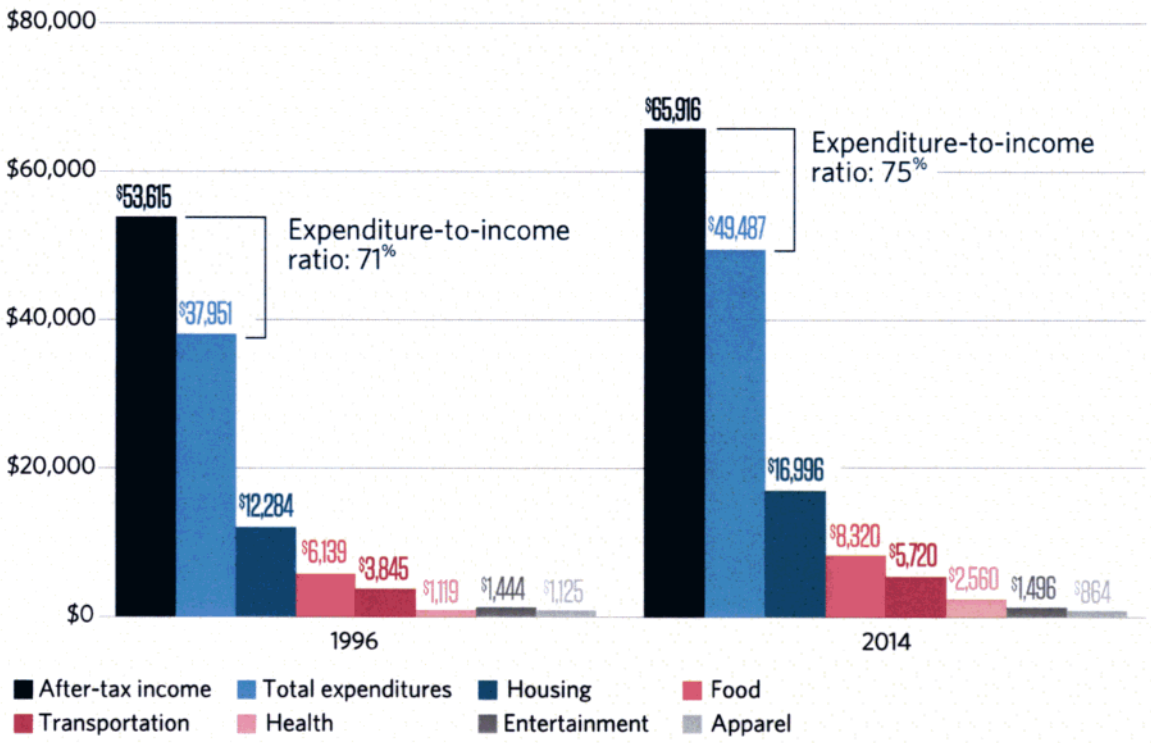
From 2004 to 2008, median household income grew by only 1.5 percent,[3] while median expenditures increased by about 11 percent. During that period, the expenditure-to-income ratio (the percentage of a household's budget used for spending) jumped by 9 percent. As the recovery began, median household expenditures returned to pre-crisis levels, but median household income continued to contract. By 2014, median income had fallen by 13 percent from 2004 levels, while expenditures had increased by nearly 14 percent. This change in the expenditure-to-income ratio in the years following the financial crisis is a clear indication of why and how households feel financially strained.

Figure 3

A Typical Family of Four Had Higher Expenses Relative to Income in 2014 Than It Did Almost 19 Years Earlier

Median expenditures for households with two earners and two children, 1996 and 2014



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60. Tax liability was calculated assuming median income for a family of four in 1996 and 2014. See the methodology for more information.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 1996-2014

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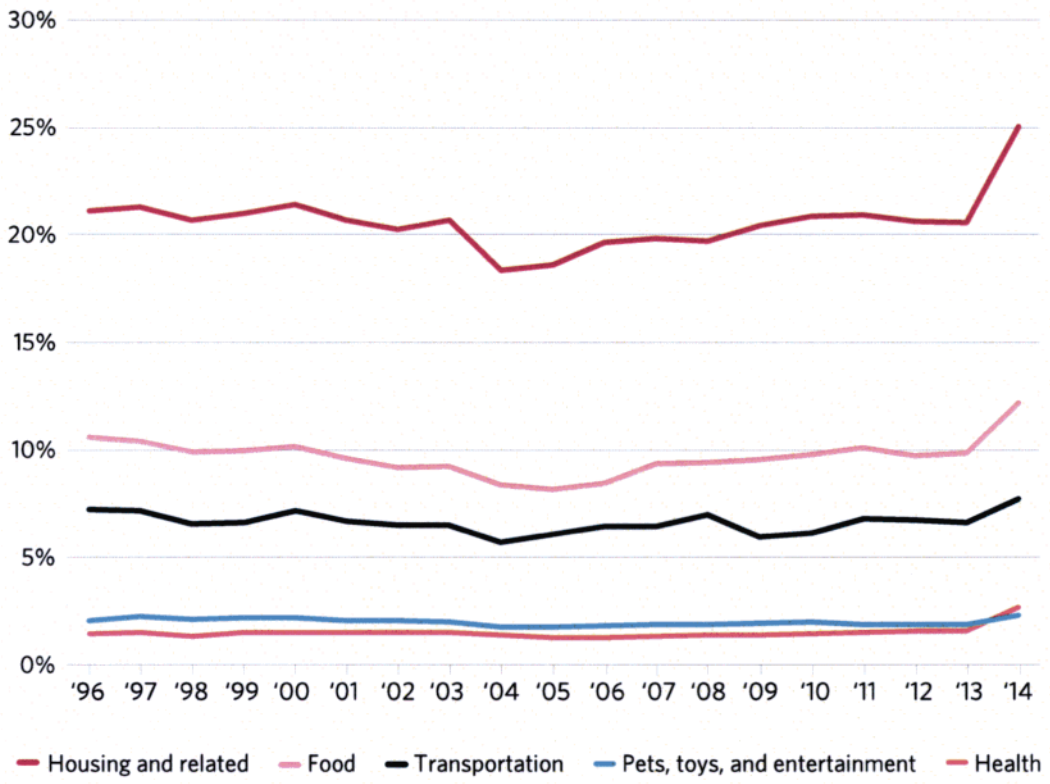
For a typical family of four (two earners and two children), while median household income increased by about $10,000 between 1996 and 2014, annual expenditures also increased by about the same amount, driven largely by higher spending for core needs: housing, food, and transportation. Although the absolute change in income and expenditures was similar, this family had less slack in its budget in 2014 than in 1996, as its expenditure-to-income ratio grew from 71 percent to 75 percent.

Figure 4

Housing, Food, and Health Care Consumed Larger Shares of Income in 2014 Than They Did 19 Years Earlier

Median expenditures as a percentage of income, 1996-2014



About two-thirds of families' spending goes to core needs: housing, food, and transportation. In 2014, housing obligations accounted for the largest share of household pretax income, about 25 percent. Over the 19-year study period, aggregate median housing expenditures absorbed 21 percent of families' pretax income. The second-largest expenditure, food, typically consumed nearly 10 percent of family income, while transportation took 7 percent. The proportion of household spending that these categories account for has shifted very little over the past two decades.

Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 1996-2014

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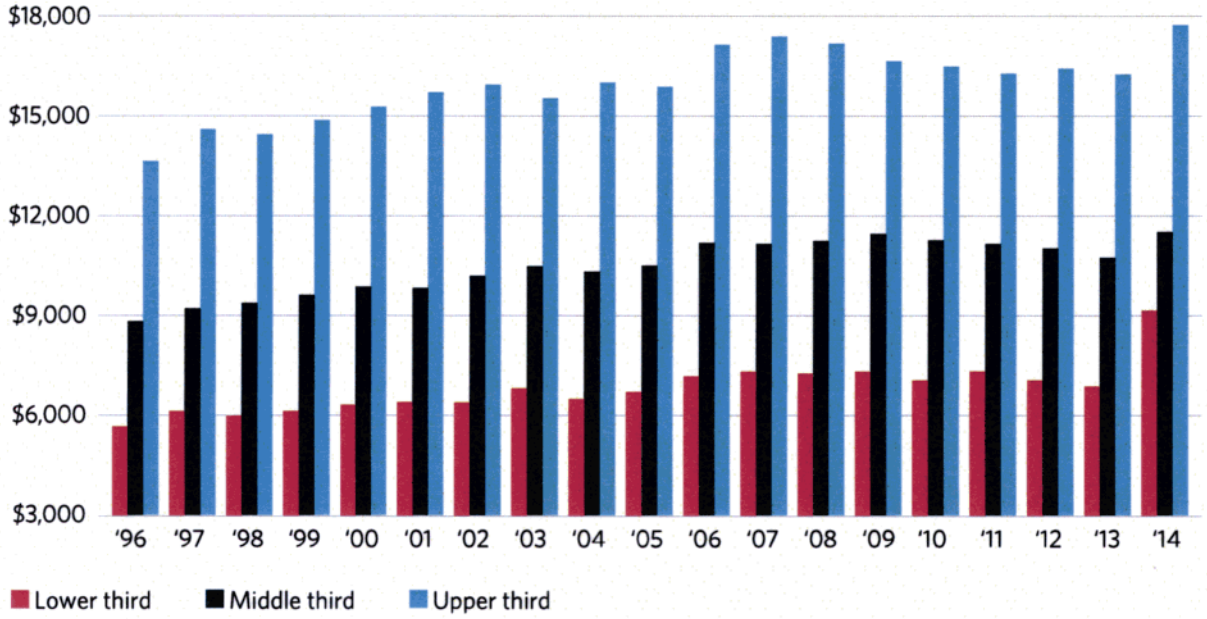
Figure 5

Lower-Income Households' Housing Costs Grew by More Than 50% Over the Past 19 Years

Housing expenditures by income thirds, 1996-2014



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 1996-2014

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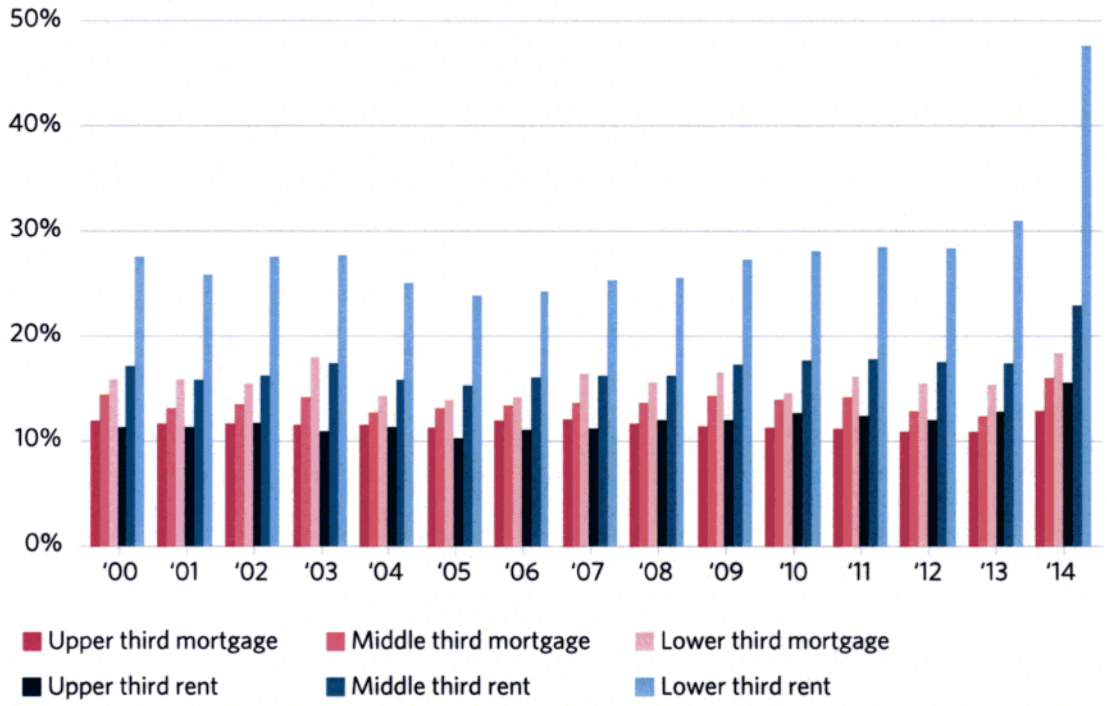
Over the past two decades, spending on housing increased for Americans in all income tiers. In 2014, households in the lower third spent much less in absolute dollar terms (about $9,200) than those in the middle or upper thirds, whose median housing expenditures reached $11,500 and $18,000, respectively. However, the typical lower-income household spent far more on housing as a share of income (40 percent) than those in the middle (25 percent) or at the top (17 percent).

Figure 6

Lower-Income Renters Spent Close to 50% of Their Income on Rent in 2014

Percentage of income used for shelter by income third and housing status, 2000-14



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60. For homeowners, housing costs include mortgage principal and interest and property taxes; for renters, they include rent.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 2000-14

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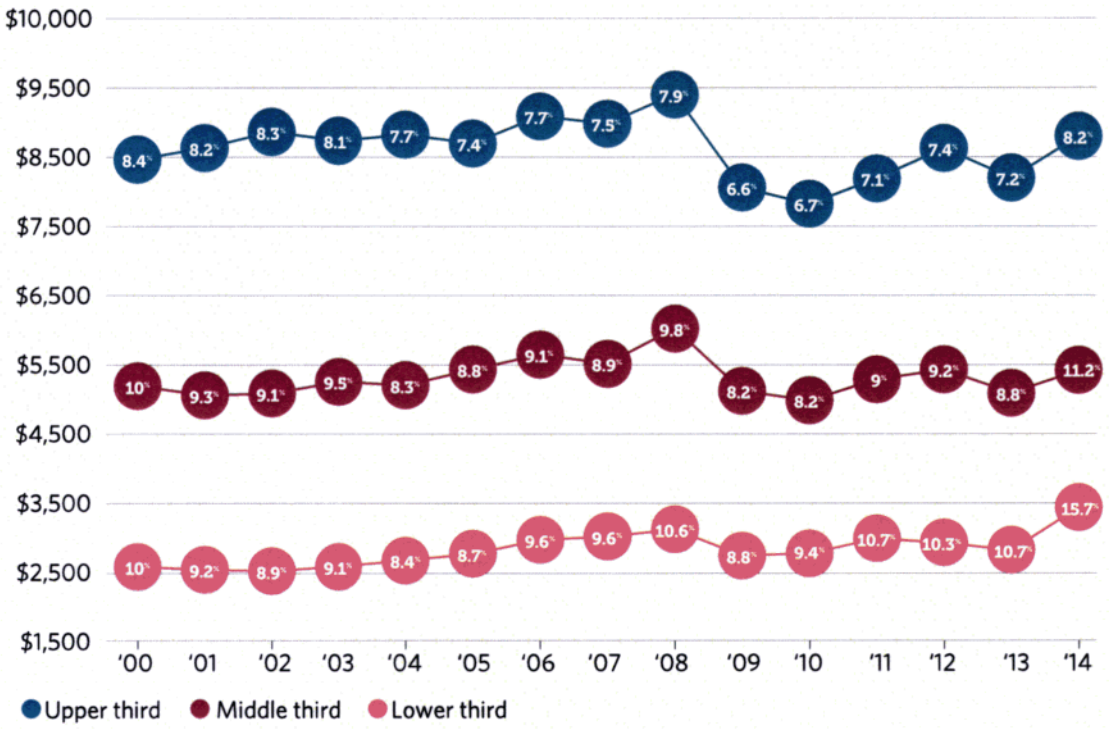
Since the start of the housing crisis in 2007, homeownership rates have declined among households in the middle- and upper-income tiers. These decreases have affected the rental market, as former owners became renters, leading to rental vacancy rates at historical lows below 7 percent.[4] The diminished supply of rental properties increased the cost of rental housing dramatically; in 2014, renters at each rung of the income ladder spent a higher share of their income on housing than they had in any year since 2004. Although both renters and homeowners spent more for housing in 2014, notable differences in the proportion of household resources going to shelter were evident across income groups, with lower-income renter households spending close to half of their pretax income on rent.

Figure 7

Lower-Income Families Routinely Spent a Larger Share of Income on Transportation Than Wealthier Families Did During the Past 15 Years

Expenditures in dollars and as a share of income, by income thirds, 2000-14



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60. The data shown reflect transportation "expenditure outlays," which include all costs related to owning, leasing, renting, and maintaining a vehicle for legal operation, excluding tolls; spending related to the use of public transportation; and principal payments, such as cash used for vehicle purchase down payments that are counted in other transportation expenditure categories.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 2000-14

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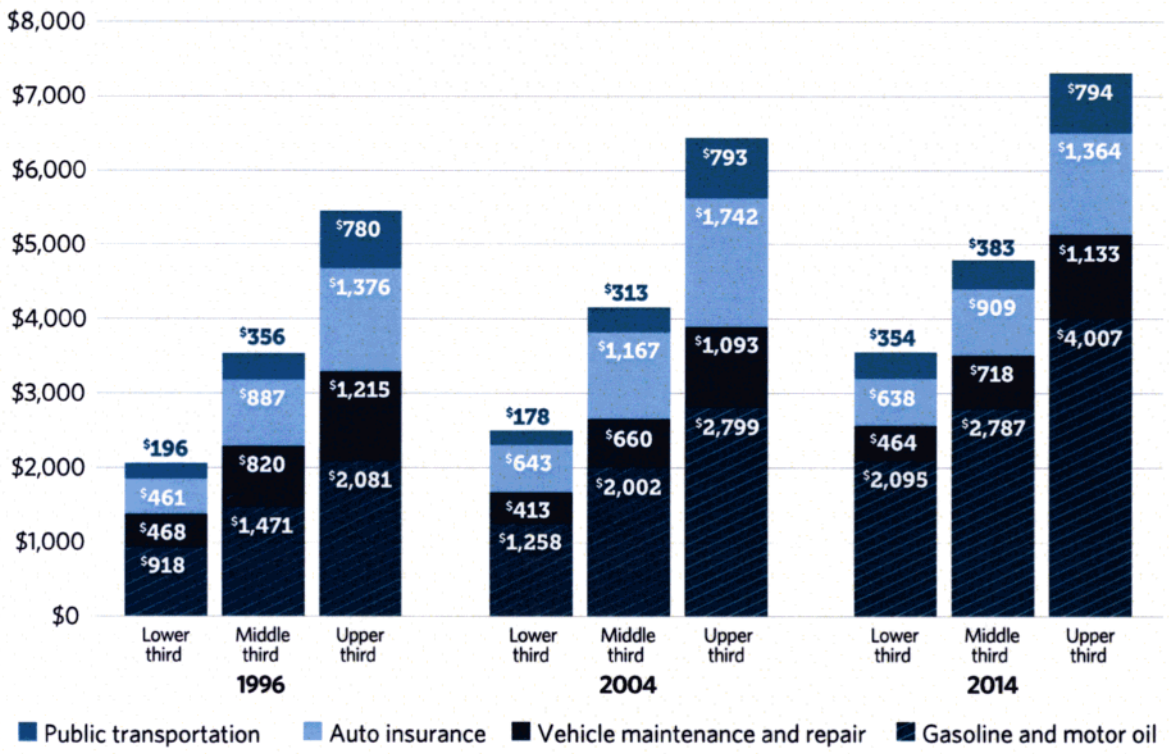
As with housing, households in the lower income group spend significantly less in absolute dollars, but much more as a share of their income, on transportation than did those in the middle- or upper-income groups. Further, transportation costs increased in recent years for households at the bottom, while this spending was more stable for the other income groups. Lower-income households spent nearly 16 percent of their income on transportation in 2014, up from 9 percent four years earlier. In contrast, households in the middle spent about 11 percent of their income on transportation in 2014, while those at the top spent 8 percent.

Figure 8

Households at the Bottom Spent More on Gas in 2014 Than on All Transportation 19 Years Earlier

Subcategory spending by income thirds, 1996, 2004, and 2014



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60. This figure uses weighted population means instead of medians because the median values of all expenditures except gasoline and motor oil equaled zero for both the middle- and lower-income households.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 1996-2014

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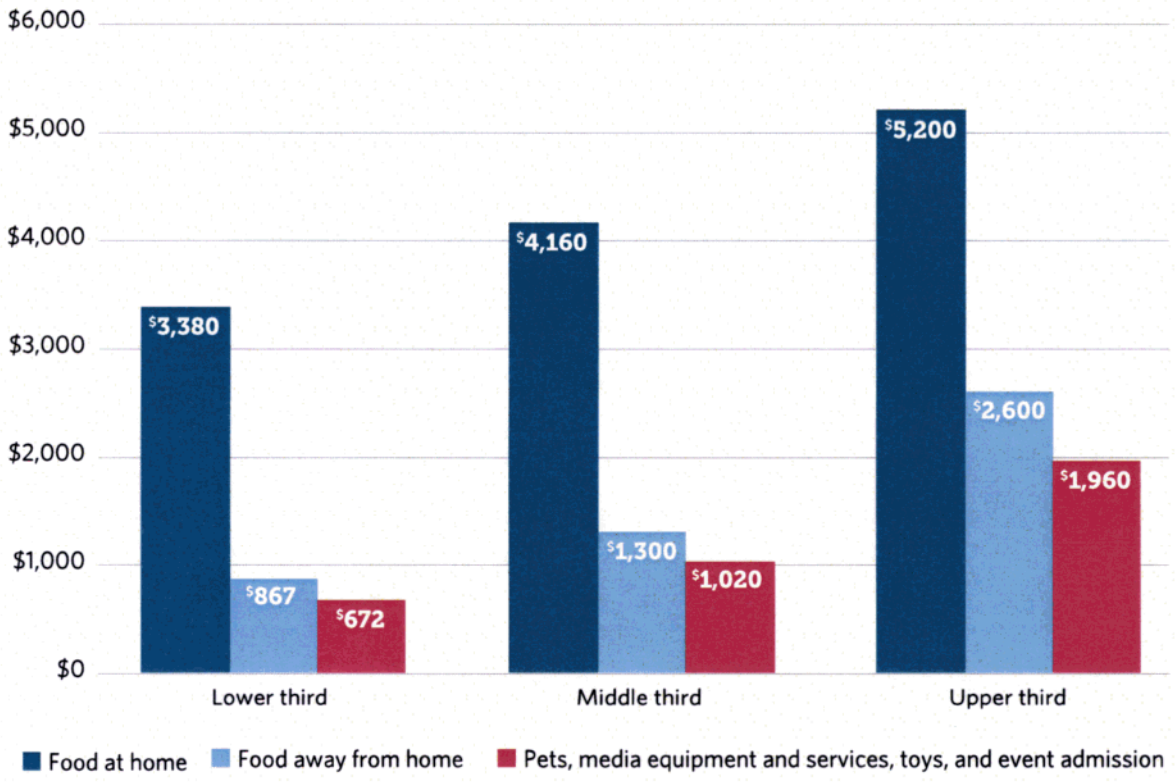
As the share of household income used for transportation increased, the amount going to various subcategories also grew. For all income groups, expenditures for gasoline and motor oil doubled between 1996 and 2014. For households in the lower third, the average annual cost of fuel, auto insurance, vehicle maintenance and repair, and public transportation in 1996 averaged $2,000 a year; by 2014, this group spent nearly $2,100 just on fuel. These extreme cost increases force households to make difficult choices and trade-offs to meet core needs.

Figure 9

Households With More Slack in Their Budgets Spent More on Food and Entertainment

Food and entertainment spending by income thirds, 2014



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 2014

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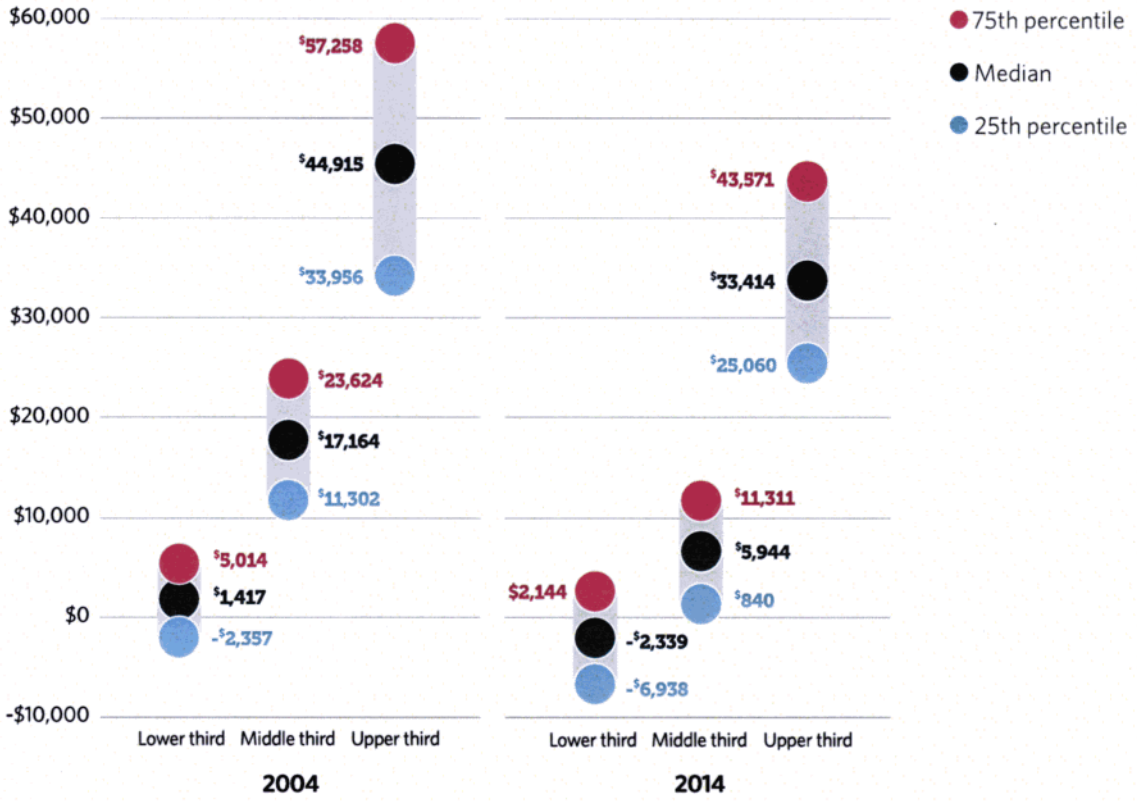
Though systemic economic conditions, such as recessions or stock market changes, affect trends in consumer expenditures, individual households also make decisions about how to spend their discretionary dollars. In 2014, households across the income distribution spent much more on groceries than on eating out, but, predictably, those in the top third spent much more on food away from home than the other groups. Households at the top also spent more than others on entertainment, including pets and pet care, media equipment and services, admission to events such as movies or plays, and toys for children. Typical households at the top spent $380 a month on eating out and entertainment. Conversely, households in the bottom third, which had significantly less slack in their budgets, devoted very few resources to these two categories—about $128 a month.

Figure 10

All Households Had Less Financial Slack in 2014 Than in 2004, but Lower-Income Households Went Into the Red

Amount of income remaining after all expenditures by income thirds, 2004 and 2014



Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60. Income is pretax, post-transfer.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 2004 and 2014

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The amount of slack that families had in their budgets declined for all income groups between 2004 and 2014. This means households had less income to devote to wealth-building investments, such as short- and long-term savings, education, and life insurance. In 2004, the typical household in the lower third had a little less than $1,500 left over after accounting for annual outlays. Just 10 years later, this amount had fallen to negative $2,300, a $3,800 decline. These households may have had to use savings, get help from family and friends, or use credit to meet regular annual household expenditures. The typical household in the middle third saw its slack drop from $17,000 in 2004 to $6,000 in 2014. Of note, because income is measured before taxes, some families will have had even less slack in their budgets than this figure implies.

Appendix A

Select Sample Population Demographics

	Demographics	1996			2014		
		Lower third	Middle third	Upper third	Lower third	Middle third	Upper third
	Median Income	$14,500	$38,500	$81,000	$15,500	$39,500	$95,000
Race	Black	21%	12%	8%	22%	14%	8%
	Asian	3%	3%	3%	5%	5%	7%
	White	74%	84%	89%	72%	79%	84%
	Other	2%	1%	0%	2%	2%	2%
Marital status	Married	30%	53%	79%	36%	45%	70%
	Widowed	6%	3%	1%	4%	3%	1%
	Divorced	18%	17%	10%	16%	17%	11%
	Separated	8%	4%	2%	5%	4%	1%
	Never married	38%	23%	9%	40%	32%	17%
Family type	Husband and wife	11%	18%	30%	15%	15%	27%
	Husband and wife, plus children	13%	29%	44%	14%	22%	36%
	Single parent	21%	8%	3%	14%	10%	4%
	Single person or other	56%	44%	23%	57%	52%	33%
Education	Less than high school	28%	15%	6%	14%	15%	4%
	High school graduate	33%	34%	27%	28%	28%	17%
	Some college or associate degree	23%	20%	19%	35%	34%	31%
	College degree or greater	16%	30%	50%	23%	23%	47%

	Demographics	1996			2014		
		Lower third	Middle third	Upper third	Lower third	Middle third	Upper third
Home-ownership	**Own**	34%	57%	81%	45%	47%	75%
	Rent	66%	43%	19%	55%	53%	25%
Occupation	**Manager, professional**	14%	24%	44%	14%	31%	52%
	Administrative support, including clerical, retail sales, business goods/services sales, technician	31%	28%	23%	30%	27%	22%
	Service industry	25%	12%	7%	35%	22%	12%
	Operator, assembler, laborer	18%	22%	14%	19%	19%	13%
	Precision production, craft, repair	8%	11%	11%	2%	1%	1%

Notes: Data are adjusted for inflation using the Bureau of Economic Analysis' Personal Consumption Expenditure Price Index; population is limited to households in which the respondent or spouse is between the ages of 20 and 60. The latest occupation data shown are for 2013.

Sources: Pew's analysis of Bureau of Labor Statistics Consumer Expenditure Survey Public-Use Microdata, 1996-2014

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Methodology

This analysis draws primarily from the Bureau of Labor Statistics' Consumer Expenditure Public-Use Microdata (CEPUMD) to show current and historical trends in expenditures for American households. The CEPUMD consists of nonaggregated household-level data, collected by the the Bureau of Labor Statistics (BLS) and the U.S. Census Bureau on a quarterly basis. The CEPUMD is part of BLS' Consumer Expenditure Survey (CE) program, which seeks to provide information on the buying habits of American consumers and collects data on up to 95 percent of household expenditures, income, and demographics. These data are used by the Census Bureau as the source for the Supplemental Poverty Measure and to regularly revise the marketbasket of goods and services used to weight the Consumer Price Index.

The BLS made significant changes to the methodology and variable construction of the CEPUMD in 2004, 2005, 2013, and 2014, which do not affect the long-term trends. However, when comparing year-to-year expenditures, the variance between a year with and without methodological changes may be different than expected.

All dollar amounts have been adjusted for inflation to 2014 using the Bureau of Economic Analysis' Personal Consumption Expenditure (PCE) Price Index. To ensure that results were not driven by the deflator—the method by which inflation was adjusted—Pew conducted the analyses using the Consumer Price Index for All Urban Consumers (CPI-U), Consumer Price Index Research Series Using Current Methods (CPI-U-RS), and the PCE. Although estimates of total expenditures from some years produced statistically significant differences, other years did not. However, in all years, there did not seem to be an economically significant difference. Ultimately, Pew researchers decided to use the PCE deflator.

The population chosen for observation is all households in which the reference person—or, in the case of married households, the spouse—was age 20 to 60 during at least one of the years studied. Additionally, only households that provided sufficient income information to be ranked by the BLS are included in the analysis.

The after-tax income numbers used in Figure 3 were based on calculations of estimated tax liability assuming median household income, using only standard deductions and exemptions listed on Form 1040 from the Internal Revenue Service for the years studied, and using IRS tax tables. Thus, the figure represents the maximum possible income tax liability for a typical family of four during these years; other factors if considered could alter the estimated tax liability.

Variables

Household is a consumer unit comprising all members who are related by blood, marriage, or legal arrangement; a person living alone or sharing quarters with others who are not financially dependent on each other; or two or more people living together who share income to pay for any food, shelter, or other expenses.

Food includes all household spending for food consumed at and away from home.

Housing includes all expenditures for shelter, utilities (fuel oil, electricity, water, etc.), property taxes, mortgage interest, repairs, maintenance, rent, insurance, and other costs related to occupying a dwelling.

Rent includes only monies used to pay for rental of a housing structure.

Mortgage includes mortgage principal payments, mortgage interest, and property taxes.

Transportation includes all costs related to owning, leasing, renting, and maintaining a vehicle for legal operation, excluding tolls, and spending related to the use of public transportation.

Health care includes expenditures for health care, health insurance premiums, medical services, prescriptions, and medical supplies.

Entertainment includes fees for admission, electronics purchases (such as TVs, radios, portable audio players, etc.), and spending related to pets, playgrounds, and other forms of entertainment not specified.

Apparel includes all clothing items, footwear, and accessories, and the materials to make both, as well as costs related to storage and cleaning.

Income is the total money earned by the household before taxes as well as inflows from social benefits, including alimony, child support, Social Security, life insurance, sales of securities, pensions, worker compensation, and other sources during the 12 months before the interview date. Except where otherwise noted, income figures are pretax, post-transfer.

Endnotes

1 Walter Lake (2015), Kiwi & Cassava Version 3 [Computer software], Washington, https://github.com/Kiwi-den-den/KIWI.git.

2 This chartbook follows the lead of the Bureau of Labor Statistics in referring to consumer units interchangeably as households and families. However, not all consumer units are families. The BLS definition of a consumer unit is: "(1) All members of a particular household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who use their incomes to make joint expenditure decisions. Financial independence is determined by spending behavior with regard to the three major expense categories: Housing, food, and other living expenses. To be considered financially independent, the respondent must provide at least two of the three major expenditure categories, either entirely or in part."

3 In 2004, the Consumer Expenditure Survey started to include income data produced using multiple imputations. This change in methodology allowed the BLS to better capture income data when the respondent did not provide or refused to provide information on one or more sources of income. The result of the methodical change is an increase in household income, which may explain in part the steep increase in income and the decrease in the expenditure-to-income ratio. Some caution should be exercised when comparing income values before 2004 with those after 2004. However, other nonrelated data sets, such as the U.S. Census Bureau's Table H-8, Median Household Income by State: 1984 to 2014, also indicate that median household income increased by 2.3 percent from 2003 to 2004 and by 6.9 percent from 2004 to 2005. Therefore, this analysis assumes that median household income did increase but that the magnitude of that growth indicated in the Consumer Expenditure Survey may reflect a combination of the improved data collection methodology and the actual increase.

4 U.S. Census Bureau, "Annual and Quarterly Charts of Rental and Homeowner Vacancy Rates and Homeownership Rates," accessed Oct. 13, 2015, http://www.census.gov/housing/hvs/data/charts.html.

For further information, please visit:

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Contact: Sultana Ali, communications officer
Email: sali@pewtrusts.org
Project website: pewtrusts.org

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BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-39: Arizona Goes Solar Homepage

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The Renewable Energy Standard established by the Arizona Corporation Commission (ACC) provides short- and long-term renewable energy goals for Arizona.

- Learn More About RES

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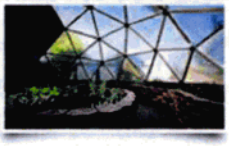

Your local electric company, the State of Arizona and the federal government provide a number of incentives to help make going solar affordable.

- View State & Federal Incentives

Arizona Goes Solar is a collaborative effort led by the Arizona Corporation Commission and implemented by the electric utilities in Arizona.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-40: US Census Bureau

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Age, Race, Sex and Education

- Selected Social Characteristics (2015 ACS, DP02)
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American FactFinder provides access to data about the United States, Puerto Rico and the Island Areas. The data in American FactFinder come from several censuses and surveys. For more information see Using FactFinder and What We Provide.

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BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-41: Arizona Solar Jobs Census, 2015

National Solar Jobs Census 2015

GW Solar Institute
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[bw] RESEARCH PARTNERSHIP

JANUARY 2016

Acknowledgements

The Solar Foundation® (TSF) is a national 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transforms markets. In 2010, TSF conducted its first *National Solar Jobs Census* report, establishing the first comprehensive solar jobs baseline and verifying that the solar industry is having a positive impact on the U.S. economy. Using the same rigorous, peer-reviewed methodology, TSF has conducted an annual *Census* in each of the last six years to track changes and analyze trends.

TSF would like to acknowledge and thank its research partners. Without their foresight and leadership, this report would not have been possible. Research partners include: the George Washington University Solar Institute for providing assistance and support in reviewing and validating report results and analysis; the Solar Energy Industries Association (SEIA) for use of its National Solar Database and peer review; GTM Research/SEIA for providing survey respondents with the U.S. Solar Market Insight: 2014 YIR report, and; the following universities for their contributions to the forthcoming state *Census* reports: Florida Solar Energy Center at the University of Central Florida, North Carolina Clean Energy Technology Center at North Carolina State University, Energy Policy Innovation Council at Arizona State University, and Michigan State University.

Sponsors of this year's *Census* effort include: Energy Foundation, William and Flora Hewlett Foundation, Tilia Fund, George Washington University Solar Institute, SEIA, Recurrent, SolarCity, First Solar, Sol Systems, E.ON, Trina, State of Minnesota Department of Commerce, State of New Mexico Energy Minerals and Natural Resources Department, sPower, Standard Solar, All Earth Renewables, and groSolar.

We also want to thank all the solar employers that participated in the survey. Your responses were critical in providing us with accurate and timely data.

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SolarCity

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Executive Summary

The Solar Foundation's *National Solar Jobs Census 2015* is the sixth annual edition of current employment, trends, and projected growth in the U.S. solar industry. Given this industry's rapid transformation, The Solar Foundation has conducted annual employer surveys of the domestic solar labor force and perspectives on job growth and future opportunities. Data for *Census 2015* is derived from a statistically valid sampling and survey that went to nearly 400,000 establishments throughout the nation, in sectors ranging from manufacturing, to construction and engineering, to sales. The results from the *Census* are based on rigorous survey efforts over the course of October and November 2015 that include 287,962 telephone calls and over 44,220 emails to known and potential energy establishments across the United States, resulting in data from 19,000 firms and a total of 2,350 full completions from U.S. solar establishments.

This year's *Census* found that the solar industry continues to outpace most other sectors of the economy, **adding workers[1] at a rate nearly 12 times faster than the overall economy and accounting for 1.2% of all jobs created in the U.S. over the past year.** The Solar Foundation's long-term research shows that **solar industry employment has grown by 123% since 2010, resulting in over 115,000 new domestic living-wage jobs.**

As of November 2015, the solar industry employs nearly 209,000 solar workers, representing a growth rate of 20.2% since November 2014. Meanwhile, U.S. businesses as a whole added just over 2.4 million jobs at an annual growth rate of 1.74%.[2] Over the next 12 months, surveyed employers expect to see total employment in the solar industry increase by 14.7% - which is 13 times faster than the overall economy is expected to grow[3] - to approximately 240,000[4] solar workers.

This report includes up-to-date information on the solar industry - quantifying employment growth since last year's study and since the publication of *Census 2010*. These research findings also provide information on the potential for further growth and factors that are likely to impact the industry over the coming years.

In addition to the above statistics, the following were observed as of November 2015:

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[1] In this survey, solar employees are defined as a worker that spends at least 50% of their time on solar-related work. However, we have consistently found that 90% or more of these workers spend 100% of their time on solar-related work.

[2] BLS, Current Employment Statistics for November 1, 2014 to October 31, 2015, updated January 8, 2016.

[3] JobsEQ 20153Q; Projected growth is 1.1%

[4] The survey took place prior to the extension of the federal solar investment tax credit (ITC) beyond 2016. The extension is expected to reduce pressure to complete projects in 2016. This will likely result in lower solar employment growth in 2016 but higher solar employment in 2017 resulting in greater stability in solar employment. Prior to this policy change, major job losses had been expected for 2017.

- **2015 was the third consecutive year in which solar employment grew by approximately 20%.** At 20.2%, the 2015 growth fell just short last year's *Census* projected growth of 20.9%. By contrast, growth in 2013 and 2014 exceeded the *Census's* prior year's projected growth.

- **Over one out of every 83 new jobs created in the U.S. over the 12-month period was created by the solar industry** – representing nearly 1.2% of all new jobs.

- **Solar is a major source of new U.S. jobs.** Of the 35,000 solar workers added since November 2014, 83% were newly created positions with the remaining comprised of existing positions that have added solar responsibilities (17%).

- **Employees of installation companies accounted for 22,900 or 65% of the new jobs added in 2015**. The U.S. solar installation sector employs 77% more people than the domestic coal mining industry. Since 2014, solar installation has created more jobs than oil and gas pipeline construction and crude petroleum and natural gas extraction combined.[5]

- **Of the nearly 209,000 solar workers in the United States, approximately 90% are 100% dedicated to solar activities.** The "all-solar" percentage of workers is effectively unchanged since 2013.

- **Demand-side sectors (installation, sales and distribution, and project development) make up about 80% of overall solar industry employment;** installation firms account for the largest share of the workforce at 57%. Manufacturing comprises the second largest share at almost 15% of U.S. solar jobs.

- **All sectors - with the exception of solar manufacturing - grew over the past year.** Manufacturing jobs are expected to recover from the 2,200 job decline in 2015, growing by 3,800 jobs in 2016. These expectations are supported by industry construction activity.

- **Approximately 63% of the nearly 209,000 jobs are in the residential market segment, while 15% are in commercial and 22% were in utility-scale project development.** Utility-scale development is less labor intensive than residential so there are fewer utility-scale jobs despite the greater amount of utility MW installed.

- **About one in five employers report that it is "very difficult" to find qualified employees.** Except for manufacturing, all of the "very difficult to hire" percentages increased from 2014. Installation increased from 19.4% to 26.0%, sales and

[5] JobsEQ 20153Q

distribution increased from 20.0% to 23.4%, and utility-scale project development nearly doubled in difficulty from 12.5% to 24.5%.

- **Wages paid to solar workers remain competitive with similar industries and provide many living-wage opportunities.** Solar installers pay a median wage of $21 per hour, a 5% increase over the $20 per hour wage in 2014. Manufacturers pay assemblers a median of $18 per hour. Sales representatives and solar designers earn the highest medians of $28.85 and $26.92 per hour respectively. All of these are above the national median wage of $17.04 per hour (BLS, May 2014, wage data is not yet available for 2015).

- **Women represent a greater proportion of the solar workforce than in previous years**. Women account for 49,775 solar workers – 24% of the total; this is up from over 37,500 or 22% in 2014. A lower proportion of certain racial and ethnic minorities are working in the solar industry than in 2014. The workforce is comprised of approximately 5% African American, 9% Asian/Pacific Islander, 11% Latino/Hispanic, and 8% veterans. Despite some of the percent declines from 2014, there was little loss in employed workers of diverse backgrounds.

- **Experience is the most important hiring requirement for all sectors**. Two-thirds of employers require experience compared with 35% requiring a bachelor's degree or higher, and 10% requiring an associate's degree but not a B.A. Nonetheless, the solar industry provides an opportunity for workers in low-wage jobs who pursue some training in solar-specific technologies to move into sustainable wage careers in as little as 12 months.

- **Policies and incentives remain important.** Among policies and incentives, the 2015 *Census* found that 78% of solar firms noted that the federal ITC considerably or somewhat increased business prospects followed by 57% for state-level renewable portfolio standards (RPS) and energy efficiency resource standards (EERS); and 56% of businesses that expect the EPA Clean Power Plan to considerably or somewhat increase business prospects.

National Solar Jobs Census 2015 continues to demonstrate that the U.S. solar industry is having a positive and growing impact on the national economy, supporting jobs across every state in the nation.

As with the previous *Census* studies, this report includes information about all types of companies engaged in the analysis, research and development, production, sales, installation, and use of all solar technologies – ranging from solar photovoltaics (PV), to concentrating solar power (CSP), to solar water heating systems for the residential, commercial, industrial, and utility market segments.

The findings presented herein are based on rigorous survey efforts that include nearly 288,000 telephone calls and over 44,000 emails to known and potential solar

establishments across the United States, resulting in a maximum margin of error for employment-related questions of ±1.99% at a 95% confidence interval. Unlike economic impact models that generate employment estimates based on economic data or jobs-per-megawatt (or jobs-per-dollar) assumptions, the *National Solar Jobs Census* series provides statistically valid and current data gathered from actual employers.

About The Solar Foundation®

The Solar Foundation® (TSF) is an independent 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transforms markets. TSF is considered the premier research organization on the solar labor workforce, employer trends, and the economic impacts of solar. It has provided expert advice to leading organizations such as the National Academies, the Inter-American Development Bank, the U.S. Department of Energy, and others during a time of dynamic industry growth and policy and economic uncertainty.

While TSF recognizes that solar energy is a key part of our energy future, it is committed to excellence in its aim to help people fairly and objectively gauge the value and importance of solar technologies.

About BW Research Partnership

BW Research is widely regarded as the national leader in labor market research for emerging industries and clean energy technologies. In addition to the *Census* series, BW Research has conducted rigorous solar installation and wind industry labor market analysis for the National Renewable Energy Laboratory, wind energy and energy retrofit studies for the Natural Resources Defense Council, a series of comprehensive clean energy workforce studies for the Commonwealth of Massachusetts, Illinois, Vermont, Florida, Pennsylvania, Iowa, and California and numerous skills and gap analyses for community colleges, workforce investment boards, state agencies, and nonprofit organizations.

BW Research provides high-quality data and keen insight into economic and workforce issues related to renewable energy, energy efficiency, transportation, recycling, water, waste and wastewater management, and other environmental fields. The principals of the firm are committed to providing research and analysis for data-driven decision-making.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-42: SBB_WP1DR Renewables, Microgrid and Technology Innovation Post Test Year Plant Additions.xlsx

RESIDENTIAL UTILITY CONSUMER OFFICES'
SIXTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 16, 2016

RUCO 6.15: Please state how many systems are included in the revenue requirement and the average system size.

Response: APS assumes systems means solar partner program systems.

2015 Installations - 499
2016 Installations - 1,099
Total - 1,598

Average system size = 5.913 kW AC

Witness: Scott Bordenkircher

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-43: APS Response to EFCA 27.1

ENERGY FREEDOM COALITION OF AMERICA'S
TWENTY SEVENTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
JANUARY 17, 2017

EFCA 27.1: Referring to page 16 lines 3-9 of Mr. Bordenkircher's testimony:

a) The installation cost for 10MW of residential solar is stated to cost $30.1M. Please reconcile that to the stated average price per watt of $2.77.

b) Is the 10 MW of residential solar based upon DC or AC rating?

c) Please reconcile the total program cost of $40M with the $30.1M for the rooftop solar installations by providing a breakdown of the additional capital investment including communications, inverter control system, battery storage, etc.

d) Are the $30/month credits to the approximate 1,600 installations (page 14 line 5) included in the capital cost estimates?

e) What are the estimated annual costs associated with administering the Solar Partner program?

f) What are the estimated annual costs for maintaining the 1,600 installations and replacing any damaged equipment or equipment failures?

Response:

a) The $30.1M cost includes Construction Overhead Loads and AFUDC. The direct construction cost associated with SPP was $27.7M and it was that cost which was appropriately used to calculate the price of $2.77 per watt.

b) The 10 MW of residential solar is based upon a DC rating.

c) Please see attached as APSRC01869.

d) No, those are O&M expenses.

e) The SPP program is administered in-house and program expenses are not tracked as an individual project.

f) Estimated annual costs for maintaining the SPP installations is approximately $17.00 per kW or $176,000 annually.

Witness: Scott Bordenkircher

Capital

Line No.	Work Order/Funding Project	Operating Unit	Project Name	Purpose	Category	Estimated In-Service Date	June Filing Total Projected Costs	2015 Capital	2016 Capital (Actuals plus forecast)
1	SOLAR PRTNR CAP_FP: Solar Prtnr - Rooftop Solar Capital	SOLAR : Solar On Grid	Solar Partner Program	Install 10MW of residential rooftop solar systems (~1500) on selected feeders	RM_Distributed Solar	12/30/2016	$ 30,090,139	$ 716	$ 30,089,423
2	SOLAR COM P1_FP: Solar Partners Com and App Cost P1	DCMMN : Distribution Common	**Solar Power Partners –** Communication Devices	Install the required communications, monitoring, and control equipment to support Resource Management's 10MW residential rooftop solar program	SG_Distributio n	6/30/2016	$ 5,644,770	$ 28,780	$ 5,615,990
3	ES-SPP-NRC_FP: SPP Energy Storage	DCMMN : Distribution Common	**Solar Power Partners –** Energy Storage	Procure and install two battery storage systems at a location where the effect on mitigating high solar penetration can be tested. This will occur under the 10 MW Solar Power Partner program	TII_Technolog y Innovation	11/30/2016	$ 4,331,082	$ -	$ 4,331,082
4	Total		Total SPP				$ 40,065,991	$ 29,496	$ 40,036,495

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-44: Vote Solar 1.1

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.1: Please provide a representative sample of hourly non-NEM customer usage data over the test year for customers currently taking service on Schedule E-12. Please provide data in excel or csv format excluding any personal identifying information.

Response: Attached as APSRC01582 is the census rather than a sample of hourly Non-NEM customer usage data for those customers on E-12 for 2015. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding.

Please note the attachment is too large to upload to the APS external SharePoint site, so the attachment will be provided through an alternate method. Special instructions to access the data will be sent separately to Vote Solar. Please contact APS for this information.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-45: UniSource Homepage

We're more than a utility

UniSource Energy Services provides safe, reliable energy to more than 243,000 customers across Arizona. Our natural gas service reaches about 150,000 customers in northern and southern Arizona, while our electric service reaches more than 93,000 customers in Mohave and Santa Cruz counties.

Company overview

UES and its sister company, Tucson Electric Power, are among a family of utilities owned by Fortis, Canada's largest investor-owned gas and electric utility holding company. Fortis completed an acquisition of UNS Energy Corporation, TEP's and UES' parent company, in August 2014.

Natural gas service

UES provides natural gas service in Santa Cruz, Mohave, Yavapai, Coconino and Navajo counties.

Electric service

UES provides electric service in Mohave and Santa Cruz counties. Our service territory in Mohave County is located in the northwest corner of the state. It includes both Kingman, located in the high desert central portion of the county, and Lake Havasu City, situated in the low desert along the Colorado River.

Our Santa Cruz County service territory serves customers in the south central portion of the state, approximately 60 miles south of Tucson adjacent to the U.S. border with Mexico. We provide service to most of the county, including Nogales - its largest city.

Fortis

Fortis is the largest investor-owned electric and gas distribution utility in Canada. Its regulated utilities account for approximately 93 percent of its total assets and serve more than 3 million customers across Canada and in the United States and the Caribbean. Fortis owns non-regulated hydroelectric generation assets in Canada, Belize and Upstate New York. For more information, visit fortisinc.com.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-46: Vote Solar 1.2

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.2: Please provide a representative sample of hourly non-NEM customer usage data over the test year for customers currently taking service on Schedule ET-2. Please provide data in excel or csv format excluding any personal identifying information.

Response: Attached as APSRC01583 is the census rather than a sample of hourly Non-NEM customer usage data for those customers on ET-2 for 2015. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding.

Please note the attachment is too large to upload to the APS external SharePoint site, so the attachment will be provided through an alternate method. Special instructions to access the data will be sent separately to Vote Solar. Please contact APS for this information.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-47: Vote Solar 1.3

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.3: Please provide a representative sample of hourly non-NEM customer usage data over the test year for customers currently taking service on Schedule ECT-2. Please provide data in excel or csv format excluding any personal identifying information.

Response: Attached as APSRC01584 is the census rather than a sample of hourly Non-NEM customer usage data for those customers on ECT-2 for 2015. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding.

Please note the attachment is too large to upload to the APS external SharePoint site, so the attachment will be provided through an alternate method. Special instructions to access the data will be sent separately to Vote Solar. Please contact APS for this information.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-48: Vote Solar 1.4

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.4: Please provide a representative sample of hourly NEM customer usage data over the test year for customers currently taking service on Schedule E-12. Please provide data in excel or csv format excluding any personal identifying information. Please include hourly data on APS deliveries, NEM customer exports and NEM customer on-site consumption. In addition, please include data on the installed DG system capacity for each customer in the sample.

Response: Attached as APSRC01585 is the census rather than a sample of hourly NEM customer usage data for those customers on E-12 for 2015. The attachment includes hourly data on what APS delivered to the customer, what APS received from the customer and the customer's site consumption. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding. Attached as APSRC01594 is a list of DG system capacities where available. The customers in the spreadsheets can be matched using the unique identifier "ID".

Please note the attachments are too large to upload to the APS external SharePoint site, so the attachments will be provided through an alternate method. Special instructions to access the data will be sent separately.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-49: Vote Solar 1.5

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.5: Please provide a representative sample of hourly NEM customer usage data over the test year for customers currently taking service on Schedule ET-2. Please provide data in excel or csv format excluding any personal identifying information. Please include hourly data on APS deliveries, NEM customer exports and NEM customer on-site consumption. In addition, please include data on the installed DG system capacity for each customer in the sample.

Response: Attached as APSRC01586 is the census rather than a sample of hourly NEM customer usage data for those customers on ET-2 for 2015. The attachment includes hourly data on what APS delivered to the customer, what APS received from the customer and the customer's site consumption. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding. Attached as APSRC01595 is a list of DG system capacities where available. The customers in the spreadsheets can be matched using the unique identifier "ID".

Please note the attachments are too large to upload to the APS external SharePoint site, so the attachments will be provided through an alternate method. Special instructions to access the data will be sent separately to Vote Solar. Please contact APS for this information.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-50: Vote Solar 1.6

VOTE SOLAR'S
FIRST SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 4, 2016

VS 1.6: Please provide a representative sample of hourly NEM customer usage data over the test year for customers currently taking service on Schedule ECT-2. Please provide data in excel or csv format excluding any personal identifying information. Please include hourly data on APS deliveries, NEM customer exports and NEM customer on-site consumption. In addition, please include data on the installed DG system capacity for each customer in the sample.

Response: Attached as APSRC01587 is the census rather than a sample of hourly NEM customer usage data for those customers on ECT-2 for 2015. The attachment includes hourly data on what APS delivered to the customer, what APS received from the customer and the customer's site consumption. The attached document is the actual load research data that APS used to create its proposed rate design in this proceeding. Attached as APSRC01596 is a list of DG system capacities where available. The customers in the spreadsheets can be matched using the unique identifier "ID".

Please note the attachments are too large to upload to the APS external SharePoint site, so the attachments will be provided through an alternate method. Special instructions to access the data will be sent separately to Vote Solar. Please contact APS for this information.

Witness: Leland Snook

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-51: APS Response to RUCO.11

RESIDENTIAL UTILITY CONSUMER OFFICES'
SIXTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
DECEMBER 16, 2016

RUCO 6.11: How much money does the average residential customer contribute to fixed cost recovery per year?

Response: As detailed in the table below, the average non-solar residential customer contributed an estimated $1,248 per year towards fixed cost recovery during the Test Year, which includes contributions to the grid costs and fixed budget items like DSM and renewable program funding. This amount is estimated as the annual revenue per home, excluding taxes, less the revenue related to the recovery of fuel costs.

In comparison, using the same method, the average solar customer contributed an estimated $614 per year towards fixed cost recovery during the Test Year. However, this is not a consistent comparison because the average solar customer has higher site energy usage compared to non-solar customers. Therefore, a third estimate is provided which represents the fixed cost recovery from a non-solar customer with kWh usage similar to the site load of the solar customer. This amount is $1,653 of fixed cost recovery per year, which is directly comparable to the $614 for solar customers.

Contribution to Fixed Cost Recovery ($-year)
Test Year 2015

	Average Non-Solar Customer	Average Solar Customer	Comparative Size Customer
inputs			
AVG bill ($-month)	138	68	183
AVG billed kWh-month	1,063	525	1,413
Fuel cost ($-kWh)	0.032	0.032	0.032
results			
Total revenue ($-year)	1,656	816	2,196
Fuel related revenue	408	202	543
Fixed cost contribution	1,248	614	1,653

Witness: Chuck Miessner

Response Continued:

Notes:

1. Average bill includes 2015 Test Year base rates and adjustors; excludes taxes
2. Average non-solar kWh and revenue excludes green power rider and area lighting
3. Comparative size customer is the site load for the solar home
4. Comparative size customer bill estimated as 1413/1063 kWh X $138
5. Fuel related revenue = Avg. billed kWh X fuel cost X 12 months
6. Fixed cost contribution = total revenue less fuel related revenue
7. Fixed costs include fixed budget items such as DSM and renewable program funding

Sources:

1. Bills, revenue, kWh - FERC Form 1 page 304, CY2015 data
2. Comparative size customer Avg. kWh - see response to RUCO 3.6

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-52: Residential E-12 and ET-2 Fixed Cost Calculations

Fixed Cost Calaculation A

Total Residential Revenue Requirement	1,926,207,779
Residential Energy Revenue Requirement	468,828,894
Residential Fixed Energy Requirement	1,457,378,885
Adjustment for Revenue Not Recovered	7.96%
Residential Fixed Energy Requirement at Current Rates	1,349,924,866
Residential Customers	1,059,292
Annual Fixed Cost / Residential Customer	1,274
Residential Energy Consumption (MWH)	13,518,424
Residential Energy Revenue Requirement ($/kWH)	0.03468

Fixed Cost Calaculation B

Total Residential Revenue Requirement	1,926,207,779
Residential Variable Fuel Usage	432,589,568
Residential Fixed Energy Requirement	1,493,618,211
Adjustment for Revenue Not Recovered	7.96%
Residential Fixed Energy Requirement in Current Rates	1,383,492,230
Residential Customers	1,059,292
Annual Fixed Cost / Residential Customer	1,306
Residential Energy Consumption (MWH)	13,518,424
Fuel Assumption from RUCO 6.11	0.032

	E-12	ET-2
% of All Residential Customers	46%	29%
Average Residential Revenue ($/ kWH)	0.1414	0.1289
Average Fuel cost ($/kWH)	0.0320	0.0320
Average Fixed Cost Recovery ($/kWH)	0.1094	0.0969
Annual Fixed Cost / Residential Customer	1,306	1,306
Average Monthly Consumption Required to Recover Fixed Costs	994	1,123
% of Summer Bills < Average Required Monthly Consumption	76%	38%
% of Winter Bills < Average Required Monthly Consumption	89%	76%

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-53: APS Response to Staff 5.36

ARIZONA CORPORATION COMMISSION STAFF'S
FIFTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
OCTOBER 4, 2016

Staff 5.36: **Rate Design**.

a. How does APS propose to address residential customers who receive shockingly high bills under the new rate design? Explain fully.

b. Will the mandatory nature of the APS proposed new residential rate design result in increased uncollectibles? If not, explain fully why not.

c. Will any other aspects of the APS proposed new residential rate design result in increased uncollectibles? Explain.

Response:

a. Respectfully, APS does not anticipate that its customers will receive shockingly high bills under our proposed new rate design. Instead, we believe our customers may well benefit from the additional opportunity to exercise control over their energy expenses, and regardless, will continue to receive reliable electricity and excellent customer service for a reasonable and fair value.

APS has and continues to develop a comprehensive education and outreach plan for our customers as it relates to our new rates. Extensive customer communications, with supporting material, will be provided to our customers both in advance of and beyond any effective date of new rate design, and will include traditional customer mailings, bill inserts, e-mail contacts with appropriate links to aps.com, and a variety of energy and demand management tips and guides on various aps.com webpages. Our Call Center Associates will also be well-equipped to explain new rates as an element in new service connect, credit and collection, high bill and other typical utility-customer transactions, both pre and post effective date. Consistent components of our outreach plan include methods within which customers can manage and reduce demand and energy consumption, effectively promoting a means within which customers can better manage costs through multiple elements of the new rate design. A framework of this education and outreach plan was shared at APS's Third Technical Conference by witness Derstine on September 29, 2016.

Witness: Stacy Derstine

For over 90% of APS's residential customers, peak demand swings in any particular month are 2 kW or less. A demand charge billed off a swing in demand of 2 kW or less would not result in a shockingly high bill impact. Bill impact estimates to our customers as it relates to the proposed rate design have been provided in our rate review filings. Please also see the Small, Medium and Large Customer Bill impacts data provided from APS's Third Technical Conference presented by APS witness Miessner for more information.

An important element within APS transition plan to new rates will be a comprehensive "best rate analysis" review for all residential customers. Predicated upon historical usage (both energy and demand), customers will be transitioned to the best (most economical for them) new demand rate, and will have at their disposal all of the education material and channels described above, and in APS's Third Technical Conference, to help optimize their ability to save on new rates. Additional tools to assist a customer in optimizing their potential savings include text and e-mail notifications and alerts regarding dollar, energy and demand thresholds.

APS has more than 120,000 existing customers on residential demand rates, the vast majority of whom save money as compared to our energy only and time-of-use energy rates. We are confident that our customers are interested and capable of aligning their energy use with rate plans that prospectively save them money through pricing signals that help lower the overall cost of providing energy services to them, through the utility. And, we're committed to working with and educating our customers, collectively and individually, to ensure that they are placed in the best position possible to maximize the value for their energy dollar.

b. APS proposes a suite of rates for its customers, including three TOU with demand rates, a flat rate and a rate without a demand charge for customers with average usage under 600 kWh per month. Historically, neither rate increases nor rate design changes have a substantial impact on the percentage of uncollectible accounts. APS does not anticipate that the rates and rate design proposed in this case will have an impact on

the percentage of uncollectible accounts.

c. See response to Request 5.26(b).

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-54: EFCA 14.1

ENERGY FREEDOM COALITION OF AMERICA'S
FOURTEENTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
NOVEMBER 28, 2016

EFCA 14.1: APS has suggested that its Solar Partners Program ("SPP") is designed to provide distributed generation solar ("DG") to APS customers with "limited income" (see e.g. Pinnacle West's 2016 Proxy Statement at page 3 for one such example).

a. What means did the Company employ to inform potential customer participants about the SPP? Note means such as telephone calls, email, face to face solicitations, traditional mailing, or other methods of contact utilized in response to this questions.

b. How many total APS customers did APS reach out to or contact regarding the SPP using the means identified in response to subpart (a) of this Data Request?

c. How did the Company select which of its customers it would contact using the means identified in response to subpart (a) of this Data Request?

d. When the Company indicates that the SPP makes DG available to customers that have "a limited income" what is the criteria that APS uses to define a "limited income" customer?

e. How many of the customers identified in response to subpart (b) of this Data Request did the Company identify as low income?

f. Please provide a list of everything that the Company did to market the SPP to customers it deemed low income.

g. How many customers participating in the SPP are considered low income and how does the Company know?

Response:

a. APS used the following means to inform potential customer participants about the SPP: email, direct mail (letters and postcards), door hangers, door to door ambassadors, Pandora radio, digital banner ads, newspaper print ads, bill inserts, social media (Facebook), telemarketing, and community events.

b. 344,000 customers received direct mail and email. Marketing used digital, newspaper, social media, Pandora

Witness: Scott Bordenkircher

radio and community events to cover our customer base in the Metro Phoenix area.

c. APS reached out to our entire customer base in the Metro Phoenix area with a focus on our research feeders and our limited income customers.

d. APS considers the following groups to be part of the "limited income" customer base:

- Residential customers who qualify for the E-3 rate rider, Energy Support Program. The qualification for the rate rider is that the customer is within 150% of the federal poverty level.

- Residential customers who participated in the APS Weatherization Program which provided additional door and window insulation and weather sealants, duct work, new lighting. To participate in this program, customers needed to meet the limited income criteria, which is within 200% of the federal poverty level.

e. Below is a breakdown of the "limited income" customers by category:

- 89,000 E-3 customers

- 54,000 E-3 customers in Phoenix Metro, Yuma and Casa Grande target areas

- 8,222 E-3 customers after filtering for geographic criteria, west to southwest facing, roof size, etc.

- Added 1,571 additional weatherized customers filtered against geographic criteria

- Total 9,793

f. Limited income customers were exposed to radio, digital, newspaper, bill inserts, and social media, community events, telemarketing as well as direct mail and email marketing.

g. At the time of application, 131 out of 1,598 (8.2%) customers participating in the SPP program were E-3

customers. The ratio compares to the makeup of customers during the test year where 86,634 out of 1,046,990 (8.3%) total customers were E-3/E-4 customers and it is even more favorable considering that eligible limited income customers constituted less than 1% of APS residential customers.

BEFORE THE ARIZONA CORPORATION COMMISSION

Arizona Public Service Company

Docket No. E-01345A-16-0036

PREPARED DIRECT TESTIMONY OF

JAMES HEIDELL

On Behalf of Energy Freedom Coalition of America

Attachment JAH-55: EFCA 24.33

ENERGY FREEDOM COALITION OF AMERICA'S
TWENTY FOURTH SET OF DATA REQUESTS TO
ARIZONA PUBLIC SERVICE COMPANY REGARDING
THE APPLICATION TO APPROVE RATE SCHEDULES DESIGNED TO
DEVELOP A JUST AND REASONABLE RATE OF RETURN
DOCKET NO. E-01345A-16-0036
AND
DOCKET NO. E-01345A-16-0123
JANUARY 13, 2017

EFCA 24.33: Regarding the E-56R rate:

a. Are current NEM customers with installed generation over 100 kW subject to the E-56R rate rider?

b. Will existing NEM customers with system sizes over 100 kW be moved to this rider?

c. Why is APS proposing to move new customers with installed DG over 100 kW to the E-56R rider?

d. Has APS evaluated the impact of this proposal on deployment of commercial solar and/or storage in its service territory?

e. Please provide all public notices that have referenced the movement of new commercial customers with installed generation over 100 kW to the E-56R rate rider.

f. How was the 100 kW threshold established? Please provide all supporting workpapers.

g. How does APS justify valuing exports under E-56R at a lower rate than the value established in the Value of Solar docket.

Response:

a. Most customers with solar generation over 100 kW are currently served under rate EPR-6.

b. Under APS's proposal they will be grandfathered on rate rider EPR-6.

c. Rate E-56R provides cost recovery for standby service, which is an important issue for partial requirements customers.

d. The proposal is not applicable to storage on its own. However, it could help incent a solar customer to install storage to reduce the standby charges. APS has not assessed the impact of the proposal on potential solar adoption.

Witness: Chuck Miessner

e. APS has provided public notice of the rate case, which includes this proposal. The notice is publically available.

f. It comports with the existing threshold established by PURPA and approved by the ACC.

g. Commercial customers under existing rates have offset rates for solar production in the 4 to 8 cents per kWh range. Also, most commercial customers do not export a significant amount of energy.