

# **KW (H2O) – USING SUNSHINE TO POWER ARIZONA'S WATER FUTURE**

## **A SURVEY OF ARIZONA WATER OPERATORS WITH SOLAR**

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# Reasons for the Solar Survey

- EPA estimates drinking and wastewater systems account for 3 to 4 % of energy use in the US and 3% of the national energy consumption at a cost of \$4B annually (U.S. EPA, 2012b).
- EM&S Committee in promoting its mission on energy efficiency, renewable energy and water conservation wanted to discern:
  - Solar Deployment at AZ Water Plants
  - Costs and Savings
  - Operational Impacts
  - Lessons Learned by Operators

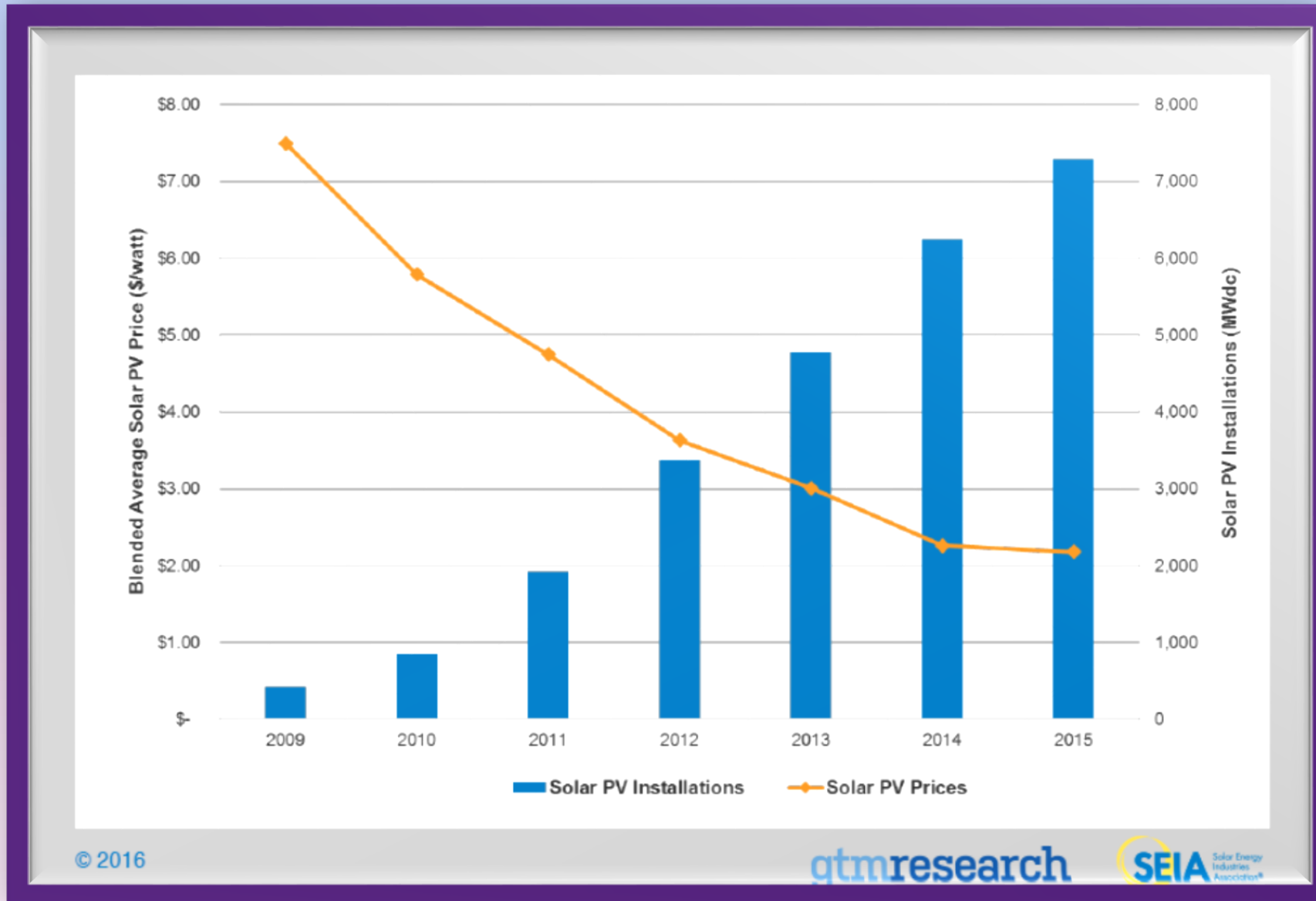
# The First Solar Cell – Bell Labs April 25, 1954

New York Times said “the silicon solar cell may mark the beginning of a new era, leading eventually to ....the harnessing of the almost limitless energy of the sun.”



In 1955 Western Electric and Hoffman Electronics commercialized solar cells;  
Hoffman's cost was \$1785/watt for 2% efficient cell

# SEIA Chart on Declining Costs of Solar (2015)



# AZ Water Plant Solar Deployment by Community

Arizona Water Plants with Solar Systems	Project Completion	Size kW-DC	2016 Production	SSA/Purchase
Community	Anticipated		(Estimated via PV Watts)	
Bisbee	8/1/13	400.0	700,000	Purchase
Douglas	2/1/16	297.6	494,098	Purchase
Flagstaff <sup>1</sup> - 3 systems	12/19/13	818.4	1,371,365	SSA
Gila Bend	12/1/12	460.0	832,000	Purchase
Gilbert	11/1/11	2,257.9	4,426,361	SSA
Globe	12/21/12	495.5	895,000	PPA
Kingman	12/20/12	50.0	92,000	Purchase
Peoria - Beardsley Water Plant	1/1/10	59.9	107,585	Purchase
Phoenix	1/1/13	7,500.0	15,200,000	PPA
Pima County	2010 & 2011	2,000.0	3,450,000	PPA
Prescott Valley	4/1/12	1,460.0	2,263,645	PPA
Scottsdale - (under design)	8/1/17	2,300.0	4,783,839	SSA
Somerton	2013	272.0	274,000	Purchase
Tempe - South Water Treatment	3/1/14	924.0	1,600,000	SSA
Tempe - Johnny Martinez	3/20/17	1,200.0	1,820,000	SSA
Tucson - Central Avra Valley Storage and Recovery Program (CAVSARP)	2011 & 2013	4,000.0	11,010,000	PPA
Yuma - Aqua Viva Water Treatment	11/14	604.0	1,186,092	PPA
Yuma - Desert Dunes Water WRF	11/14	604.0	1,172,776	PPA
<b>Totals</b>		<b>25,703.3</b>	<b>49,319,893</b>	
<sup>1</sup> Flagstaff 2015 production data				

# GGE's & CO2 Equivalents for AZ Water Plants Annual Solar Generated

## Greenhouse gas emissions from



7,322



Passenger  
vehicles  
driven for one  
year

-or-



83,070,090



Miles driven  
by an average  
passenger  
vehicle

-or-



11,000



Tons of waste  
recycled  
instead of  
landfilled

-or-



1,571



Garbage  
trucks of  
waste recycled  
instead of  
landfilled

## CO<sub>2</sub> emissions from



3,900,173



gallons of  
gasoline  
consumed

-or-



36,986,409



Pounds of coal  
burned

-or-



459



tanker trucks'  
worth of  
gasoline

-or-



3,660



homes' energy  
use for one  
year

-or-



8.8



Wind turbines  
installed

-or-



5,118



homes'  
electricity use  
for one year

-or-



185



railcars' worth  
of coal burned

-or-



1,228,672



Incandescent  
lamps switched  
to LEDs

-or-



# WIFA Green Program Loans and Owned Solar Systems





# Categorically Green CLEAN WATER Projects

## Energy Efficiency

- Projects that achieve a 20% reduction in energy consumption (high efficiency premium motors and equipment)
- Renewable energy projects such as wind, solar, geothermal, micro-hydroelectric (energy from pipe flow), and biogas combined heat and power systems (CHP) that provide power to the POTW or feed into the grid that the utility draws from
- Collection system Infiltration/Inflow (I/I) detection equipment
- Energy management planning, including energy assessments, energy audits, optimization studies reasonably expected to result in a capital project

## Water Efficiency

- Installing any type of water meter in previously unmetered areas, ....
- Replacing existing broken water meters with Automatic Meter Reading (AMR) or meters with built in leak detection
- Retrofitting AMR capabilities or leak detection equipment to existing meters
- Water audit and water conservation plans reasonably expected to result in a capital project
- Water reuse projects that replace potable sources with non-potable sources
- Gray water, condensate and wastewater effluent reuse systems
- Extra treatment costs and distribution pipes associated with water reuse



# WIFA Loan Amounts & Principal Forgiveness

*From Susan Craig, WIFA from Records Request*

WIFA Solar Projects				
<i>City</i>	<i>Project Type</i>	<i>Loan Year</i>	<i>Loan Amount</i>	<i>Forgivable</i>
Bisbee	Wastewater	2013	\$1,600,000	\$400,000
Douglas	Wastewater	2014	\$1,300,000	\$400,000
Gila Bend	Water	2012	\$2,050,000	\$1,550,000
Somerton	Wastewater	2012	\$1,187,080	\$300,000
Somerton	Water	2012	\$2,046,854	\$700,000

**Economically disadvantaged communities may receive significant debt forgiveness**

# PPA and SSA Leased Systems – 2010 to 2012





# PPA and SSA Leased Systems

## 2013- 2017



# Sample of Solar Incentives and Costs

Year	Community	Incentive \$/kWh	Cost of Solar \$/kWh	
2010	Peoria	\$.138	DNA	
2011	Gilbert	Incentives paid for 60% of vendor capital cost	\$.075 & 2.5% esc	
2012	Prescott Valley	To solar vendor	\$0.085 & 3% esc	
2013	Phoenix	To solar vendor	\$0.0674 & 1% esc	
2013	Tucson CAVSARP	To solar vendor	Approx. \$.07 & esc	
2013	Somerton	\$0.8 to \$0.12		
2014	Tempe – South WTF	\$.04	\$0.05 fixed	
2016	Douglas	\$0.0566 & \$585K cap	DNA	
2017	Tempe – Johnny Martinez WRF	None	\$0.055 fixed	
2017	Scottsdale	None	<\$0.6 fixed	



# Comments, Savings for Owned Systems

- **Peoria** – Early (2010) and small system 59.9KW but **\$14,000** solar savings annual.
- **Bisbee** – “energy savings - solar and efficiency savings less the annual WIFA loan payments - are **\$12,000** annually.”
- **Douglas** reported **\$25,000** in solar savings in 2016.
- **Kingman's** solar is meeting 20% of the plant's energy needs .... While Kingman had no comparative savings with the new plant...WIFA's debt forgiveness helped “solar show a good ROI.”
- “Initially **Gila Bend** was not seeing much savings. The solar plant was overbuilt... (APS) greatly assisted us with adding interconnections for two wells consuming large amounts of power.” Savings in 2016 were **\$97,000**.
- Despite difficulties (i.e. vendor bankruptcy, flood, and trackers “...now producing about 60% of what was promised” ), **Somerton** still benefits from solar savings as their credit per kWh for on-site generation ranges from \$.08 to \$.12/kWh.

**Do “owned” systems show higher rate of solar savings?**

# Maybe.... But Leased Solar Systems Save Upfront \$

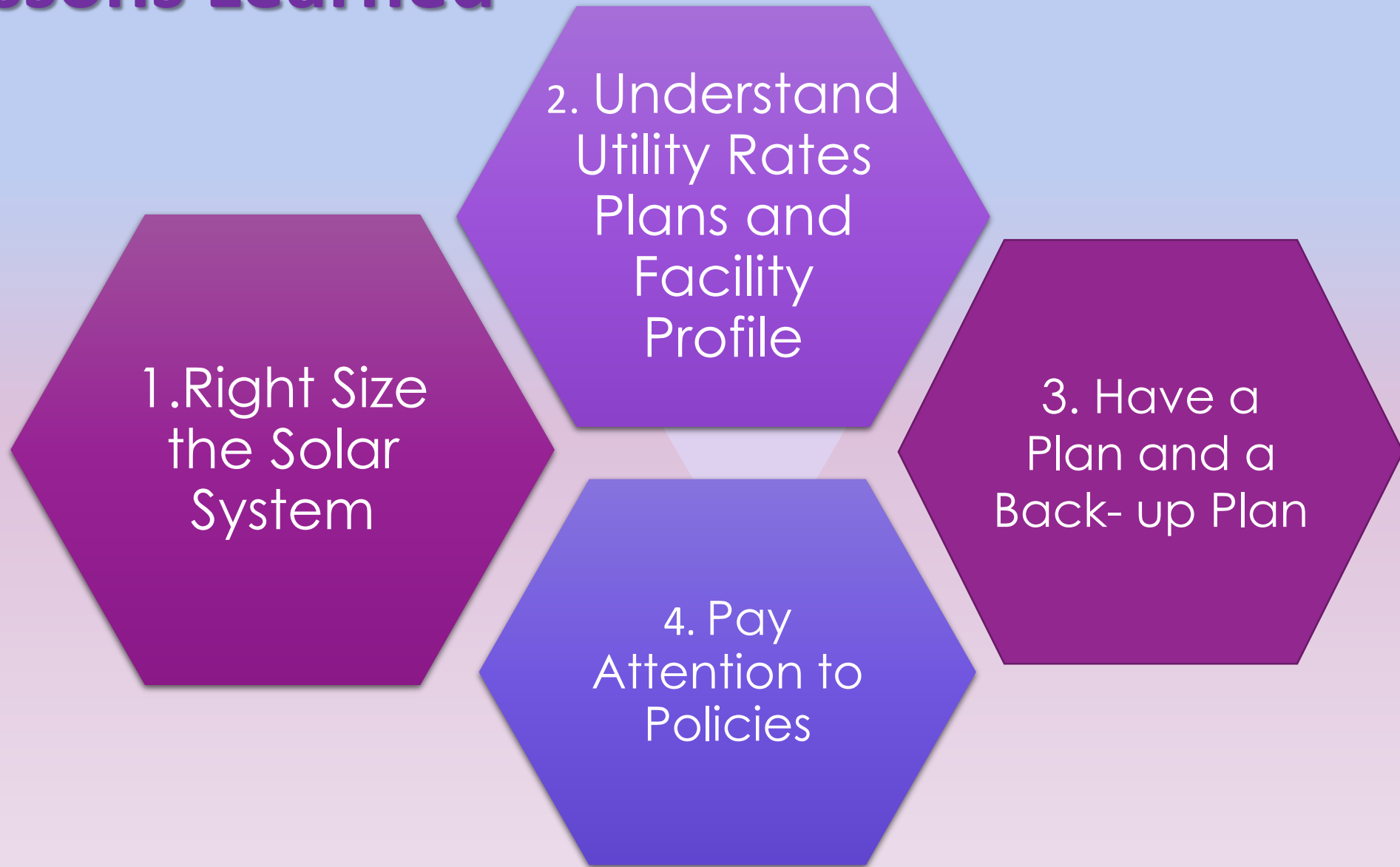
## Flagstaff Solar PPA with NRG (Ameresco as ESCO)

FY 2014-15		A	B	C = A x B	D	E = C + D	F	G = E - F
Solar PV Site		VOS (Baseline Utility Cost), \$kWh	Actual Annual Solar Delivered, kWh	Annual Energy and Operational Cost Savings	Total APS Incentives	Total Annual Energy and Savings & APS Incentives	Total Annual Costs (Principal, Interest, O&M, MEP, M&V and Insurance)	Total Annual Energy and Cost Savings
Aquaplex		\$0.0930	453,184	\$ 42,146	\$ 55,742	\$ 97,888	\$ -	\$ -
Rio de Flag		\$0.0930	538,783	\$ 50,107	\$ 66,270	\$ 116,377	\$ -	\$ -
Sun Bear (Wildcat)		\$0.0930	416,472	\$ 38,732	\$ 51,226	\$ 89,958	\$ -	\$ -
<b>TOTALS:</b>			<b>1,408,439</b>	<b>\$ 130,985</b>	<b>\$ 173,238</b>	<b>\$ 304,223</b>	<b>\$ 257,674</b>	<b>\$ 46,549</b>

FY 2015-16		A	B	C = A x B	D	E = C + D	F	G = E - F
Solar PV Site		VOS (Baseline Utility Cost), \$kWh	Actual Annual Solar Delivered, kWh	Annual Energy and Operational Cost Savings	Total APS Incentives	Total Annual Energy and Savings & APS Incentives	Total Annual Costs (Principal, Interest, O&M, MEP, M&V and Insurance)	Total Annual Energy and Cost Savings
Aquaplex		\$0.0958	431,919	\$ 41,373	\$ 53,126	\$ 94,499	\$ -	\$ -
Rio de Flag		\$0.0958	527,065	\$ 50,488	\$ 64,829	\$ 115,316	\$ -	\$ -
Sun Bear (Wildcat)		\$0.0958	412,652	\$ 39,528	\$ 50,756	\$ 90,284	\$ -	\$ -
<b>TOTALS:</b>			<b>1,371,635</b>	<b>\$ 131,389</b>	<b>\$ 168,711</b>	<b>\$ 300,100</b>	<b>\$ 259,940</b>	<b>\$ 40,160</b>

# Lessons Learned

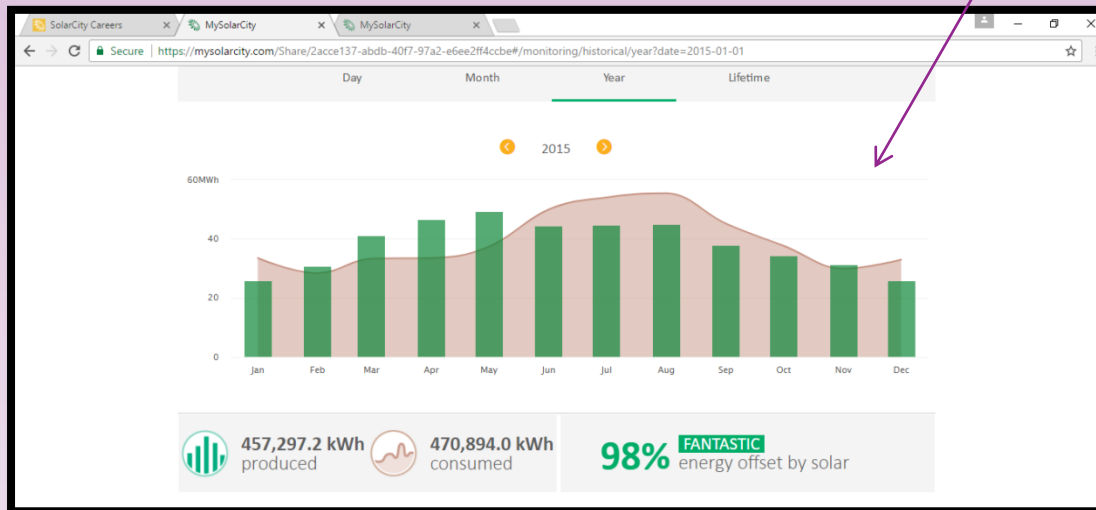


# 1.Right Size the Solar System

- Phoenix Lake Pleasant sized for 70% production of a 50MGD plant- now at 27MGD.
- Bisbee conducted audit post solar and saved an additional 30% energy use

## Lessons:

- Question sizing especially for new buildings or plants
- Rule of thumb – don't size for more than 70-75% solar energy / electrical use and know energy mix (#2)
- Assess not just history but future impacts or EE projects
- Run scenarios (e.g. Mesa exercise for CAP Plant “what if” divert flow to new Signal Butte WTF) if change impacts solar savings in future





## 2. Understand Utility Rates Plans and Facility Profile

- Review history and mix of peak/ off peak rates with solar
- Pima County did major analyses of standard vs. TOU rate for 2M systems
- Solar energy reduces kWh use – will plant see lower rate plan at slightly higher cost/ kWh? Impact on solar savings?
- Power companies rate trend to increase fixed cost (kW demand) charges vs. increase kWh variable charges

### Lessons:

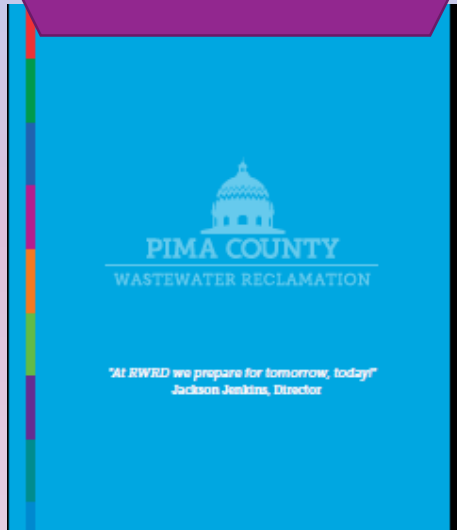
- Become familiar with utility billing systems and rate plans and ask for detailed reports
- Grace Kelly has navigated these complexities, and suggests “Hiring a third-party consultant familiar with utility rates to vet solar proposals, assess utility rate impacts and determine the best financial outcome” as a key to success

#### Bill History

MESA CITY  
OF 7750 E  
BROWN RD

Bill Month Year	Price Plan	Total kWh	16% 22% 62%			Max KW	Total Bill
			On Pk kWh	Sh Pk kWh	Off Pk kWh		
Jun-14	E61	892,569	167,111	247,536	477,923	2,044.00	\$81,036.44
May-14	E61	826,737	153,079	238,427	435,230	1,703.00	\$75,245.60
Apr-14	E61	729,316	89,425	83,520	556,371	1,515.00	\$52,068.86
Mar-14	E61	636,475	81,487	75,969	479,019	1,301.00	\$47,064.71
Feb-14	E61	570,699	75,374	70,822	424,503	1,340.00	\$43,500.52
Jan-14	E61	559,524	72,697	68,850	417,976	1,205.00	\$42,744.19

### 3. Have a Plan and a Back- up Plan



[https://webcms.pima.gov/UserFiles/Server/Server\\_6/File/Government/Wastewater r%20Reclamation/Publications/FacilityPlan\\_2016.pdf](https://webcms.pima.gov/UserFiles/Server/Server_6/File/Government/Wastewater%20Reclamation/Publications/FacilityPlan_2016.pdf)

### Plans:

- Flagstaff, Pima County, Tempe, Tucson developed plans and goals for renewable energy which helped drive deployment
- Plans lead to taking advantage of solar benefits – e.g. demand reduction; integrating solar with SCADA schedules; or rate plan TOU analyses to maximize savings
- Plans also appeared to foster development of staff expertise and knowledge

### Back-up Plans:

- Gila Bend added 2 wells to solar interconnection as system oversized
- Somerton contractor bought up CPV arrays for replacement parts ( flood damage) and reverse engineering system

## 4. Pay Attention to Policies

### **APS agrees to lower rate increases -**

*Utility company reaches deal with solar, consumer advocates*

- APS originally proposed ...paying 3 cents / kWh to new solar customers, a huge cut from the current 14.5 cents per kWh. The agreement sets a rate of 12.9 cents per kWh, but that rate is adjusted down each year by as much as 10% until it reaches commercial rates.
- Bob Christie, AP

## **Appeals Court Says No Property Tax for Rooftop Solar Panels**

*May 19, 2017*

- An Arizona Court of Appeals ruling says companies that lease rooftop solar systems to homeowners can't be charged property tax for the systems.
- Leasing companies SolarCity and SunRun sued the department.
- The ruling .....upholds a lower court judgment that said the state Department of Revenue was wrong when it determined in 2013 that leased rooftop solar systems should be subject to property tax.

# Battery Back-up Technology for Solar Has Arrived

## Kauai 13MW Solar and 52 Power Pack Battery Storage March 2017



<https://www.theverge.com/2017/3/8/14854858/tesla-solar-hawaii-kauai-kiuc-powerpack-battery-generator>

- KIUC didn't purchase the solar panels and battery system from Tesla outright.
- Instead, the utility contracted with Tesla to purchase *electricity*... a 20-year contract in place to buy the solar-generated power for 13.9 cents per kilowatt hour
- In effect, Tesla is now in the power generation business.
- “Coming Soon” to Scottsdale Water Campus’ 2.3 MW install
- Scottsdale purchased the Battery Back-up units
- Director says “Solar alone does not shave cost. Solar/Battery combo [is] estimated to save \$1.4M over a 20 year period. Projected cost savings are in demand charges.”

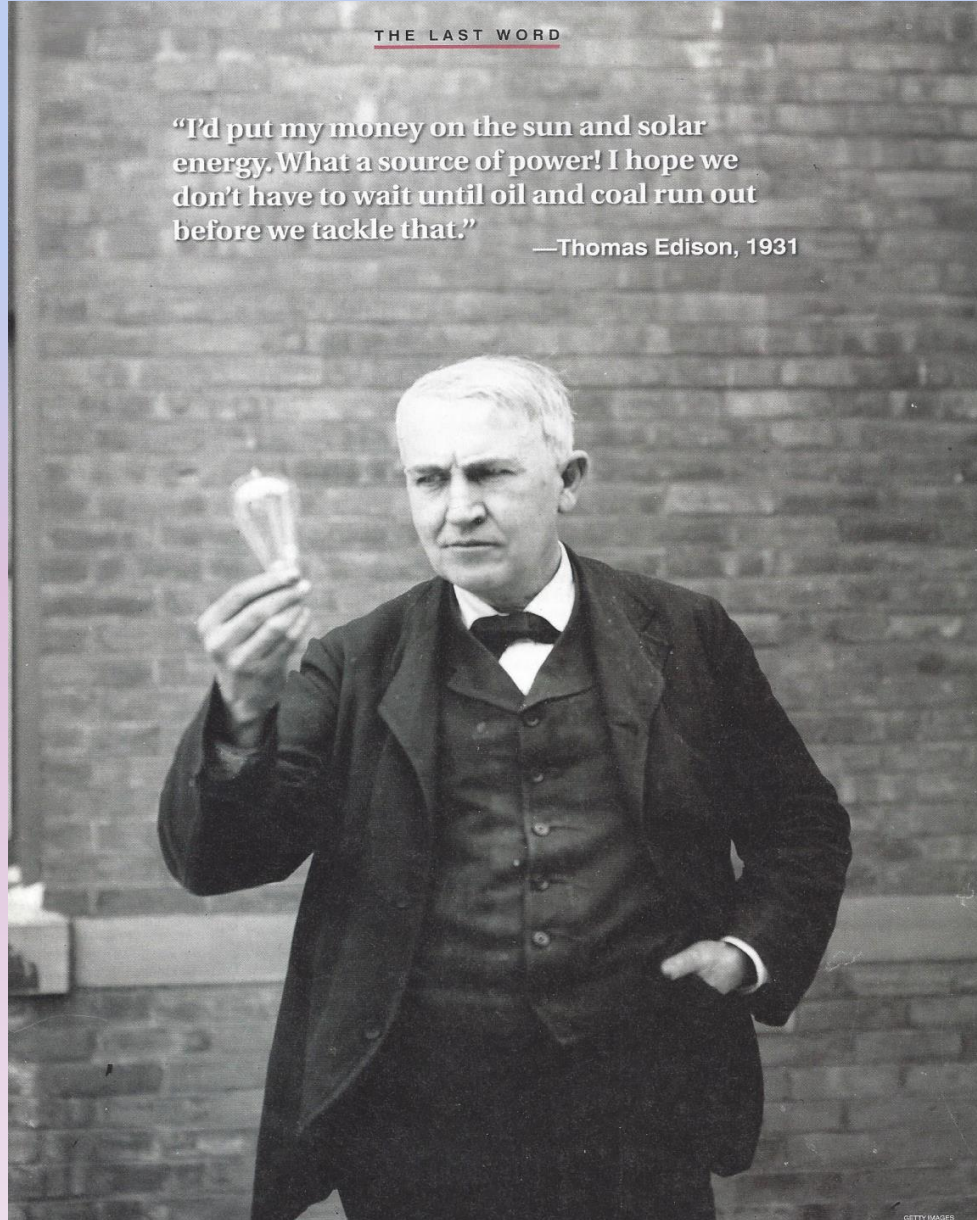


# The Last Word

THE LAST WORD

"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."

—Thomas Edison, 1931



GETTY IMAGES