2014 Value of Solar Executive Summary

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1 Introduction

In 2012, Austin Energy became the first utility in the U.S. to offer a Value of Solar (VOS) rate in place of net energy metering for its residential customers. This decision established Austin Energy's leadership in the area of VOS and it has received national attention. Austin Energy's work has been highlighted in numerous media articles and showcased at several major events. The State of Minnesota is even patterning their program after Austin Energy's program.

The VOS rate states that the "the credit would be adjusted annually to account for market value changes and other factors that influence the value of the solar energy generated."

Clean Power Research (CPR), developer of the DGValuator™ VOS modeling software, was selected as the contractor to provide the analytical support required to perform the annual update. This report summarizes results of the Austin Energy VOS analysis.

2 Objective

The objective of this project was to calculate the long-term value of solar to Austin Energy. This information will be used by Austin Energy as input for the basis of a rate offered to customers.

3 Key Tasks

Austin Energy specified in the Scope of Work that "this VOS evaluation will include a detailed assessment of the current components to examine the applicability of these components considering Austin Energy's current rate structure and programs, as well as the characteristics of the ERCOT energy market."

The project included four key tasks:

1. Assess the need to modify the list of included value components.
2. Perform the analysis using PV fleet production for Austin Energy's actual PV fleet rather than a hypothetical, single-location PV system.
3. Incorporate ERCOT market data into the analysis.
4. Develop an Incentive Ramp Down Schedule Tool for use by Austin Energy in the design of both the residential PV Rebate Program and the Commercial Performance Based Incentive for PV with the VOS program used as an input.

4 Project Analysis

Task 1: Value Components to be Included

The first task of this project was to assess the need to modify the list of included value components. All of the elements in the analysis are based on utility costs, therefore the VOS reflects these avoided costs.

Previous VOS analysis studies (the original 2006 study and subsequent study updates) included the following value components:

- Energy
- Generation Capacity
- Environment
- T&D Deferral
- Loss Savings

Previous studies did not include societal benefits. After discussion with Austin Energy, it was decided that societal benefits should continue to be excluded from the VOS analysis. Societal benefits should be reflected in the rebates, while the VOS analysis should focus on utility benefits.

Table ES-1 summarizes the value components that were included in the VOS analysis. The list of components is similar to what was included in previous studies. The major differences were:

- The value component *Energy Value* from the previous studies was renamed Guaranteed Fuel Value because this clarified the fact that it included protection from fuel price uncertainty.
- The value component *Plant O&M Value* was listed separately.
- Previous studies identified *Loss Savings* as a separate value component. Since loss savings magnify the other value components, this study presents loss savings as a multiplier of other value components rather than as a separate value component.

Table ES-1. Value components included.

Value Component	Basis
Guaranteed Fuel Value	Cost of fuel to meet electric loads and T&D losses inferred from nodal price data & guaranteed future NG prices.
Plant O&M Value	Costs associated with operations and maintenance.
Generation Capacity Value	Capital cost of generation to meet peak load inferred from nodal price data.
Avoided Transmission Cost of Service (TCOS)	Savings resulting from avoided TCOS payments.
Avoided Environmental Compliance Cost	Cost to comply with environmental regulations and policy objectives.

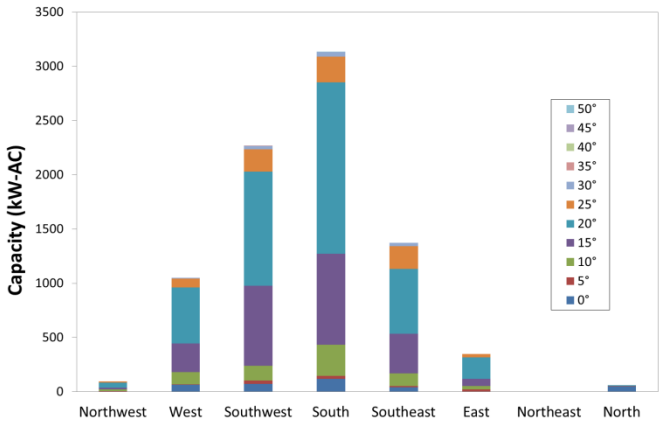
Task 2: PV Fleet Analysis

The second task was to perform the analysis based on expected production from Austin Energy's actual fleet of PV systems rather than a single-location hypothetical system. Previous VOS studies were based on a hypothetical system configuration. The 2012 study, for example, performed the analysis for seven different configurations: Horizontal, South 30°, Southwest 30°, West 30°, West 45°, 1-Axis, and 1-Axis 30°. The resulting VOS rate was ultimately based on the value of solar for a 30°-tilted, south-facing PV system.

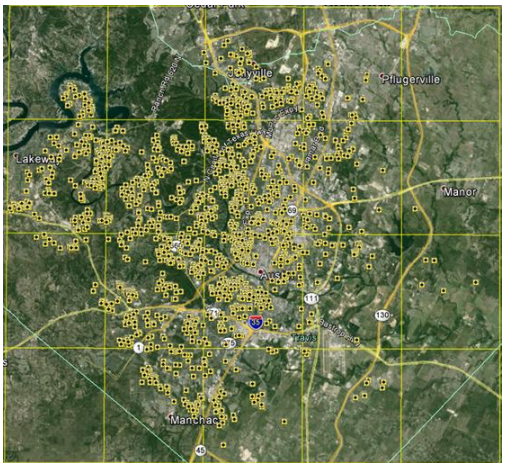
Under this project, Austin Energy provided detailed system specifications for 2,423 PV systems. The total capacity of these systems was 8.33 MW_{AC}. The left side of Figure ES-1 presents the composition of this fleet by azimuth orientation and tilt. The right side of the figure illustrates how each system was then mapped to a SolarAnywhere® tile (the source of the solar irradiance data). This enabled CPR to simulate PV production one system at a time for every hour and then sum the hourly production to arrive at Austin Energy's PV fleet production. This was performed for 2011 and 2012. This PV fleet production data was used for all VOS calculations.

Figure ES-1. Austin Energy's PV fleet.

PV Fleet Composition



PV System Locations



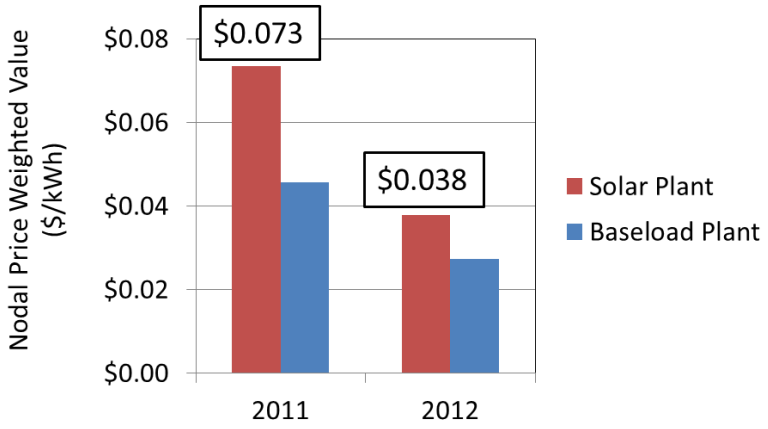
Task 3: Incorporate ERCOT Market Data into the Analysis

The third task was to incorporate ERCOT market data into the VOS analysis. The previous study attempted a partial integration of ERCOT market prices. It assumed that the previous ERCOT prices would remain constant and applied these prices for several years. A similar approach was attempted under this current study. It required the following steps:

- Obtain hourly nodal prices ($/kWh) for 2011 and 2012.
- Obtain hourly PV fleet production (kWh/h) that was time-correlated with hourly nodal prices.
- Calculate the annual solar-weighted value by multiplying hourly PV fleet production (kWh/h) by hourly nodal prices ($/kWh), summing the result ($/year), and dividing by the annual PV fleet production (kWh/y).

The results of the analysis are presented in Figure ES-2. Results (in red) show that the solar-weighted value was $0.073 per kWh in 2011 and $0.038 per kWh in 2012. For reference purposes, the same analysis performed for a baseload plant (results in blue). The results suggest that solar earns a premium over a baseload plant indicating that solar is available when it is most needed during on-peak, higher priced periods.

Figure ES-2. 2011 and 2012 nodal price weighted value.



Specific dollar values were obtained for 2011 and 2012. They varied, however, by a factor of almost two. As a result, it was decided that they could not be used to directly forecast the future VOS. Instead, an alternative approach was taken that still took into account the ERCOT market structure:

- Obtain forecasted, implied hourly heat rates from Austin Energy for 2014 to 2022 that represented ERCOT's nodal price market.
- Match 2011 PV fleet production to 2014 – 2022 hourly heat rates on an hour-by-hour basis.[1]
- Multiply 2011 PV fleet production by 2014 – 2022 heat rates.
- Sum results and divide by the energy to obtain a weighted heat rate that includes all aspects of the ERCOT nodal market.
- Perform the analysis for both solar and baseload plants.
- Compare the results for the solar and baseload plants to determine the solar-weighted heat rate, effective capacity, and capacity cost.

The result of the analysis provided the following parameters:

- Data inferred from Austin Energy's Heat Rate Forecast of the ERCOT market (2014 – 2022) combined with PV fleet production (2011)
  - Solar-weighted heat rate: ***8,024 Btu/kWh***
  - Effective capacity: ***62% of capacity cost***
- Data provided directly by Austin Energy
  - Capacity cost: ***$676/kW***
  - Planning Reserve margin: ***13.75%***
  - O&M cost: ***$7.04/kW-yr***

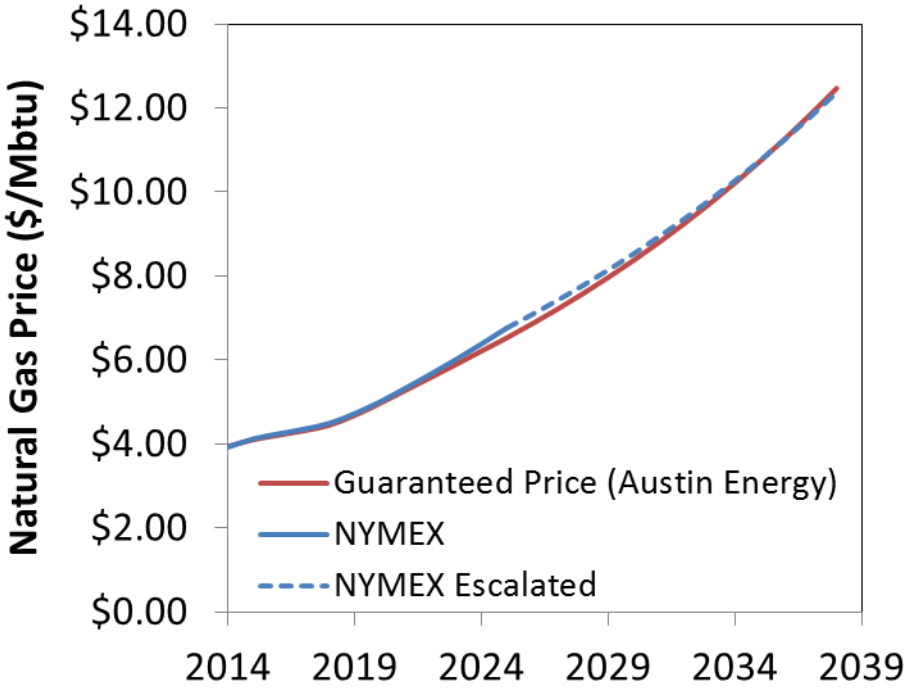
Guaranteed Natural Gas Price Data

Two additional key pieces of information required to perform the analysis were risk-free discount rates and guaranteed future natural gas prices. Risk-free discount rates were obtained from U.S. government treasury bills of varying maturities.

The guaranteed natural gas price was obtained by Austin Energy based on a 25-year firm price quote they received from a counter party with AA credit rating on 9/23/2013 that was willing to lock in prices. This corresponds to the red line in Figure ES-3. For comparison purposes, the blue line corresponds to NYMEX futures prices and the dashed blue line corresponds to NYMEX futures escalated at 4.75% per year after 2025. Results indicate that there is good agreement between the two separate sources of guaranteed natural gas prices. Note that both spot purchase and long-term prices for natural gas have decreased since the last study. Fuel is a major component of the VOS, and as such a change in fuel prices has a corresponding impact on the VOS.

[1] This step loses exact correlation by combining different years but hourly PV production cannot be accurately forecasted years in advance.

Figure ES-3. Guaranteed natural gas prices.



Additional Input Assumptions

Additional input assumptions required to perform the VOS analysis are listed in Table ES-2.

Table ES-2. Additional input assumptions.

Utility-Owned Generation			**Environmental**		
Capacity			Avoided Environmental Cost	$0.020	per kWh
Generation Overnight Capacity Cost	$676	per kW	Environmental Value Escalation Rate	2.60%	per year
Generation Life	30	years			
Reserve Planning Margin	13.75%		**Transmission**		
Energy			Capacity-related capital cost	$28.0	per kW-yr
Heat Rate	8024	BTU per kWh	Years until new capacity is needed	0	years
Heat Rate Degradation	0%	per year			
O&M cost (first Year) - Fixed	$7.04	per kW-yr	**Distribution**		
			Capacity-related Capital Cost	$0	per kW
Economic Factors			**PV Assumptions**		
Discount Rate	Various	per year	PV Degradation	0.50%	per year
General Escalation Rate	2.10%	per year	PV Life	25	years

Task 4: Develop Incentive Ramp-Down Schedule Tool

As PV continues to move out of the early adopter phase, customers will look increasingly at the payback for solar as a decision driver for installing PV. Incentives are only one component of the payback. Having a way to model the adoption of PV given the customer sensitivity to the payback is essential when planning budgets over the long-term to meet goals. The Incentive Ramp-Down Schedule Tool was developed as part of this study to help Austin Energy look at the inputs affecting the choice to install PV including: cost/escalation, goals and growth targets, and project the level of incentives necessary over time for both residential and commercial programs to meet capacity goals.

5 Results

The input assumptions listed above were used to calculate the 2014 levelized VOS. The results are presented in Table ES-3. The results are presented by value component, separating the results into economic value and technical factors for purposes of transparency. The economic value is based on a perfect load match and no losses. This result is then modified using technical factors including "Load Match" (for capacity-related values) to reflect the match between PV production profiles and utility loads and a "Loss Savings" factor to reflect the distributed nature of the resource.

While the technical analysis requires a substantial amount of data analysis, the result can be summarized as a single number. Thus, Distributed PV Value (levelized $/kWh) for each component equals the product of: Economic Value (levelized $/kWh) times Load Match (%) (for capacity related components) times 1 plus Loss Savings (%). The sum of all of the value components results in the2014 VOS rate of $0.107/kWh.

Table ES-3. 2014 levelized VOS.

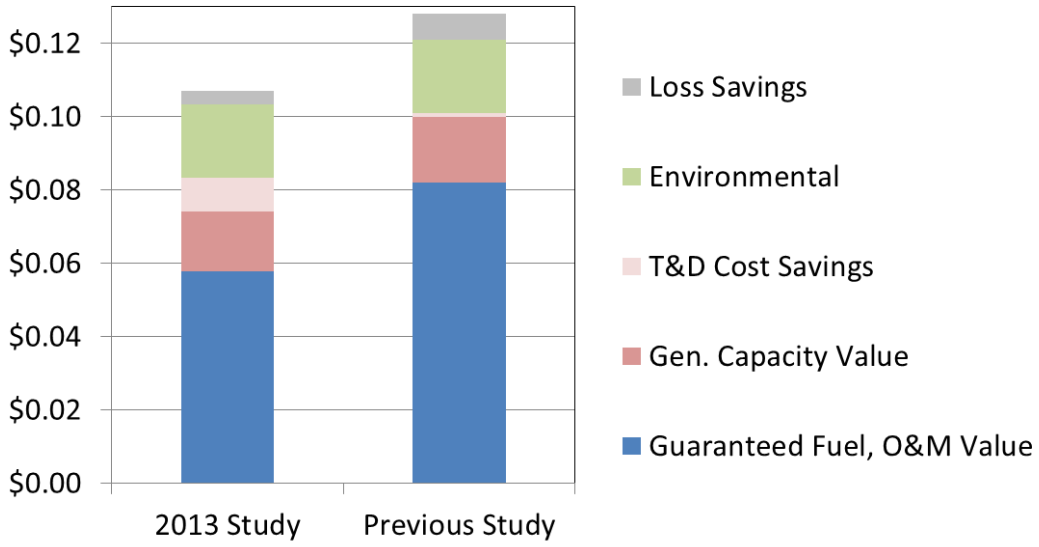
	Economic Value ($/kWh)	Load Match (No Losses) (%)	Distributed Loss Savings (%)	Distributed PV Value ($/kWh)
Guaranteed Fuel Value	$0.053		4%	$0.055
Plant O&M Value	$0.005		4%	$0.005
Gen. Capacity Value	$0.026	62%	6%	$0.017
Avoided Trans. Capacity Cost	$0.015	62%	6%	$0.010
Avoided Dist. Capacity Cost	$0.000	39%	7%	$0.000
Avoided Environmental Cost	$0.020		0%	$0.020
	$0.119			$0.107

6 Discussion

It is useful to put these results into context by comparing them to the results from the previous VOS analysis. The results are compared in Figure ES-4. The 2014 VOS is $0.107/kWh, while the 2013 VOS was $0.128/kWh. The primary reason these results have changed are as follows:

- Natural gas prices have declined since the last VOS analysis.
- The assumed life has been reduced from 30 years to 25 years.
- Loss savings are slightly lower.
- Transmission savings results have increased.
- The methodology has been refined to fully incorporate ERCOT market data.
- The environmental methodology and value were carried over from the previous study.

Figure ES-4. Comparison to previous results (levelized $/kWh).



7 Conclusions

The objective of this project was to calculate the long-term VOS to Austin Energy. This information will be used by Austin Energy as input for the basis of a rate offered to customers.

There were several key results of the study. First, the 2014 VOS for Austin Energy is 10.7 cents per kWh. Second, the study demonstrated that the VOS approach is applicable even when energy-only nodal price data is a critical input into the analysis. Third, several methodological advancements were made. The most notable advancement was clarification of the method to calculate Guaranteed Fuel Value using implied heat rate data from ERCOT market data, guaranteed natural gas prices, and risk-free interest rates.

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