Control Number: 40000

Item Number: 306

Addendum StartPage: 0

Project No. 40000

COMMISSION PROCEEDING TO ENSURE RESOURCE ADEQUACY IN TEXAS	* *	PUBLIC UTILITY COMMISSION OF TEXAS

SUNPOWER CORPORATION COMMENTS FOLLOWING SEPTEMBER 6, 2012 WORKSHOP

SunPower Corporation (SunPower) offers the following comments in regard to the workshop on Resource Adequacy held on September 6, 2012. SunPower Corp. (NASDAQ: SPWR) designs, manufactures and delivers the highest efficiency, highest reliability solar panels and systems available today. Residential, business, government and utility customers rely on the company's experience and guaranteed performance to provide maximum return on investment. SunPower has offices in North America, Europe, Australia, Africa and Asia, and opened its Austin, Texas office in 2011.

Introduction

SunPower Corporation supports the PUCT's efforts to address reliability and resource adequacy concerns in Texas in Project 40000. Energy is the cornerstone of a strong and growing Texas economy. In reviewing the energy and capacity market policy options proposed in the Brattle Report to ERCOT[1], we conclude that there are aspects of both market designs and resulting range of policy recommendations that can help facilitate investment in new generation. While the market design choices before us are important, it is equally important to properly design implementation rules affecting market participation by a full range of generators. The purpose of this filing is to describe the key operating characteristics of photovoltaic (PV) generation, how market rules should accommodate those characteristics and illustrate how doing so would benefit the Texas electric system.

The benefits of PV electric generation have been demonstrated in energy markets world-wide. PV is summer peaking, consumes no water to generate power, it is fast to market, scalable, can serve wholesale and retail needs, and offers stable, predictable costs to end use customers. SunPower has successfully deployed 2.5 GW of PV power plants and onsite systems to serve wholesale and retail markets in the United States, Europe, and Asia.

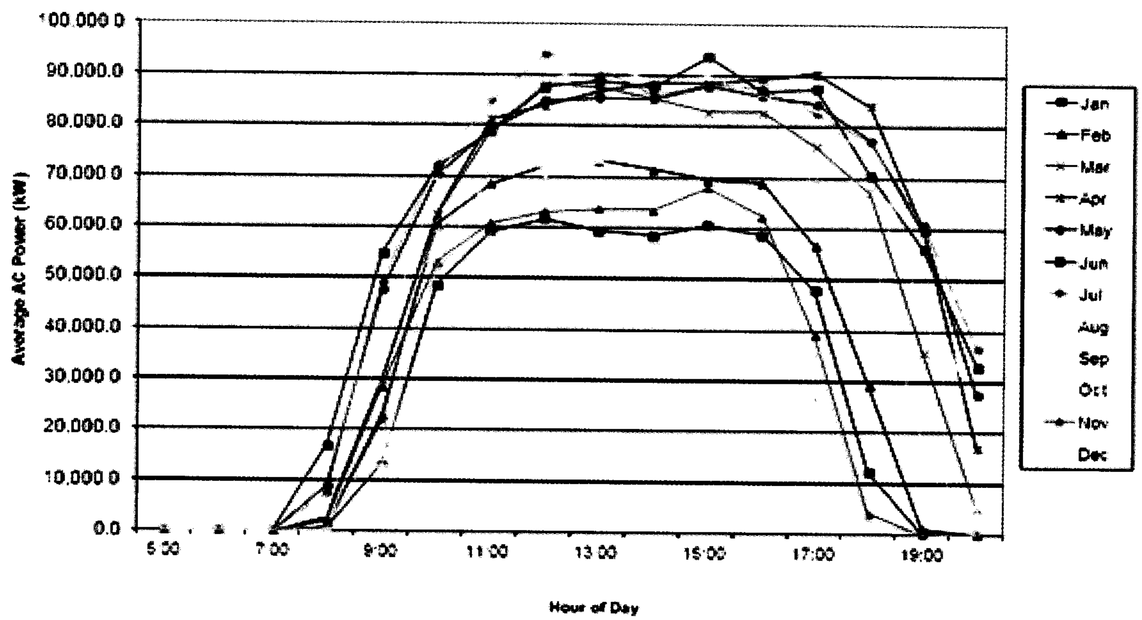
Texas is fortunate to have tremendous solar resources and PV can play an important role in meeting the State's energy and capacity needs. The key to incorporating solar resources is to ensure the Texas energy market design is flexible enough to capture the benefits of PV and does not inadvertently exclude development or discourage future investments in high value, on-peak PV generation. It is particularly important that the assessment of capacity value for PV be done in aggregate across the full class of system configurations. SunPower believes market design aspects that influence future PV investment throughout the state can and should be handled within Project 40000 or other similar broad based projects. SunPower encourages the Commission to continue to seek technical input and expertise from leading solar industry companies as we move forward with potential solutions to meet the future generation needs of Texas.

306

Capacity Value of PV

PV generation as a resource class is broadly recognized as providing significant peak capacity benefits because it is generally coincident with peak load. Single axis tracking PV systems, in particular, produce approximately 25% more energy than fixed-tilt PV systems, with the higher output coming primarily during the early morning and late afternoon "shoulder" periods. Late afternoon and evening production matches the period of the Texas summer peak. The benefit of longer peaking periods is sometimes underappreciated as PV generation profiles used for planning purposes often assume fixed tilt systems. Figure 1 below shows the generation profile of a single axis tracker in West Texas, showing high production levels in the late afternoon.

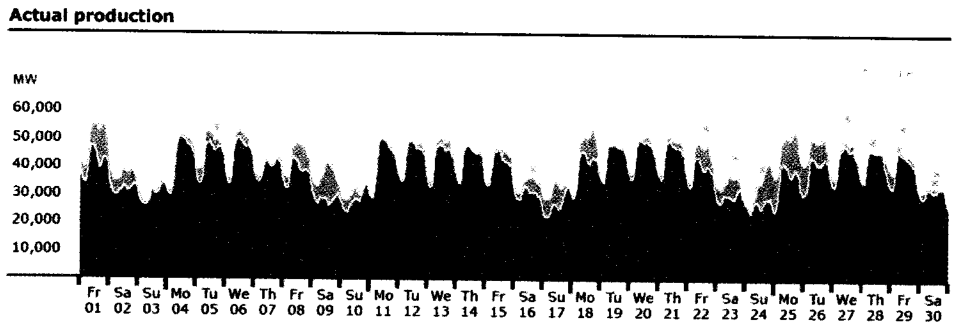
Figure 1-Annual Single Axis PV production in Midland, TX



Another planning consideration is the variability of PV generation output. The output of a small individual PV system can vary significantly and quickly in response to local cloud conditions, in particular low fast moving cumulus clouds. It has sometimes been argued that this characteristic precludes PV systems from providing reliable capacity, introducing an unacceptable level of risk to the overall system. This argument is incorrect, however, because such cloud effects are highly localized and the geographical diversity of PV generating units – whether central station PV plants or dispersed, smaller PV plants – damps out these fluctuations significantly. The aggregate sum of all PV systems, including DG and central station, is capable of providing highly reliable capacity contribution to the grid even if output fluctuates at a few individual locations.

Fig 2 demonstrates the peak capacity contribution of approximately 20,000 MW of predominantly fixed tilt generation in Germany in June of 2012. The German example is particularly interesting given the relatively large amount of PV generation currently operating and contributing to peak capacity in the region.

Figure 2- Electricity Production From Solar And Wind In Germany 2012



	max. power	date max. power	monthly energy
Solar	19.7 GW	30.06., 13:00 (+2:00)	3.7 TWh
Wind	15.3 GW	25.06., 18:45 (+2:00)	2.9 TWh
	[illegible]	[illegible]	[illegible]

Graph: Bruno Burger, Fraunhofer ISE; Data: EEX, http://www.transparency.eex.com/de/

The key to capturing this peak value is to consider PV resources in aggregate, rather than on a site by site basis. Therefore, we recommend that the capacity value of PV resources in Texas be determined as an aggregate class. PV capacity value should be calculated using the Effective Load Carrying Capability (ELCC) or equivalent methodology, which calculates the hourly contribution of PV generation to load during reserve margin constrained hours.[1] As explained in a 2006 NREL report, referenced below,

> "The ELCC of a power generator represents its ability to effectively increase the generating capacity available to a utility or a regional power grid without increasing the utility's loss of load risk (Garver, 1966). For instance, a utility with a current peaking capability of 2.5 GW could increase its capability 2.55 GW with the same reliability by adding 100 MW PV, provided the ELCC of the 100 MW PV is 50 MW, or in relative terms, 50%.

This report calculates that ELCC in Texas at modest levels of penetration (2% of annual energy, equating to about 3300 MW) is in the range of 49-64% depending on PV system configuration (fixed and tilt angle vs. tracking)[2]. This percentage is the amount of nameplate PV capacity which should be considered as firm generation. This approach to PV capacity valuation has precedent in both CAISO and PJM, where new PV capacity is valued at 58% during summer and 38% of nameplate for reserve margin planning, respectively.

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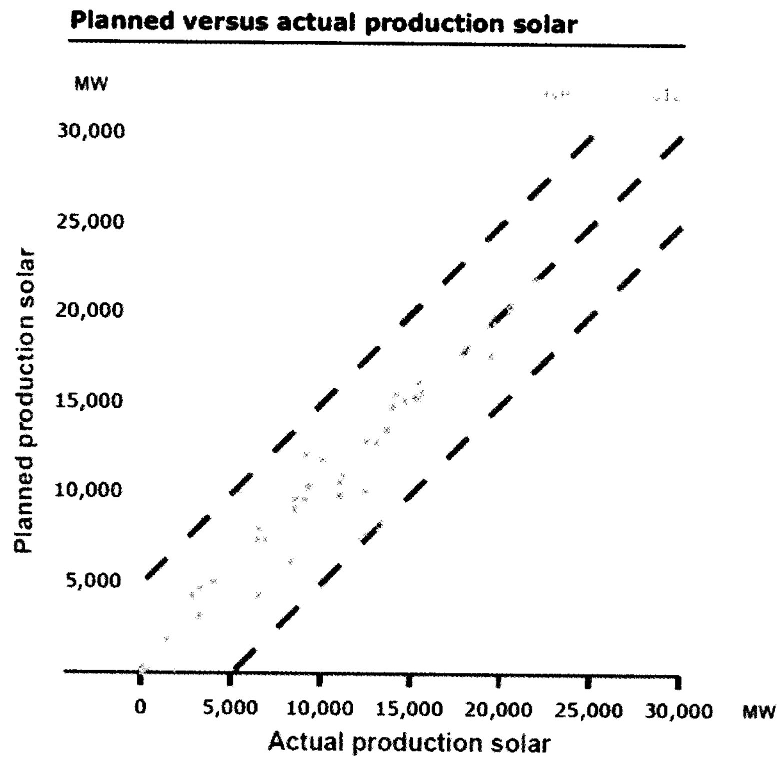
[1] North American Electric Reliability Corporation (NERC), Methods to Model and Calculate Capacity Contributions of Variable Generation for Resource Adequacy Planning, March 2011

[2] Perez *et al*, "Update: Effective Load-Carrying Capability of Photovoltaics in the United States", National Renewable Energy Laboratory (NREL) 2006

Because of the significant differences in generation output among PV system configurations, SunPower recommends that tracking and fixed PV resources be considered separately for the purpose of determining capacity value. See Exhibit A, showing state by state ELCC capacity factors categorized by configuration.

Forecasting tools can greatly facilitate the reliable integration of PV generation into system operations. Figure 3 illustrates day ahead forecast vs. actual PV generation in Germany. It is important to note that forecast accuracy is very good when PV generation output is high, which corresponds to periods of peak demand hours. Hence, PV capacity is particularly dependable during times when reserves are tight.

Figure 3- Electricity Production From Solar And Wind In Germany 2012, Fraunhofer ISE



Dispatch

As outlined above, participation of PV capacity in the wholesale market will, in aggregate, reliably meet peak loads and help achieve reserve margin targets with minimal risk. This occurs due to the natural characteristics of the generation source – PV generates electric power when the sun is high and hot temperatures drive air conditioning loads - and is independent of the capability to dispatch up or down.

PV systems are technically dispatchable within the limits of the solar resource. That is, PV systems can be dispatched down so that generation will not exceed a defined limit and, if not generating at 100% of potential output, can also be dispatched up. However, like many conventional generators with low marginal costs, PV systems are not economically dispatched in general. The systems will typically be run at full possible output for economic reasons, precluding upward dispatch. Downward dispatch also can result in significant economic penalty. Therefore the use of this capability is generally reserved only to manage reliability events. PV systems would be economically dispatched downwards in ERCOT if exposed to very low or negative wholesale prices, but that is extremely unlikely to occur during the hours in which PV generates.

SunPower Recommendations

It is in Texas' interest to foster a flexible and diverse energy market that includes increasing percentages of low operating cost renewable resources in combination with fast responding natural gas plants. To obtain these benefits there must be appropriate market signals. Therefore, SunPower encourages the PUC to meet electric reliability needs as follows:

i. Continue to rely heavily on an energy market structure with price caps high enough to encourage cost effective peak reductions by customers (DR) and construction of new generation.
ii. Establish an administrative process to periodically set the level of required resources necessary to meet reliability criteria.
iii. Empower entities to procure energy under long term contracts; encourage procurement in a manner that addresses ERCOT's need to quickly add peaking resources which use minimal water and can be flexibly deployed in a centralized or distributed manner.
iv. If the PUC wishes to make minimal immediate market changes but is concerned with near term (2014/2015) resource adequacy, a number of short term incentives could be put in place to encourage solar and DR resources in targeted load pockets since they are uniquely able to immediately address resource adequacy needs at point of demand. This action would allow the PUCT to address immediate reliability concerns while elements of long term capacity markets are developed and implemented.

Conclusion

PV can make a valuable contribution to electric generating capacity in Texas. Given the benefits of PV, care should be given to design a market that encourages investment in all proven electric generating technology, particularly resources that meet the State's peak resource needs and save water. The precise market design is not as important as the key generation and market impact assumptions and subsequent implementation rules that influence project investment. Generation assumptions include determining PV capacity value as a class and differentiating between fixed and tracking systems when establishing this capacity value. Using the Effective Load Carrying Capability (ELCC) methodology to establish PV capacity value is one way to accomplish this goal.

Respectfully Submitted,

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Exhibit A

Statewide ELCCs

Geometry / Penetration	2 axis tracking 2%	5%	10%	15%	20%	Horizontal 2%	5%	10%	15%	20%	South 30° tilt 2%	5%	10%	15%	20%	Southwest 30° tilt 2%	5%	10%	15%	20%
Arkansas	71%	68%	61%	53%	45%	55%	52%	47%	42%	37%	57%	54%	47%	41%	36%	65%	61%	55%	48%	41%
Alabama	69%	66%	59%	51%	44%	54%	51%	46%	40%	36%	56%	52%	46%	40%	35%	63%	59%	53%	46%	40%
Arizona	71%	68%	61%	53%	45%	55%	52%	47%	42%	37%	57%	54%	47%	41%	36%	65%	61%	55%	48%	41%
California	75%	72%	65%	57%	48%	59%	56%	51%	45%	40%	61%	57%	51%	44%	38%	69%	66%	59%	52%	45%
Colorado	66%	63%	56%	48%	41%	51%	48%	43%	38%	33%	53%	50%	44%	38%	33%	59%	56%	50%	43%	37%
Connecticut	62%	58%	51%	44%	37%	47%	44%	39%	34%	30%	49%	46%	40%	34%	30%	54%	50%	44%	38%	33%
Delaware	62%	58%	51%	44%	38%	47%	44%	40%	35%	30%	50%	46%	40%	35%	30%	55%	51%	45%	39%	34%
Florida	57%	53%	46%	40%	34%	43%	40%	35%	31%	27%	46%	42%	36%	31%	27%	49%	46%	40%	35%	30%
Georgia	69%	65%	58%	50%	43%	53%	50%	45%	40%	35%	55%	52%	46%	39%	34%	62%	59%	52%	45%	39%
Hawaii	51%	47%	40%	34%	28%	42%	39%	34%	30%	26%	41%	38%	32%	27%	23%	43%	40%	34%	29%	25%
Idaho	67%	62%	55%	47%	40%	50%	47%	42%	37%	32%	53%	49%	43%	37%	32%	58%	54%	47%	41%	35%
Illinois	70%	66%	59%	51%	44%	54%	51%	46%	41%	36%	56%	53%	46%	40%	35%	63%	59%	53%	46%	40%
Indiana	64%	60%	53%	46%	39%	49%	46%	41%	36%	32%	51%	48%	42%	36%	31%	57%	53%	47%	41%	35%
Iowa	73%	69%	62%	54%	46%	57%	54%	48%	43%	38%	59%	55%	49%	42%	37%	66%	63%	56%	49%	42%
Kansas	75%	72%	65%	57%	48%	59%	56%	50%	45%	40%	61%	57%	51%	44%	38%	69%	66%	59%	51%	44%
Kentucky	53%	49%	42%	36%	30%	39%	37%	32%	28%	24%	42%	39%	33%	28%	24%	45%	42%	36%	31%	26%
Louisianna	71%	68%	61%	53%	45%	55%	53%	47%	42%	37%	58%	54%	48%	41%	36%	65%	61%	55%	48%	41%
Massachussetts	56%	52%	45%	39%	33%	42%	39%	34%	30%	26%	45%	41%	35%	30%	26%	48%	45%	39%	33%	29%
Maryland	60%	56%	49%	42%	36%	46%	43%	38%	33%	29%	48%	45%	39%	33%	29%	52%	49%	43%	37%	32%
Maine	28%	23%	16%	12%	10%	17%	15%	11%	8%	7%	21%	17%	13%	10%	8%	17%	14%	10%	7%	6%
Michigan	65%	61%	54%	47%	40%	49%	47%	42%	37%	32%	52%	48%	42%	37%	32%	57%	54%	48%	41%	36%
Minnesota	46%	42%	35%	29%	24%	33%	30%	26%	22%	19%	36%	32%	27%	23%	20%	37%	34%	28%	24%	20%
Missouri	72%	69%	62%	54%	46%	58%	54%	48%	43%	38%	59%	55%	49%	42%	37%	66%	63%	58%	49%	42%
Mississipi	71%	68%	61%	53%	45%	55%	52%	47%	42%	37%	57%	54%	47%	41%	36%	64%	61%	54%	48%	41%
Montana	73%	71%	65%	57%	49%	58%	56%	51%	45%	40%	60%	57%	51%	44%	39%	69%	66%	60%	53%	46%
North carolina	56%	52%	45%	39%	33%	42%	39%	34%	30%	26%	45%	41%	35%	30%	26%	48%	45%	39%	33%	29%
North Dakota	49%	45%	38%	32%	27%	36%	33%	29%	25%	22%	39%	35%	30%	26%	22%	41%	37%	32%	27%	23%
Nebraska	74%	71%	64%	56%	48%	58%	55%	50%	44%	39%	60%	57%	50%	44%	38%	68%	65%	58%	51%	44%
New Hampshire	43%	38%	31%	26%	22%	30%	27%	23%	20%	17%	33%	30%	25%	21%	18%	33%	30%	25%	21%	17%
New Jersey	64%	60%	53%	46%	39%	49%	46%	41%	36%	31%	51%	48%	41%	36%	31%	56%	53%	47%	40%	35%
New Mexico	62%	58%	51%	44%	37%	47%	44%	39%	35%	30%	50%	46%	40%	35%	30%	55%	51%	45%	39%	33%
Nevada	59%	55%	48%	41%	35%	45%	42%	37%	32%	28%	47%	44%	38%	33%	28%	51%	48%	42%	36%	31%
New York	53%	48%	40%	34%	28%	36%	35%	30%	26%	22%	41%	37%	32%	27%	23%	43%	39%	33%	28%	24%
Ohio	63%	59%	52%	45%	38%	48%	45%	40%	35%	31%	50%	47%	41%	35%	30%	55%	52%	46%	40%	34%
Oklahoma	68%	64%	57%	49%	42%	52%	49%	44%	39%	34%	54%	51%	45%	39%	34%	61%	57%	51%	44%	38%
oregon	42%	38%	31%	25%	21%	30%	27%	23%	19%	16%	33%	29%	24%	20%	17%	33%	29%	24%	20%	17%
Pennsylvania	53%	48%	41%	34%	29%	38%	35%	31%	27%	23%	41%	38%	32%	27%	23%	43%	40%	34%	29%	25%
Rhodes Island	64%	61%	54%	46%	39%	49%	46%	41%	36%	32%	52%	48%	42%	36%	31%	57%	54%	48%	41%	35%
South Carolian	57%	53%	47%	40%	34%	43%	40%	35%	31%	27%	46%	42%	36%	31%	27%	49%	46%	40%	35%	30%
Southe dakota	59%	55%	48%	41%	35%	44%	41%	37%	32%	28%	47%	43%	38%	32%	28%	51%	48%	42%	36%	31%
Tennesseee	51%	47%	40%	34%	28%	37%	35%	30%	26%	23%	40%	37%	31%	27%	23%	42%	39%	34%	29%	24%
Texas	64%	60%	53%	46%	39%	49%	46%	41%	36%	32%	51%	48%	42%	36%	31%	56%	53%	47%	41%	35%
Utah	42%	37%	30%	25%	21%	29%	27%	22%	19%	16%	32%	29%	24%	20%	17%	32%	29%	24%	20%	17%
Virginia	57%	53%	46%	39%	33%	43%	40%	35%	31%	27%	45%	42%	36%	31%	27%	49%	46%	40%	34%	29%
Vermont	46%	42%	35%	29%	24%	33%	30%	26%	22%	19%	36%	33%	27%	23%	20%	37%	33%	28%	23%	20%
Washington	17%	12%	7%	5%	4%	8%	6%	5%	4%	3%	11%	8%	6%	4%	4%	7%	6%	4%	4%	3%
Wisconsin	59%	55%	48%	41%	35%	44%	41%	37%	32%	28%	47%	43%	37%	32%	28%	51%	47%	42%	36%	31%
West Virginia	51%	47%	40%	33%	28%	37%	34%	30%	26%	23%	40%	36%	31%	26%	23%	42%	39%	33%	28%	24%
Wyomming	44%	39%	32%	27%	22%	31%	28%	24%	20%	18%	34%	30%	25%	21%	18%	34%	31%	26%	21%	18%

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