Austin Energy

Review of Strategic Plan for Local Solar in Austin

Prepared by DNV KEMA Energy & Sustainability

October 17, 2013

FINAL REPORT

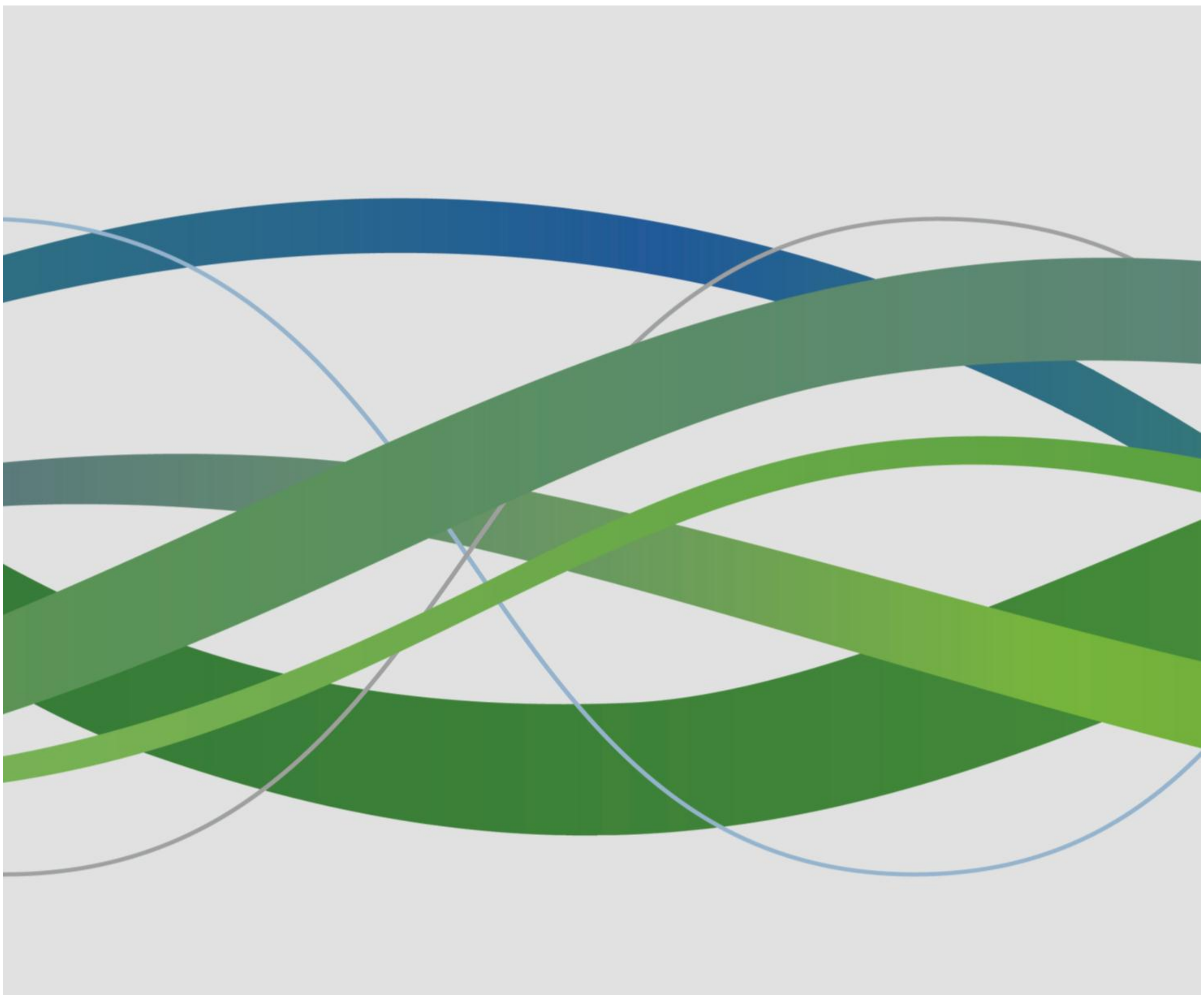

Table 1: Revision History

Date	Reason for Change(s)	Author
9/3/13	V1 – Draft outline for discussion	DNV KEMA
9/5/13	V3 – Initial draft for DNV KEMA review	DNV KEMA
9/6/13	V4 - Updated draft for Austin Energy preliminary review	DNV KEMA
9/11/13	V5-7 - Review in-progress edits	DNV KEMA
9/13/13	V8 – Interim Deliverable to Austin Energy	DNV KEMA
9/16/13	V10 – Interim Deliverable with requested AE edits	DNV KEMA
9/25/13	FINAL – AE requested edits	DNV KEMA
10/2/13	FINAL v2 – AE requested edits	DNV KMEA
10/8/13	FINAL v3 – AE requested edits to Executive Summary	DNV KMEA
10/14/13	FINAL v4 – Formatting Changes	DNV KEMA
10/15/13	FINAL v6 – Formatting Changes	DNV KEMA
10/16/13	FINAL REPORT	DNV KEMA

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1. Executive Summary

DNV KEMA has reviewed the Local Solar Advisory Committee's (LSAC) report "A Strategic Plan for Local Solar in Austin". The LSAC report advocates adoption of "Scenario 2" which calls for increasing the City of Austin's 2020 solar goal to 400MW (consisting of 100MW customer-sited, 100MW local utility scale, 200MW non-local other utility scale solar).

The DNV KEMA review concludes that the LSAC's recommended goal of 100 MW of customer rooftop solar is technically feasible and confirms many of the forecasted benefits and solar equipment cost declines. However, this assessment critiques the LSAC utility cost assumption of forecasted cost savings of local utility scale and other utility scale solar as compared to the LCOE of new gas fired generation. DNV KEMA suggests that the comparison should be between the cost of the proposed solar resources and least cost alternative of meeting forecasted demand. For local utility scale solar, the impact of this assumption change in year 2020 would be $4.79 million of additional cost, versus the LSAC's forecasted $0.5 million in savings, a $4.85 million difference. For other utility scale solar, the impact of this assumption change in year 2020 would be $7.48 million of additional cost from other utility scale solar versus the LSAC's forecasted $11.27 million in savings, an $18.75 million difference. For all solar categories, the additional costs could be as high as $93 million over the 2013-2020 period and $236 million for the 2013-2030 period. In year 2020, this would equate to over 1% of Austin Energy's forecasted revenue, as illustrated below:

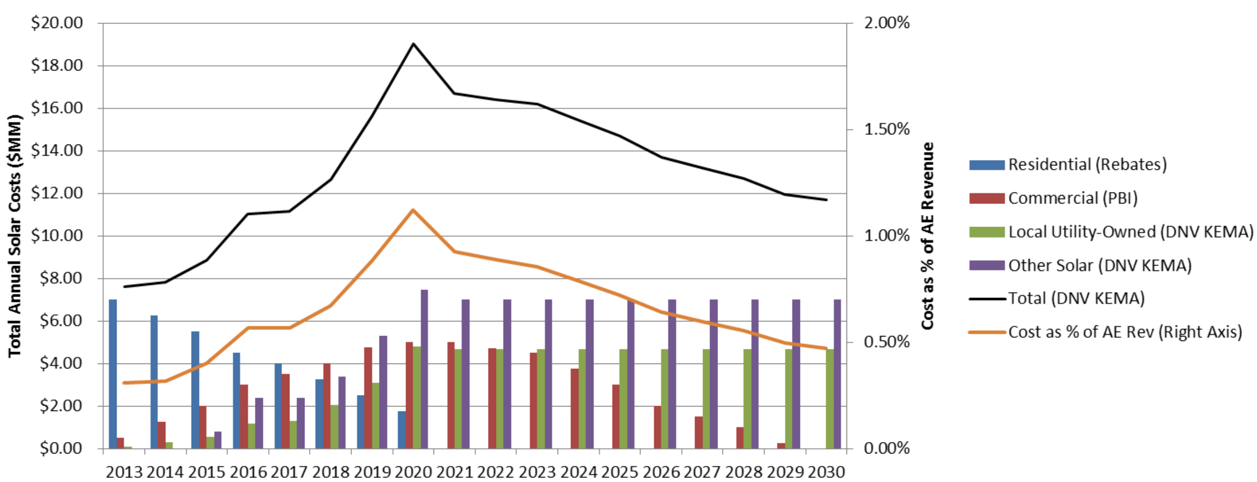

Figure 2: Annual Solar Costs Forecast 2013-2030

Although outside the scope of this report, the City of Austin and Austin Energy may wish to assess the affordability of the recommended solar scenario vis-à-vis the 2% cost increase limit and other utility spending projects. The graphic below illustrates forecasted solar cost against the 2% affordability target from the both the original LSAC report and DNV KEMA's assessment:

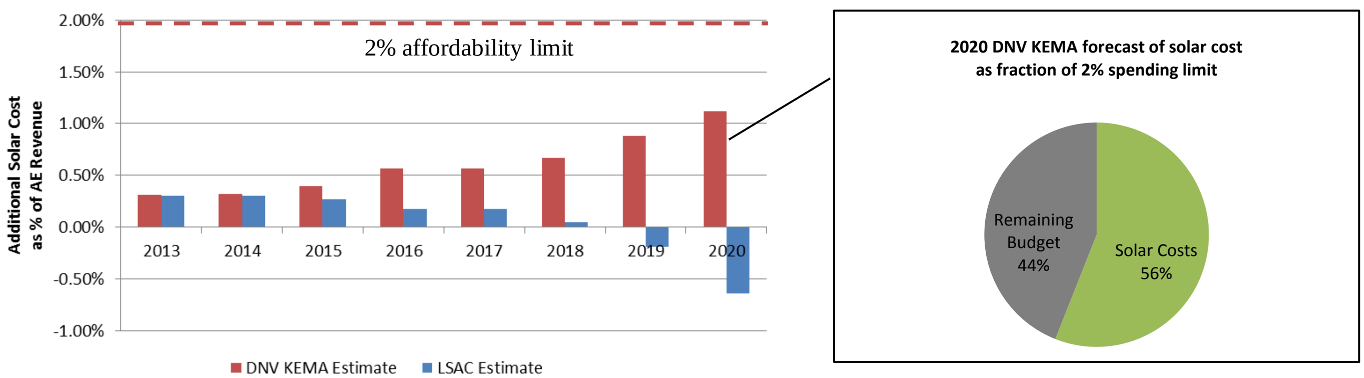

Figure 3: Annual Solar Costs Forecast vs. 2% affordability limit 2013-2020

The table below summarizes this report's review of the LSAC's three scenarios and DNV KEMA's findings:

	Scenarios		
	1 Business as usual (200MW existing)	2 Meet demand growth (400MW)	3 Plant Replacement (600MW)
Penetration Technical Feasibility			
Customer	Feasible	Feasible	Feasible
Utility	Feasible	Uncertain[1]	Uncertain[1]
Other	NA	Feasible	Feasible
Utility Cost Assumptions			
Customer	Confirmed	Confirmed	Confirmed
Utility	Confirmed	Uncertain[2]	Uncertain[2]
Other	NA	Uncertain[2]	Uncertain[2]

Table 4: Scenario Assessment Summary

[1] Interconnection and grid remediation presents an additional implementation risk to achieving the 100 MW utility scale goal. Although not mentioned in the LSAC report, siting, permitting, and interconnecting generation greater than 10 MW involves considerable review and coordination within the City of Austin, Austin Energy, and ERCOT. There is also uncertainty within the City of Austin about the availability of sufficient city-owned sites.

[2] The uncertainty related to the utility cost implications for local utility scale and other utility scale solar are related to the "Net Cost" assumption discussed on page 1 of the executive summary and in section 3.2. DNV KEMA suggests that the LSAC's methodology of comparing solar costs to new natural gas power plant construction should be changed to a comparison of solar cost to the least-cost supply alternative. This approach is described in section 3.2.

DNV KEMA inventoried and reviewed the LSAC report's assumptions and cited sources for consistency with known and published solar-related cost data. Special attention was paid to the Lazard Levelized Cost of Energy Analysis as this source was cited throughout the report and provided the basis for several cost and benefit assumptions. The table below summarizes the most significant endorsements and questions DNV KEMA makes based on this review:

Confirmed	Uncertain
• Local physical solar resource potential • Projected decline of installed solar cost • Benefit of residential rebate phase-out • Benefit from commercial PBI and resulting solar project scale	• Negative net cost of utility scale solar (local and other) • Unaccounted for administration and grid remediation cost • Unaccounted for ITC expiration

Table 5: Confirmations and Questions Summary

DNV KEMA investigated the feasibility of achieving 100 MW of customer-sited distributed solar, as suggested by the LSAC report. Based on a rooftop potential report, sponsored by the US Department of Energy (DOE), Solar America Cities, and Austin Energy in 2009, it is estimated that over 1,000 MW of residential and over 800 MW of commercial and industrial rooftop solar capacity is feasible.[3] Based on review of this source and additional analysis, DNV KEMA believes the 100 MW of customer-side distributed generation proposed by the LSAC report is feasible.

For local utility scale solar, the DOE report cites a technical availability of 9 MW of utility solar and 431 MW of civic solar. This study appears to confirm the technical feasibility of the LSAC's 100 MW suggested goal, but does not address the short or long-term economic feasibility of such an investment. Although DNV KEMA questions the applicability the LSAC report's "net-cost"

[3] Wiese, Steven. "Assessment of Rooftop Area in Austin Energy's Service Territory Suitable for PV Development". 2009

assumptions, the assessment largely agrees with penetration technical feasibility and the economic development benefits that local utility scale solar generates.

The LSAC report also recommends 200 MW of other, non-local utility scale solar. Since this category is not local, DNV KEMA believes it would be technically feasible to secure 200 MW of solar from areas outside Austin. However, DNV KEMA believes the costs incurred and achieved by non-local, utility scale solar as estimated in the LSAC report are overly optimistic.

In addition, DNV KEMA compared a number of metrics to benchmark Austin Energy's solar standing alongside three municipal utilities of similar size: Sacramento Municipal Utility District (SMUD), CPS Energy, and Los Angeles Department of Water and Power (LADWP). DNV KEMA found that Austin Energy charges competitive rates to all customer sectors, and offers a generous rate for distributed solar. Austin Energy currently has 1.27% solar capacity to grid capacity, second only in this peer group to SMUD, which claims 4.32%[4]. However, CPS and LADWP both have plans in the near future for the addition of several hundred MW's of local and non-local utility scale solar. All utilities reviewed here are targeting 33%-35% renewable energy supply by 2020, except CPS, which is targeting 20% renewable supply by 2020. Ultimately, Austin Energy remains competitive in all categories reviewed here. Among these municipalities, a significant and aggressive trend toward increasing solar capacity continues.

[4] Solar capacity to grid capacity percentages are calculated by DNV KEMA based off of reported installed solar capacity (Table 22) and total grid capacity (Table 21).

2. Background and Purpose

The Austin City Council created the Austin Local Solar Advisory Committee (LSAC) and charged the committee with developing a strategic plan to ensure the optimum utilization of Austin's local solar resource base. LSAC, consisting of representatives of a broad cross-section of stakeholders, submitted in November of 2012 a report "A Strategic Plan for Local Solar in Austin" outlining three scenarios for local solar development. The three LSAC scenarios are:

1. Business as usual: No additional solar policy change
2. Meet AE load growth with new solar: 400MW of solar consisting of 100MW customer-sited, 100MW local utility scale, and 200MW non-local other utility scale
3. Gas plant replacement: 600MW of solar consisting of 100MW customer-sited, 200MW local utility scale, and 300MW non-local other utility scale

The LSAC report advocates that the City of Austin adopt Scenario 2 (400MW) as its solar goal. DNV KEMA is assisting Austin Energy to review the LSAC scenarios and to identify and evaluate all high level cost assumptions. This review is intended to inform Austin Energy's technical and financial planning efforts vis-à-vis the LSAC's recommended goals.

The DNV KEMA team leveraged both its industry knowledge and publically available sources to analyze the economics and solar benefits to evaluate the affordability of each of the three scenarios from both a utility perspective and from a community perspective.

For context, it is also worth noting that Austin Energy's solar goals were previously increased from 100MW to 200MW of solar capacity by 2020. This change took place in 2011 as part of Austin Energy's generation portfolio planning.

3. LSAC Findings and Assessment

3.1 Plan's Strategies for Achieving stated Goal

The LSAC report identified three scenarios in their recommendation: business as usual, meet demand growth, and plant replacement.

3.1.1 Residential Solar

LSAC made several fundamental assumptions to evaluate the financial feasibility of the proposed residential plan, which recommends a cumulative 45 MW of residential solar be installed by 2020. This section of the report will evaluate the rigor of these assumptions. The table below shows the summary of residential capacity goals and costs.

Residential									
	Pre-2013	2013	2014	2015	2016*	2017	2018	2019	2020
MWac (annual)		4	4.2	4.4	4.5	5.3	5.9	6.3	7
MWac (cumulative)	6.4	10.4	14.6	19	23.5	28.8	34.7	41	48
Installed costs ($/Wdc)	$3.90	$3.65	$3.41	$3.19	$2.98	$2.79	$2.61	$2.44	$2.28
Rebate Level ($/Wac)	$2.00	$1.75	$1.50	$1.25	$1.00	$0.75	$0.55	$0.40	$0.25
Rebate Budget ($M)	$4.00	$7.00	$6.25	$5.50	$4.50	$4.00	$3.25	$2.50	$1.75
Production factor is assumed to be 1,300 kWh/kWac, with a DC-AC derating factor of 0.95.									
Total Incentives (2013-2020): $34.75M; After 2020: $0									
NPV5% of Incentives (2013-2020): $29.31M After 2020: $0									
* The current federal investment tax credit (ITC) is scheduled to decrease from 30 percent to 10 percent in 2016. Modeling does not assume the effect of this expiration on nominal and after-tax costs									

Table 6: Residential Summary Table Adapted from LSAC Strategic Report

DNV KEMA reviewed the assumptions made by LSAC and summarized the major findings below:

Category	Assumption	DNV KEMA Response	Comments
Installed Cost	$3.90/Wdc with 6-7% Annual Decline	Reasonable	Ryan Wiser et al, in their July 2013 report titled "Tracking The Sun VI," indicate residential PV costs of $3.90/W in Texas in 2012.[5] The declining price trend of 6-7% per year is reasonable and consistent with both an industry growth rate of 25% and a commonly anticipated technology "progress ratio," (price-volume learning curve term) of 0.82.[6] [7]
Production Factor	1,300 kWh/kWac	Conservative	A production factor of just 1,300 kWh/kWac would be viewed as conservative by DNV KEMA. In the Austin climate, a typical but sub-optimal residential system could reasonably be expected to receive 5.2 peak sun hours per day per NREL's 30-year average. At a typical modern performance ratio of 0.75 for a modestly shaded and intermittently dusty residential system, this would amount to a production factor, or specific yield, of 1,423 kWh/kWp. Converting this to an ac-based capacity under warmer real field operational conditions would likely amount to a derating factor of about 0.85, not 0.95, making the expected production factor about 1,674 kWh/kW-ac. (A modern residential inverter might have an efficiency of 95%, but when coupled with the inevitable temperature, wire, and mismatch losses, the dc-to-ac conversion is about 85%.) The projected yield of 1,674 kWh/kW-ac is 29% higher than the LSAC production forecast anticipates, and would represent that much more of an energy contribution at no additional rebate cost. The higher production would increase the cost of a PBI-based incentive program, though such incentives are not common among residential installations.
Policy Impact	Did not address the impact from potential federal ITC changes in 2016	Optimistic	Based on PV cost and installed capacity trends over the past five years, and on the generally declining incentive structures in numerous states, it seems likely that the industry won't need to lobby heavily for a Federal 30% tax credit extension. While not wholly unpopular even among non-industry sectors, the political backlash of continued Federal generosity in the wake of the Solyndra case and similar loan failures may not be practical to expect. A Federal tax credit of 10% would seem to be more in line with past support. If so, there would be a drop-off of several percent in residential PV market capacity unless that discontinuity were matched by an equal boost at the state or local level, neither of which would seem likely for Austin Energy. On that basis, the residential forecast per LSAC would seem unexpectedly optimistic for growth between 2016-17, as the LSAC trend shows an 18% increase that year, with just 2-5% program increases in the three prior years.

Table 7: Evaluation of Residential Assumptions

While the LSAC report's estimated current and future installed PV costs are defensible, the report acknowledged that it did not model the expected decrease in the federal tax credit. The

[5] Wiser, Ryan et al. "Tracking the Sun VI". June, 2013

[6] Margolis, Robert. "Photovoltaic Technology Experience Curves and Markets". March, 2013

[7] Bowden, Stuart et al. Moore's Law of Photovoltaics. May, 2010

figure below shows the effect on installed costs that this change could have if the 30% tax credit were reduced to 10% in 2016. The area between the blue and red lines represents the customer's installed cost after the ITC and Austin Energy's rebate. The cost felt by the residential customer jumps from $1.20/Watt to $1.89/Watt and remains around this cost until 2020.

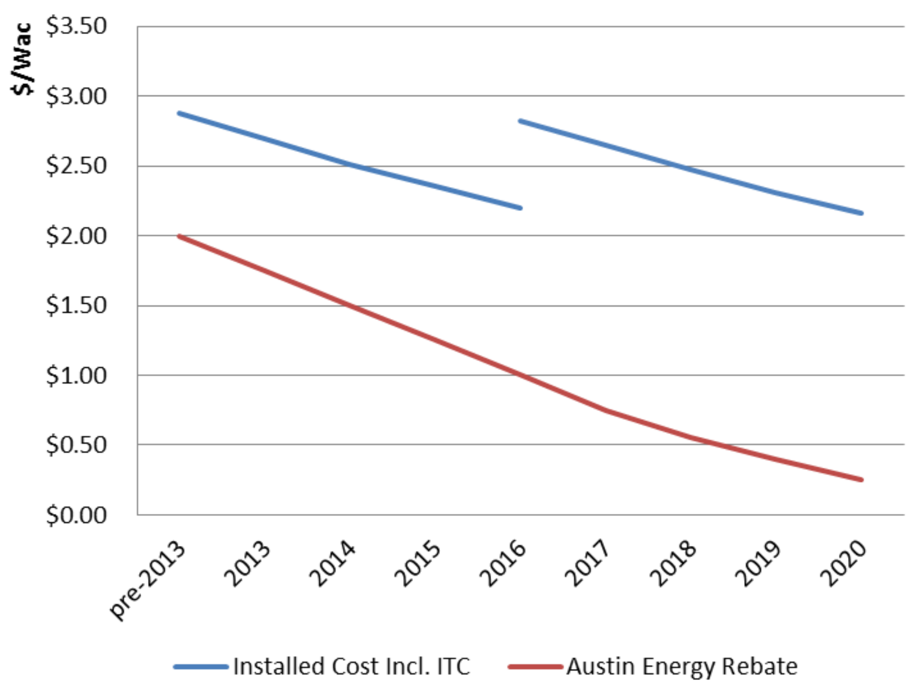

Figure 8: Committee Estimates for Installed Solar Costs Including ITC and Austin Energy Rebate

In further evaluating the feasibility of this level of solar, it is important to consider there are discussions across the country regarding the impact extensive distributed generation will have on rate schedules, although there has yet to be a consensus on the impact or which strategies can most effectively handle the movement toward distributed generation.

Further consideration should also be paid to the impact that additional import duties for PV panels will have on domestic prices. Although, to date, the impact from anti-dumping duties imposed on Chinese imports to the United States in 2012 has had little effect on the continued decline in domestic prices. Nonetheless, the City of Austin may wish to consider allowances for reducing local solar goals in the face of future supply or price disruptions.

3.1.2 Commercial Solar

LSAC's plan calls for a goal of 55 MW of commercial solar by 2020. Many of the assumptions made by the committee for commercial solar are similar to those made for residential. This section will review the rigor of the major assumptions, most of which are embedded in the Table 9, below.

Commercial									
	2012	2013	2014	2015	2016*	2017	2018	2019	2020
MWac (Annual)		1	4	4.5	7	4.4	6.1	14.3	12.8
MWac (cumulative)	1.4	2.4	6.4	10.9	17.9	22.4	28.4	42.7	55.5
Installed costs ($/Wdc)	$3.30	$3.05	$2.80	$2.60	$2.40	$2.20	$2.00	$1.85	$1.60
Installed Cost Annual Decrease		8%	8%	7%	8%	8%	9%	8%	14%
Installed costs Post ITC ($/Wdc)	$2.31	$2.14	$1.96	$1.82	$2.40	$2.20	$2.00	$1.85	$1.60
Annual PBI Budget ($M)	$0.14	$0.14	$0.13	$0.11	$0.10	$0.08	$0.06	$0.04	$0.01
Amt.: net projects ($M)		$0.21	$0.75	$0.75	$1.00	$0.50	$0.50	$0.75	$0.25
Assumes 10 year PBI contracts									
Production factor is assumed to be 1,276 kWh/kWdc, per PVWatts v.1 modeled at 5% tilt, due south orientation in Austin. Conversion from kWh/kWdc to kWh/kWac assumes a DC-AC conversion factor of 0.85.									
Annual PBI commitment costs peak at $5M/yr in 2020 and 2021 and taper to $0/yr in 2030.									
Total Incentives (2013-2020): $24.00M After 2020: $25.71									
Total (through 2030): $49.71									
NPV5% of Incentives (2013-2020): $18.29M NPV5% of Incentives (through 2030): $33.02M									
* The current federal investment tax credit (ITC) is scheduled to decrease from 30 percent to 10 percent in 2016. Modeling does not assume the effect of this expiration on nominal and after-tax costs.									

Table 9: Commercial Summary Table Adapted from LSAC Strategic Report

A summary of DNV KEMA's review of LSAC's assumptions is presented in the table below.

Category	Assumption	DNV KEMA Response	Comments
Installed Cost	$3.30/Wdc and 7%-14% annual decline	Slightly Optimistic	Wiser's 2013 Lawrence Berkeley report, the same source used to verify the exact price cited in the LSAC report for Texas residential PV cost in 2012, also lists a 2012 medium-size commercial PV cost of $4.50/Wp in Texas, so the LSAC cost figures seem considerably more optimistic than that one trusted source would suggest.[8] However, for commercial PV greater than 100 kW, for which no Texas system data were reported due to an insufficient sample size, there were states that reported costs in the $3.30/W range. For example, Colorado commercial systems averaged $3.20/W, so the LSAC quote is not implausibly optimistic.
Production Factor	1,276 kWh/kWac	Conservative	The specific yield for a commercial rooftop system in Austin, even for a popular very low-slope type, would likely be well in excess of 1,276 kWh/kWac. Depending on the value used to convert kWac to kWp, a yield of 1,276 would translate to less than 1,100 kWh/kWp, an implausibly poor result for this climate. DNV KEMA would expect a typical low-slope yield to be more in line with the product of a solar resource of 5 peak hours per day x 365 days/yr x 0.80 performance ratio for modern, maintained and unshaded commercial systems, for a dc yield of 1,460 kWh/kWp. This is the more common nomenclature used in the industry, but if that value were converted to an ac basis using a conversion factor of 0.85, the corresponding ac-based yield would be 1,718 kWh/kW-ac. This is 35% above the LSAC projection and is worthy of further study and clarification. In PVWatts, users are tasked to apply a derate factor that accounts for all losses other than temperature. The default derate factor is 0.77, which was appropriate for older systems but is widely viewed as too conservative for contemporary systems. Modern PV features true-to-nameplate module output, whereas manufacturers formerly routinely overstated actual output by 5%. Modern inverters operate in the 95-97% efficiency range, while the older PVWATTS guideline assumed efficiencies of about 90-92%. These two changes alone mean most modern PV systems should achieve annual performance ratios of 75-80%, when older systems typically hovered around 70%. PVWatts is a fine tool, but its inputs must be user-adjusted to reflect current practices and expectations, and generally, these expectations are now several percent better than when the program was introduced over 15 years ago.
Policy Impact	Did not address the impact from potential federal ITC changes in 2016	Optimistic	See Residential Section

Table 10: Evaluation of Commercial Assumptions

[8] Wiser, Ryan et al. June, 2013

From a financial perspective, the assumed installed costs seem slightly optimistic, though achievable based on a review of current sources.[9] It should be noted that the annual decline in commercial solar cost is between 7% and 14%, which is more rapid than residential. It should also be noted that LSAC acknowledged ignoring the expiration of the federal ITC in commercial as it did in the residential sector.

In calculating the financial impact from the utility's perspective, LSAC estimated annual incentive budgets. While the total estimated incentive budget from 2013-2020 is twenty-four million dollars, the year-by-year annual PBI Budget figures tabulated in the report appear to be $/kWh. DNV KEMA used the LSAC's assumed production factor and proposed addition of commercial solar to recalculate total annual budgets Annual budgets as outlined in the report and recalculated by DNV KEMA are shown below.

Commercial									
	2012	2013	2014	2015	2016*	2017	2018	2019	2020
Annual PBI Budget ($/kWh)	$0.14	$0.14	$0.13	$0.11	$0.10	$0.08	$0.06	$0.04	$0.01
Annual PBI Budget ($M)	$0.25	$0.43	$1.07	$1.70	$2.55	$2.97	$3.40	$4.03	$ 4.25

Table 11: Annual Commercial Incentive Budgets as Reported in the LSAC Strategic Report

While the LSAC reports a total incentive budget of $24.00M from 2013-2020, our calculation reports $20.39M, a small, but not insignificant difference.

Separately, the LSAC report recommends changes to include a capacity charge benefit for commercial solar. DNV KEMA would like to point out that both net-metered commercial solar (those under 20kw) and full PBI commercial solar implicitly receive capacity benefits from solar by reducing capacity demanded during the 4 Coincident Peak (4CP) days that determine capacity/transmission charges. DNV KEMA recommends Austin Energy conduct a more detailed investigation into the commercial rate schedule to fully value this benefit.

[9] Wiser, Ryan et al. June, 2013

3.1.3 Local Utility-Owned or Contracted Solar

In addition to the distributed solar, LSAC's plan calls for a goal of 100 MW of local, utility scale solar by 2020, requiring an additional installment of 70 MW. LSAC's financial analysis of utility scale solar is justifiably different than that of distributed solar. This section will review the rigor of the major assumptions made in their analysis, most of which are embedded below.

Local Utility-Owned or -Contracted									
	2012	2013	2014	2015	2016*	2017	2018	2019	2020
MWac (annual)		1	2	3	8	2	10	15	28
MWac (cumulative)	31	32	34	37	45	47	57	72	100
MW AC (cumulative, excl. WSP)	-	1	3	6	14	16	26	41	69
Solar Contract Cost ($/kWh)	$0.11	$0.11	$0.10	$0.10	$0.10	$0.09	$0.09	$0.09	$0.09
New Gas Cost ($/kWh)	$0.08	$0.08	$0.08	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Net Solar Cost ($/kWh)	$0.03	$0.03	$0.02	$0.02	$0.01	$0.01	$0.00	($0.00)	($0.01)
Production Factor (kWh/kWac)	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750
Net Solar Cost ($M)		$0.04	$0.11	$0.20	$0.35	$0.37	$0.40	$0.32	($0.05)
Net solar cost is the difference between estimated contracts for new solar and new gas generation. Net solar cost excludes the cost of the already-contracted Webberville Solar Project (WSP), though this project is counted toward meeting the goal.									
Levelized cost of solar in 2012 assumes $2.50/watt for ground-mounted single-axis tracking per Lazard's Levelized Cost of Energy Analysis – Version 5.0, 2011, blended with smaller rooftop and ground-mounted installations in the range of $136-$192/MWh. This estimate of solar costs is high relative to current committee estimates, which show large local solar costs at $2.40/watt. Solar costs are assumed to decrease at 3% per year.									
Levelized costs of new gas generation are estimated by Lazard's Levelized Cost of Energy Analysis – Version 5.0, 2011 in the range of $69-$97/MWh; modeling assumes $80/MWh. New gas costs are assumed to increase at 2% per year. These values are conservative compared to findings presented in the Committee's working group reports.									
Net solar cost (2013-2020): $1.73M (continues at -$0.05/yr after 2020, assuming no new acquisition).									
NPV5% of net solar costs (2013-2020): $1.37M.									
Total (through 2030): $1.21M. NPV5% (through 2030): $1.10M.									
Both total values assume no new acquisition after 2020, and all contract lengths through 2030.									
* The current federal investment tax credit (ITC) is scheduled to decrease from 30 percent to 10 percent in 2016. Modeling does not assume the effect of this expiration on nominal and after-tax costs.									

Table 12: Local Utility Scale Summary Table Adapted from the LSAC Strategic Report

A summary of the review of assumptions is shown below.

Category	Assumption	DNV KEMA Response	Comments
Solar Contract Cost	$0.11/kWh to $0.09/kWh	Reasonable	The 20-year PPA cost of 11 cents/kWh seems reasonable against a backdrop of assumptions centered on a standard commercial third-party system at a $2.50/W installed tracking system cost, located near Midland, TX, with a discount rate of 9% and debt cost of 8%. Under this set of assumptions, the PPA allows the investor to realize a modest lifetime benefit/cost ratio of 1.05 and a positive net present value. This economic picture improves if one assumes a continuation of electricity sales under a new PPA after 20 years. The PPA price does not seem overly generous. In the absence of any tax credits, the investment is very poor - a B/C ratio of just 0.71 and a certain no-go, even if the capital cost goes down to $1.70/W. With no tax advantages, a system cost of $1.70 or less is needed for the investment to be economic on a 20-year PPA.
Production Factors	Steady production factor	Slightly Optimistic	DNV KEMA customarily forecasts an annual decline of 0.75% per year in output. This is in good agreement with the 0.8% average degradation rate cited by NREL's Jordan and Kurtz in their white paper surveying 1,920 samples.[10] DNV KEMA would expect this inevitable but slow degradation to have a biased but small effect that would slightly dilute the expectations cited in the LSAC report.
Installed Costs	$2.50/Watt for ground-mounted single-axis tracking	Slightly Conservative	As rapidly as the installed costs for this style of PV system have declined in the past five years, the $2.50/W estimate seems very reasonable, perhaps slightly conservative compared to the latest bids being offered for comparable tracking systems in southwest locations.
Installed Costs	3% annual decrease in solar cost	Conservative	The 3% annual cost decline seems historically conservative. At an industry growth rate of 25% and assuming a technology progress ratio of 0.82 (per Margolis, 2003 and later citations), an annual cost decrease of 7% would seem likely and matches what has been seen over the past decade. If growth slows to just 5% per year, a cost drop of 3% would still be realized according to the progress ratio principle.

Table 13: Evaluation of Local Utility Scale Assumptions

The case made by LSAC for local utility scale solar is conservative or reasonable overall. However, the report compares the costs and benefits of utility solar to New Gas, which would likely inflate the achievable savings. This topic is discussed in section 3.2.

Interconnection and grid remediation presents an additional implementation risk to achieving the 100 MW utility scale goal. Although not mentioned in the LSAC report, siting, permitting, and interconnecting generation greater than 10 MW involves considerable review and coordination within the City of Austin, Austin Energy, and ERCOT. There is also uncertainty within the City of Austin about the availability sufficient city-owned sites.

[10] Jordan and Kurtz. "Photovoltaic Degradation Rates - An Analytical Review". Page 7. 2011

3.1.4 Other Utility Scale Solar

Finally, LSAC's plan calls for a goal of 200 additional MW of other utility scale solar by 2020. This section will review the rigor of the major assumptions made in their analysis, most of which are embedded below.

Other Utility Scale									
	2012	2013	2014	2015	2016*	2017	2018	2019	2020
MWac (annual)	-	-	-	15	35	-	25	50	75
MWac (cumulative)	-	-	-	15	50	50	75	125	200
Solar Contract Cost ($kWh)	$0.08	$0.08	$0.08	$0.07	$0.07	$0.07	$0.07	$0.07	$0.06
New Gas Cost ($/kWh)	$0.08	$0.08	$0.08	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Net Solar Cost ($/kWh)	$0.00	($0.00)	($0.01)	($0.01)	($0.02)	($0.02)	($0.02)	($0.03)	($0.03)
Production Factor (kWh/kWac)	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Net Solar Cost ($M)		$0.00	$0.00	($0.40)	($1.64)	($1.64)	($2.96)	($6.03)	($11.27)
Net solar cost is the difference between estimated contracts for new solar and new gas generation.									
Production factor is assumed to be 2,036 kWh/kWdc, per PVWatts v.1 modeled at latitude tilt, due south orientation, single axis tracker in Midland. Conversion from kWh/kWdc to kWh/kWac assumes a DC-AC conversion factor of 0.90.									
Levelized cost of solar in 2012 assumes $2.50/watt for ground-mounted single-axis tracking per Lazard's Levelized Cost of Energy Analysis – Version 5.0, 2011. This estimate of solar costs is high relative to current committee estimates, which show large solar costs as low as $1.80/watt. Solar costs are assumed to decrease at 3% per year.									
Levelized costs of new gas generation are estimated by Lazard in the range of $69-$97/MWh; modeling assumes $80/MWh. New gas costs are assumed to increase at 2% per year. These values are conservative compared to findings presented in the Committee's working group reports.									
Total Cost (2013-2020): -$23.94M. NPV5% of Costs (through 2020): -$17.11M.									
Total (through 2030): -$136.60M. NPV5% (through 2030): -$75.98M.									
Both total values assume no new acquisition after 2020, and all contract lengths through 2030.									
* The current federal investment tax credit (ITC) is scheduled to decrease from 30 percent to 10 percent in 2016. Modeling does not assume the effect of this expiration on nominal and after-tax costs.									

Table 14: Other Utility Scale Summary Table Adapted From LSAC Strategic Report

The table below details the assumptions made in the LSAC report and DNV KEMA's evaluation of them.

Category	Assumption	DNV KEMA Response	Comments
Solar Contract Cost	$0.08/kWh to $0.06/kWh	Reasonable (see ITC comment)	The reduced PPA of 8 cents/kWh would only look attractive if the investor were able to realize the 30% tax credit (or its equivalent Federal 1603 Grant), and if the cost were $2/W, and the location was a sunnier spot such as El Paso, and if the PPA term were 30 years. Under those terms, a favorable B/C ratio of 1.09 may be realized. At 20 years, this doesn't seem to pencil out favorably - B/C ratio dips slightly below 1.0. At $2.50/W, the B/C ratio dips to 0.91 and is far too low to justify the investment. The financing terms of 20% equity, 80% debt, 8% loan and 9% discount rate as applied above were used for this analysis as well.
Production Factor	2,250 kWh/kWac	Conservative	The production factor of 2,250 is consistent with DNV KEMA estimates for tracking system output in El Paso on a dc basis, that is, 2,250 kWh/kWp is a reasonable estimate. On an ac basis, the stated value is viewed by DNV KEMA as conservative, since a value of over 2,600 would be expected on an ac basis for this optimal southwest tracker example. Throughout, it appears there may be a mismatch of labeling on the production factor units, as 2,250 kWh/kWp is a common high-end yield that has been proven in the field, and, as noted above, yields are most commonly expressed in units of kWh/kWp.
DC-AC Conversio n Factor	DC-AC Conversion factor of 0.90	Reasonable	In general, the more generous assumption of a 0.90 conversion is probably justified for best-case contemporary utility scale systems. Most should be able to achieve the 0.90 dc to ac conversion because they feature very high efficiency inverter/transformer combinations of around 0.96. Depending on what other loss factors are considered in the conversion, this leaves plenty of calculation allowance for small but cumulative effects such as clipping, wire resistance, imperfect maximum-power-point tracking, and mismatch, which collectively would lessen the conversion factor from 0.96 but still enable it to surpass 0.90. The one large unknown in this discussion is temperature. If temperature is intended to be included in this dc to ac conversion, then 0.90 is not likely to be attained. Temperature losses alone would be in the 8% range in most southwest locations. That consideration alone would drop the overall dc to ac conversion factor back into the mid-80 percentile range. The reasonableness of this and other conversion and conventions is entirely dependent on the terms that lumped within the conversion.
Installed Costs	$2.50/W	Slightly Conservative	Although a reasonable cost assumption, as noted above, at $2.50/W, the investment does not look attractive, even in an optimal southwest location such as El Paso. At this cost, a higher PPA would be needed: at least 10 cents/kWh for 20 years.

Table 15: Evaluation of Other Utility Scale Assumptions

Although not addressed in the LSAC report, Austin Energy may also wish to consider the cost impacts from ERCOT settlement of non-local generation. Such an analysis is beyond the scope of this assessment and will depend on the nodal location of the procured other utility scale solar.

Additional analysis of other utility scale solar assumptions is included in the Appendix of this report.

3.1.5 Developing Options for Solar Financing

The LSAC report suggests Austin Energy pursue both traditional and innovative financing mechanisms, including on-bill repayment, leases or lease-to-own, commercial financing, and co-development with industry partners. The report does not go so far as to recommended specific solutions. DNV KEMA agrees that these are appropriate methods to research further. Aside from the traditional capacity-based rebate of $1.5/Watt and the Value of Solar Credit of 12.8 cents/kWh, Austin Energy also has other programs that reduce the upfront and overall costs of solar systems for their customers. Austin Energy is already offering subsidized financing through the Velocity Credit Union[11]. This ARRA-funded program offers loans as low as 1.9% APR for residential customers to purchase and install PV systems. In addition, Austin Energy has been exploring various options for community solar programs that the utility could offer. Two of the main options are:

1. SolarChoice. This is similar to Austin Energy's GreenChoice program where a customer's regular fuel charge is replaced by a renewables fuel charge, in this case SolarChoice fuel charge. The fuel charges are based on the actual costs of fuels or power purchase price to Austin Energy.

2. SolarShare. This is program allows customers to own 1-kW shares of a solar portfolio by paying for a fixed monthly fee over a fixed number of years, eg. 5 years. By the end of the period, the solar share is considered fully paid for, but the customers will continue to receive benefits of the solar share at the Value of Solar rate for 25 years (the presumed lifetime of PV systems).

In addition, in June 2013, the Governor approved SB 385 Property Assessed Clean Energy (PACE) Financing Program for commercial and industrial sectors. This program allows property owners to obtain long-term and low-cost financing from private lenders for their solar systems and repay the loan annually via an assessment on their property taxes.

[11] https://www.velocitycu.com/loans

3.1.6 Solar Accessibility

The LSAC report notes that where economies of scale can be leveraged, cost effectiveness increases and larger projects are better suited to include community members who couldn't participate otherwise. One of the key suggestions LSAC has offered to increase the accessibility of solar is to further research into community solar. DNV KEMA's prior community solar research for Austin Energy identified the feasibility of a utility-driven capacity-based model.[12] This approach would offer customers a 1-kW share of solar and would pay the system off over five to seven years, although Austin Energy would continue to maintain them throughout their lifetime. The report found this model to be feasible and provided Austin Energy with recommended rate per month.

[12] DNV KEMA. "Community Solar Program". February 2013.

3.2 Plan's Impacts Summary

3.2.1 Utility Costs

The LSAC report forecasts Austin Energy's costs of supporting Scenario 2 in nominal, NPV and percent of revenue terms. The report's cost impact by solar type is summarized in the chart from page 17 of the LSAC report copied below:

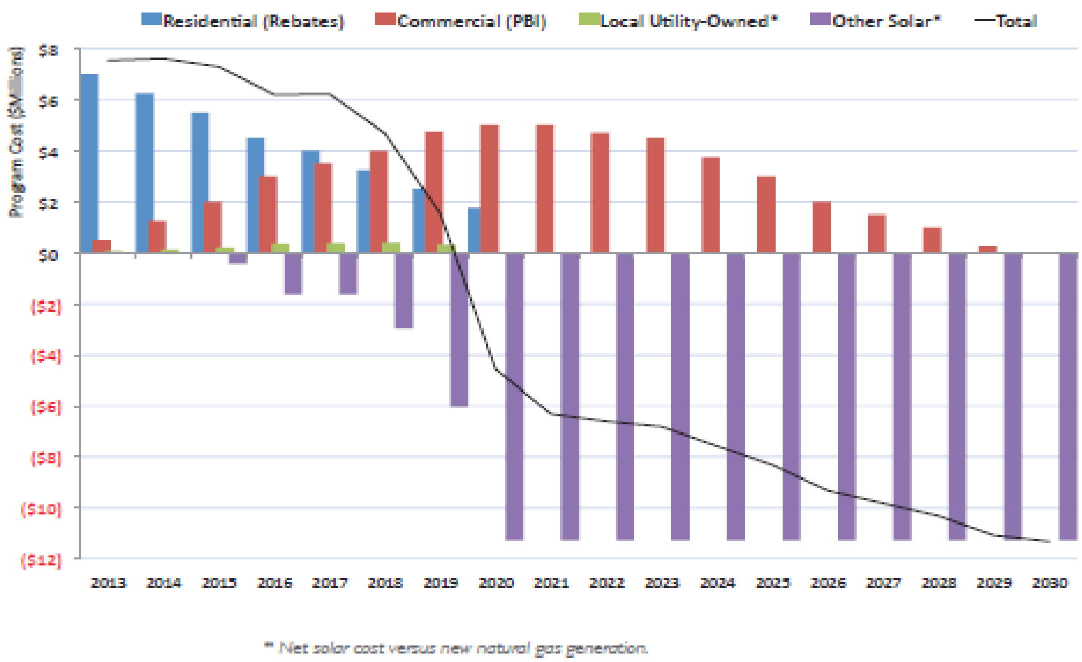

Figure 16: LSAC Summary of Costs and Savings

As the illustration shows, the forecasted total scenario cost of $36 million depends on expected savings from the other utility scale solar resource. The table below is extracted from the LSAC report footnotes.

Annual Costs ($M)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Residential (Rebates)	$7.00	$6.25	$5.50	$4.50	$4.00	$3.25	$2.50	$1.75	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Commercial (PBI)	$0.50	$1.25	$2.00	$3.00	$3.50	$4.00	$4.75	$5.00	$5.00	$4.71	$4.50	$3.75	$3.00	$2.00	$1.50	$1.00	$0.25	$0.00
Local Utility-Owned*	$0.04	$0.11	$0.20	$0.35	$0.37	$0.40	$0.32	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Other Solar*	$0.00	$0.00	($0.40)	($1.64)	($1.64)	($2.96)	($6.03)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)	($11.27)
Total	$7.54	$7.61	$7.30	$6.20	$6.23	$4.68	$1.54	($4.57)	($6.32)	($6.61)	($6.82)	($7.57)	($8.32)	($9.32)	($9.82)	($10.32)	($11.07)	($11.32)

Table 17: Utility Costs Impact Summary Table Adapted From LSAC Strategic Report

As discussed in section 3.1.4 above, the forecasted cost savings of utility scale and other utility scale solar is compared to the LCOE of new gas fired generation, as valued in the Lazard LCOE analysis. It is unclear to DNV KEMA why this comparison is relevant from the utility cost perspective. DNV KEMA suggests that the comparison should be between the cost of the proposed solar resources and least cost alternative of meeting forecasted demand. As shown in the Appendix, forward wholesale prices for peak periods (5x16) in ERCOT's South zone for 2014-2020 range from $44-50/MWh. This is a large difference from LSAC's comparison to $80/MWh increasing 2% per year. The impact of this assumption change in year 2020 would be $7.48 million of additional cost from Other Solar versus the LSAC's forecasted $11.27 million in savings, an $18.75 million difference.

Other Utility Scale	2012	2013	2014	2015	2016*	2017	2018	2019	2020
MWac (annual)	-	-	-	15	35	-	25	50	75
MWac (cumulative)	-	-	-	15	50	50	75	125	200
Solar Contract Cost ($kWh)	$0.08	$0.08	$0.08	$0.07	$0.07	$0.07	$0.07	$0.07	$0.06
New Gas Cost ($/kWh)	$0.08	$0.08	$0.08	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Forward power price $/kWh			$0.045	$0.049	$0.050	$0.048	$0.047	$0.046	$0.046
Net of Gas Solar Cost ($/kWh)	$0.00	($0.00)	($0.01)	($0.01)	($0.02)	($0.02)	($0.02)	($0.03)	($0.03)
Net of forward price cost ($/kWh)			$0.030	$0.024	$0.021	$0.021	$0.020	$0.019	$0.017
Production Factor (kWh/kWac)	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Net Solar Cost ($M)		$0.00	$0.00	($0.40)	($1.64)	($1.64)	($2.96)	($6.03)	($11.27)
Net Solar Cost vs. Forwards ($M)				$0.81	$2.38	$2.37	$3.38	$5.29	$7.48
Cumulative Other Utility Scale Cost ($M)				$0.81	$3.19	$5.56	$8.93	$14.23	$21.71

Table 18: Other Solar Cost Net of Least-Cost Supply Alternative

The LSAC report estimates that without savings from other utility scale solar, the cost of local solar would be $60 million during the 2013-2020 period. The table above suggests that considering a net cost of other utility scale solar versus the least cost supply alternative, the additional costs for other utility scale solar could be as high as $21 million during 2013-2020 period. Total cumulative solar cost for all categories for 2013-2020 could exceed $90 million. These changes to the Other Utility Scale Solar assumptions are illustrated in the figures and tables below:

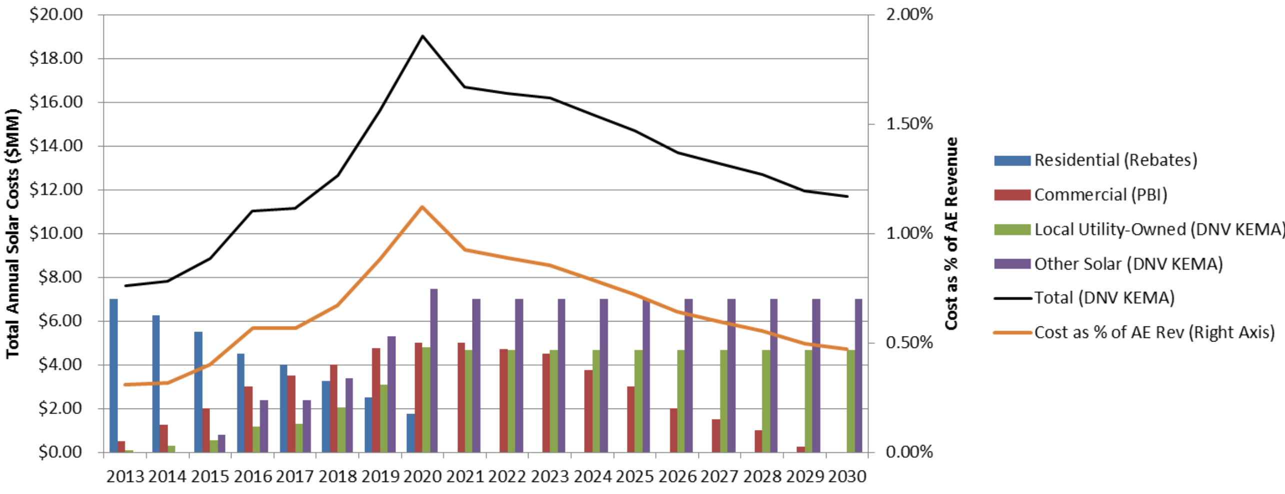

Figure 19: Revised net cost of solar forecast ($Millions)

Year	Est. Total Revenue ($M)	Residential	Commercial	Large Local (Revised)	Large Other (Revised)	Less 2012 Baseline	Total Applied Against Aff. Limit	Solar Cost as % of Est. Total Revenue	Solar Cost as % of Est. Total Revenue (Local Only)
2013	$1,167	$7.00	$0.50	$0.11	$0.00	($4.00)	$3.54	0.31%	0.31%
2014	$1,191	$6.25	$1.25	$0.30	$0.00	($4.00)	$3.61	0.32%	0.32%
2015	$1,215	$5.50	$2.00	$0.54	$0.81	($4.00)	$4.83	0.40%	0.33%
2016	$1,239	$4.50	$3.00	$1.16	$2.38	($4.00)	$7.33	0.57%	0.38%
2017	$1,264	$4.00	$3.50	$1.29	$2.37	($4.00)	$7.28	0.57%	0.38%
2018	$1,289	$3.25	$4.00	$2.05	$3.38	($4.00)	$8.48	0.67%	0.41%
2019	$1,315	$2.50	$4.75	$3.07	$5.29	($4.00)	$11.30	0.88%	0.48%
2020	$1,341	$1.75	$5.00	$4.79	$7.48	($4.00)	$14.13	1.12%	0.56%

Table 20: Cost as a Percentage of Revenue with Revised Large Local and Other Utility Scale Solar Cost

DNV KEMA confirms the LSAC's assumption of 2% annual revenue growth. This growth rate is in line with ERCOT's "Long-Term Energy Forecast rate of 1.9%[13].

3.2.2 Other Impacts and Benefits

The LSAC report also considered community benefits such as economic development, health and environmental benefits. Although no the primary focus of this assessment, DNV KEMA reviewed these stated benefits and found the assumptions and claims reasonable.

[13] Electric Reliability Council of Texas. "2013 ERCOT Planning, Long-Term Hourly Peak Demand and Energy Forecast".

For example the National Renewable Energy Laboratories Jos and Economic Development Impact model (JEDI) is a widely-cited and vetted model for these types of benefits. The local Austin, TX area benefit may be greater than the JEDI assumptions indicated. A recent review of the qualified Austin-area solar contractor database yielded over 700 local firms.

The LSAC report proposes approximately $15 million in health and environmental benefits during the period. Although not material to the utility cost perspective, this claim seems reasonable especially considering water savings in the context of the current drought and resulting economic loss in the LCRA territory. However, actual air emissions saving estimated from the LSAC report's sources may be less than forecasted due to the fact that no coal plants will be replaced in the Austin Energy territory and that the lignite and sub-bituminous plants located south of Austin will not likely reduce production as a result of Austin's increased use of solar.

4. Austin Energy Benchmarking

DNV KEMA benchmarked Austin Energy's solar program offerings, goals, and pricing with those of CPS, Energy, Los Angeles Department of Water and Power (LADWP), and Sacramento Municipal Utility District (SMUD). These utilities were chosen because they were municipalities, relatively similar in customer and revenue size and located in climates amenable to solar. Metrics for choosing these utilities are shown in Table 21. In revenue, customer count, and total grid capacity, SMUD is the closest municipality to Austin Energy considered in this review. Austin Energy's average 2011 retail prices for all sectors were lower than those of SMUD and LADWP. Compared to CPS, Austin Energy's electricity prices were higher across all sectors except for industrial, where Austin Energy averaged 6.36 cents/kWh and CPS averaged 6.57 cents/kWh.

Muni	Location	Average 2011 Retail Price[14]	Customer Count	Annual Revenue	Peak Load (MW)
Austin Energy	Austin, Texas	$0.1188/kWh…Res $0.1031/kWh…Com $0.0636/kWh…Ind $0.0923/kWh…Total	417,865[15]	1,200,000,000[15]	2,714
LADWP	Los Angeles, California	$0.1281/kWh …Res $0.1275/kWh …Com $0.1153/kWh…Ind $0.1266/kWh …Total	1,461,521[16]	3,099,260,000[17]	6,000[17]
CPS	San Antonio, Texas	$0.0926/kWh…Res $0.774/kWh…Com $0.0657/kWh…Ind $0.0838/kWh…Total	728,000[17]	1,900,000,000[18]	4,817[18]
SMUD	Sacramento, California	$0.1235/kWh…Res $0.1360/kWh…Com $0.1131.kWh…Ind $0.1192/kWh…Total	529,695[19]	1,293,000,000[19]	3,400[20]

Table 21: Utility Benchmarking Criteria as of 2013 (except where noted)

[14] EIA Sector Revenues Divided by Sector Delivered Electricity; http://www.eia.gov/electricity/data.cfm
[15] AE 2011 Annual Performance Report
[16] Email correspondence from LADWP newsroom
[17] 2011 California Energy Commission
[18]CPS quarterly financial report. Peak in 2012.
[19] smud.org
[20] smud.org

Next in their review, DNV KEMA compared Austin Energy's solar capacities, solar rates, and solar program offerings to each utility. The details of this review are shown in Table 22. DNV KEMA found that Austin Energy's 31 MW of utility scale and 7.8 MW of distributed solar are comparable to CPS' installations, though lower than SMUD, which has already achieved 158.7 MW of solar, 155 MW of which are distributed. LADWP has also installed comparatively more distributed solar per customer, but their installed utility scale capacity is lower than Austin Energy's at 11.6 MW. In addition, CPS and LADWP are aggressively increasing utility scale solar. LADWP has approved two PPAs for over 400 MW of utility scale solar and CPS has a 400 MW solar project in development. Overall, it appears that Austin Energy's peers are moving forward with portfolios including well over 100 MW of solar.

Regarding solar rates, Austin Energy is currently offering a rate of 12.8 cents/kWh, among the higher rates in this peer group. LADWP is offering feed-in tariff rates from 17 cents/kWh down to 13 cents/kWh in a stepwise decline as installed solar targets are met.[21] CPS recently proposed the SunCredit program, initially offering 5.6 cents/kWh, but estimating a 10.4 cent/kWh 20-year average market price.[22] The rollout of this program was postponed and there has been little detail regarding a replacement.

[21] http://www.ladwpnews.com/go/doc/1475/1681111/

[22] http://www.cpsenergy.com/files/SunCredit_Market_Price.pdf

Muni	Solar Capacity (MW)	Solar Capacity as Percent of Peak Load	Utility Solar Rates	Programs
Austin Energy	13.6 MW Distributed 31 MW Utility Scale 44.6 MW Total	1.6%	$0.128/kWh Value of Solar (Residential) $0.12/kWh PBI (Commercial) $1.50/Watt rebate	Residential rebates Commercial incentives Value of solar rate GreenChoice
LADWP	57 MW Distributed 11.6 MW Utility Scale 68.6 MW Total 210 and 250 MW approved utility scale PPA[23]	1.1%	$0.17 to $0.13/kWh FIT[24] Separate capacity rebate also available which can be combined with net metering customer benefits.	Solar Incentive 150 MW FIT TOD rate
CPS	10 MW Distributed 45 MW Utility scale; 55 MW Total 400 MW Utility scale in development[25]	1.1%	$0.056/kWh SunCredit (Discontinued) Net Metering Interim Solution $1.60/W STEP rebate (Residential)	STEP incentive Net Metering (until alternative is defined)
SMUD	155.3 MW Distributed 2.3 MW Utility Scale 1.1 MW Community Solar 158.7 MW total solar	4.4%	$0.0756/kWh FIT 10 year $0.0837/kWh FIT 15 year $0.0923/kWh FIT 20 year[26]. Separate capacity rebate also available which can be combined with net metering customer benefits.	Solar incentive SolarShares Community Solar FIT Program (Currently closed for new applicants) TOD rate

Table 22: Utility Comparison of Current Solar Capacities, Solar Rates, and Incentive Programs as of 2013

Lastly, the DNV KEMA team reviewed legislative and utility-set renewable and solar goals. These comparisons are shown in Table 23. Austin Energy has the most aggressive renewable goal within this group, targeting a power supply made up of 35% renewable generation by 2020 and a minimum of 200 MW solar. LADWP and SMUD have both targeted 33% renewable generation by 2020 which is in line, though not required for municipalities, with the California Renewable Portfolio Standard.

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23 http://runonsun.com/~runons5/blogs/media/blogs/a/FiT%20Program%20Proposal%20October%202012.pdf

24 https://www.ladwp.com/

25 http://www.tppa.com/events/mtgArchives/docs/am13/kosub.pdf

26 (https://www.smud.org/en/business/customer-service/rates-requirements-interconnection/documents/FIT-Pricing.pdf) The FIT price is between $0.0628 to $0.1860 for SMUD depending on the Time of Day. By comparison, Austin Energy's $0.128/kwh rate is not significantly higher even considering the capacity rebate as well.

Muni	State Renewable Goal (From DSIRE)	Muni Renewable Goal	Current Muni Renewable Percentage
Austin Energy	5,880 MW by 2015 10,000 MW by 2025 Non-wind goal of 500 MW (Muni's and Coops may opt-in)	35% renewable by January 1, 2020 (200 MW Solar)	20% Renewable (35% by 2016, per AE EMO)
LADWP	20% by 2013 25% by 2016 33% by 2020 (Muni's must adopt their own) CA Solar Initiative offers $0.2-$0.3/Watt rebate	33% Renewable by 2020 25% by 2016[27] (280MW distributed solar goal per CA SB1 by 2017; No State solar RPS carve out)	19% Renewable
CPS	5,880 MW by 2015 10,000 MW by 2025 Non-wind goal of 500 MW (Muni's and Coops may opt-in)	20% Renewables by 2020[28] (400MW of new solar planned)	11-13% Renewable[25]
SMUD	20% by 2013 25% by 2016 33% by 2020 (Muni's must adopt their own) CA Solar Initiative offers $0.2-$0.3/Watt rebate	33% plus 4% from "Grenergy" [*sic*] by 2020[29] (125MW distributed solar goal per CA SB1 by 2017; No State solar RPS carve out)	27.7% Renewable[30]

Table 23: Utility Comparison of Established Renewable and Solar Goals as of 2013

Compared to peers considered in this review, Austin Energy charges competitive rates to all customer sectors, and offers a generous rate for distributed solar. While Austin Energy currently has a similar capacity of solar to these peers, it has significantly less distributed solar than SMUD; CPS and LADWP both have plans in the near future for the addition of several hundred MW's of local and non-local utility scale solar. All utilities reviewed here are targeting 33%-35% renewable energy supply by 2020, except CPS, which is targeting 20% renewable supply by 2020. Ultimately, Austin Energy remains competitive in all categories reviewed here, although among these municipalities, a significant and aggressive trend toward increasing solar capacity continues.

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[27] http://www.energy.ca.gov/2013_energypolicy/documents/2013-07-15_workshop/presentations/07_LADWP_Howard_AB1318_7-15-13.pdf

[28] http://www.cpsenergy.com/About_CPS_Energy/Who_We_Are/Environmental_Stewardship/Sustainability_Environmental_2012_Update.asp; website states 13% purchased power renewables and claims 913.4 MW of operational renewables. Dividing 913.4 MW by our reported total capacity of 8009 MW comes out to 11.4%. Without diving into further detail, the range 11%-13% is provided here.

[29] http://smud.org

[30] https://www.smud.org/en/about-smud/company-information/documents/2012-annual-report.pdf

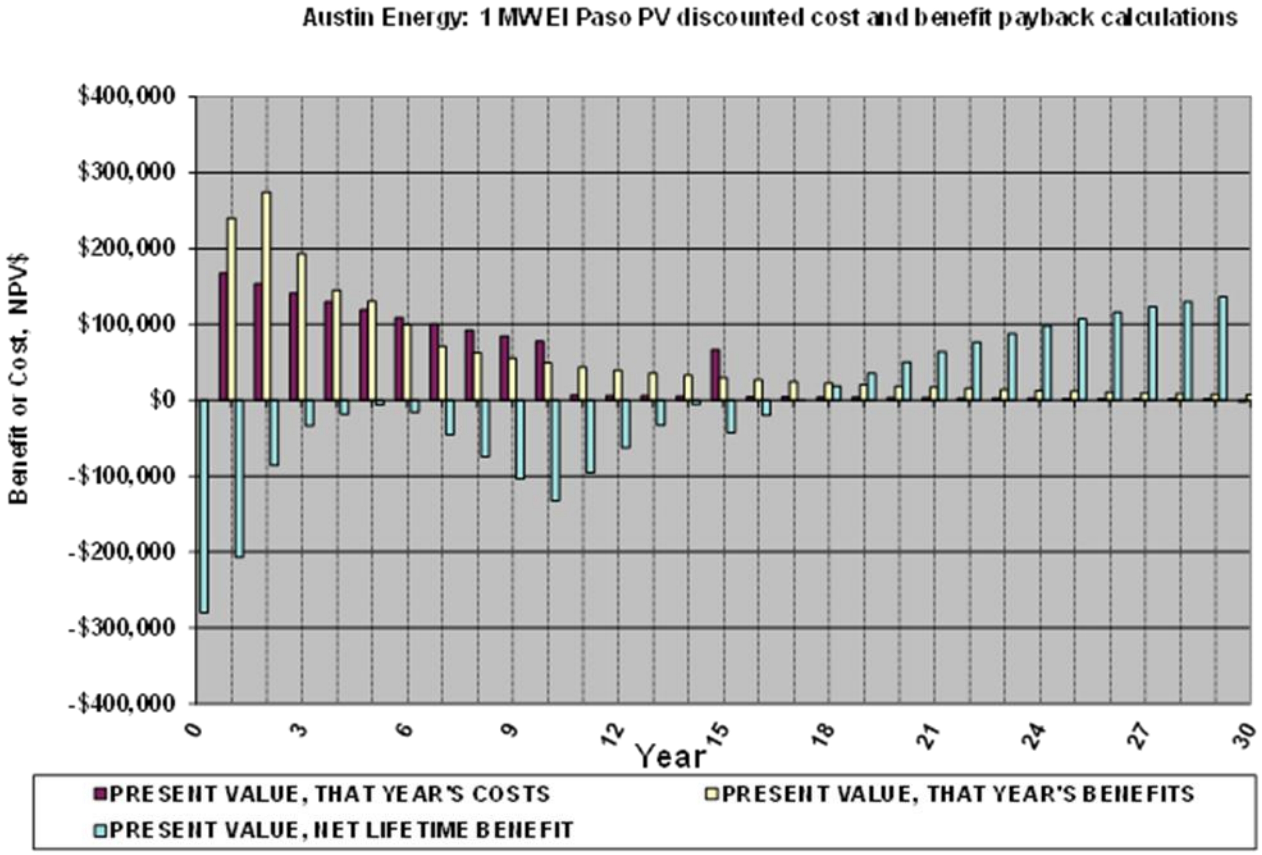
A. Appendix

Other Utility Scale Solar Assumption Analysis

LSAC's recommendation for other utility scale solar is the most optimistic of all sectors. At an installed cost of $2/W, the reduced PPA of 8 cents/kWh for 30 years could look attractive. This would be so if the investor were able to realize the 30% tax credit (or its equivalent Federal 1603 Grant), and if the location was a sunnier but distant spot such as El Paso. Under those terms, a favorable B/C ratio of 1.09 may be realized. This B/C ratio, while not a magic threshold, is viewed as satisfactorily high enough above the traditional, nominal B/C investment threshold of 1.0. DNV KEMA has assumed a B/C ratio above 1.0 would be required by investors to mitigate the substantial and foreseeable risks associated with the blend of economic assumptions needed to estimate a lifetime B/C ratio.

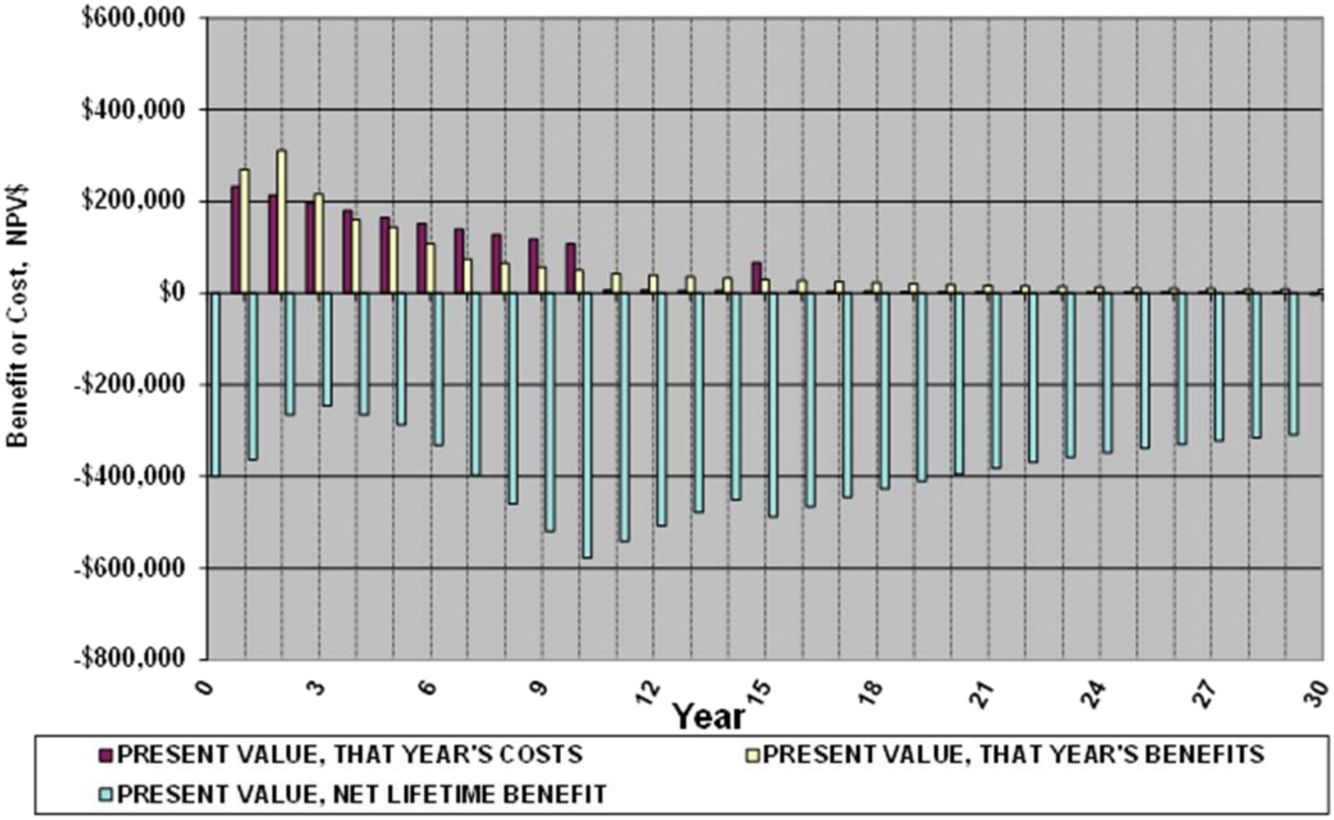
In order to maintain the same attractive B/C ratio in the absence of the 30% Federal incentive, the installed cost would need to decrease to $1.28/W. Without the Federal incentive and with only a 20-year PPA at 8 cents/kWh instead of the above-stated 30 years, the installed cost would need to decrease even further, to just $1.11/W, in order to maintain a B/C ratio of 1.09. While module prices may continue to decrease perhaps to the $0.50/W range within this planning horizon, it seems unimaginable that the combination of all other costs -- materials, labor, engineering, land, and financing/insurance to name a few – could decrease to less than $1/W. If so, the likelihood of achieving PV capital costs in the $1.11-$1.28/W seems negligibly small, suggesting the Federal incentives, if eliminated, would require 20-year PPA pricing in the 13 cent/kWh range in order to trigger PV development of the kinds contemplated here.

The first plot below shows the pro-forma discounted cash flows of costs and benefits for the $2/W base case above. The discount rate is 9%, the 80/20 debt/equity loan is at 8% for 10 years, and the 8 cent/kWh PPA is for 30 years. This scenario corresponds to a lifetime B/C ratio of 1.09, though by another key yardstick, discounted payback, the true payback does not occur for 17 years. Note the teal-colored bars represent the lifetime cumulative discounted net benefit, which almost breaks even in year 5 as the depreciation allowance fades away, dips again in year 15 after the assumed inverter replacement, and then crosses into positive lifetime benefit in the 18th year.



The second plot below shows the pro-forma discounted cash flows of costs and benefits for the base case, minus the 30% Federal incentive. The lifetime B/C ratio dips to just 0.76 and true payback is never realized at any point in the 30-year investment horizon (the teal-colored bars again represent the cumulative discounted net benefit and always remain negative in this example).

Austin Energy: 1 MW El Paso PV discounted cost and benefit payback calculations



ERCOT Forward Price Curves

	Natural Gas	5X16			2X16			7X8			RTC			WRA		
Year	NYMEX	NZ	SZ	WZ	NZ	SZ	WZ	NZ	SZ	WZ	NZ	SZ	WZ	NZ	SZ	WZ
2014	3.92	44.93	45.39	44.7	36.77	37.15	36.44	24.87	24.9	23.94	36.64	36.95	36.16	29.32	29.48	28.61
2015	4.131	48.69	48.94	47.91	39.64	39.84	39.31	25.81	25.84	24.62	39.29	39.46	38.47	30.97	31.08	30.1
2016	4.276	49.6	49.85	48.61	39.96	40.17	39.44	26.28	26.32	25.09	39.91	40.08	38.94	31.4	31.5	30.46
2017	4.379	47.69	47.95	46.04	38.22	38.43	37.16	26.07	26.11	24.62	38.56	38.73	37.09	30.65	30.75	29.35
2018	4.494	46.76	47	44.86	37.64	37.85	36.33	26.53	26.57	24.82	38.21	38.38	36.49	30.68	30.79	29.12
2019	4.707	45.93	46.18	44.03	36.98	37.19	35.67	25.44	25.48	23.72	37.34	37.52	35.62	29.75	29.86	28.19
2020	4.978	46.12	46.37	44.21	37.11	37.32	35.8	25.39	25.43	23.69	37.43	37.61	35.71	29.78	29.89	28.22

Source: NYMEX and SNL accessed 9/5/13

Table 24: ERCOT Wholesale Gas & Power Forward Option Prices