Baseline Study – Solar PV Pilot Programs

For AEP-TCC, AEP-TNC, SWEPCO, and TNMP

Submitted by: Frontier Associates and Clean Energy Associates, May 2012

1. Summary of Solar PV Pilot Programs

Initiated by AEP-Texas Central Company (AEP-TCC), AEP-Texas North Company (AEP-TNC), SouthWestern Electric Power Company (SWEPCO), and Texas-New Mexico Power Company (together, "the Utilities") in mid-2009, the Solar PV Pilot Programs (Programs) were designed to help electricity customers meet a portion of their energy needs with solar (photovoltaic, or "PV") electric systems. The Programs offer financial incentives that help offset the initial cost of installing a solar energy system for residential and non-residential customers.[1]

In addition to achieving kW and kWh savings via installation of distributed solar generation systems, the Programs' goals were to:

- Gain experience in PV installations
- Increase the number of functional capability of local PV installers
- Gather data on costs and performance, and
- Decrease incentives over time

This Baseline Study report provides year-over-year program performance data on each of these metrics. It finds that:

- The Programs to date have resulted in 111 distributed PV installations, totaling more than 1.5 MWdc of PV generating capacity, and achieving peak demand savings of more than 1.3 MWac and energy savings of nearly 2.5 million kWh.
- Between 2008 and 2012, the number of companies offering PV installations throughout Texas increased from 12 to over 200. During the same period the number of NABCEP-certified PV installers in Texas increased from 12 to 154. Relatedly, the Utilities and installers gained experience with and made process improvements through hundreds of DRG interconnections, and local jurisdictions across Texas were exposed to and improved processes for permitting and inspecting solar PV systems per local code requirements.
- Installed costs are declining rapidly, both nationally and in Texas. Texas installed costs are lower than national averages.
- Offered incentive levels have decreased from $2.50/wdc in 2009 to $1.50-$1.75/wdc in 2012, a reduction of 30%-40% in 4 years.

We conclude that the market for distributed PV systems in the Utilities' service areas and in Texas as a whole has undergone significant transformation as a result of the Programs. However, the need for utility incentives remains justified. If current trends and programs continue along a predictable and recommended path, we expect these programs will be 2-5 times more cost-effective by 2016 than in 2009.

[1] Oncor and Entergy also began offering solar PV pilot programs in 2009, and El Paso Electric began offering a program in 2010. All of these programs shared a common design and were administered by Frontier Associates and Clean Energy Associates.

2. Key Findings

a. Program Results

Figures 1 and 2 below summarize the number and capacity of PV installations that have occurred annually through the Programs. The number of installations peaked in 2010 while the total capacity installed peaked in 2011, primarily due to the completion of a large government project in AEP-TCC's service area in 2011. 2012 figures are through May 2012.

Figure 1. Number of PV Installations

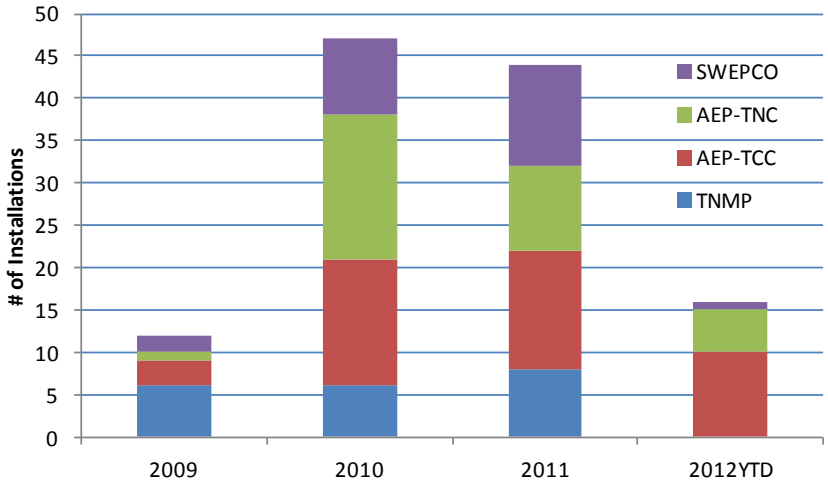


Figure 2. Capacity (MWdc) of PV Installations

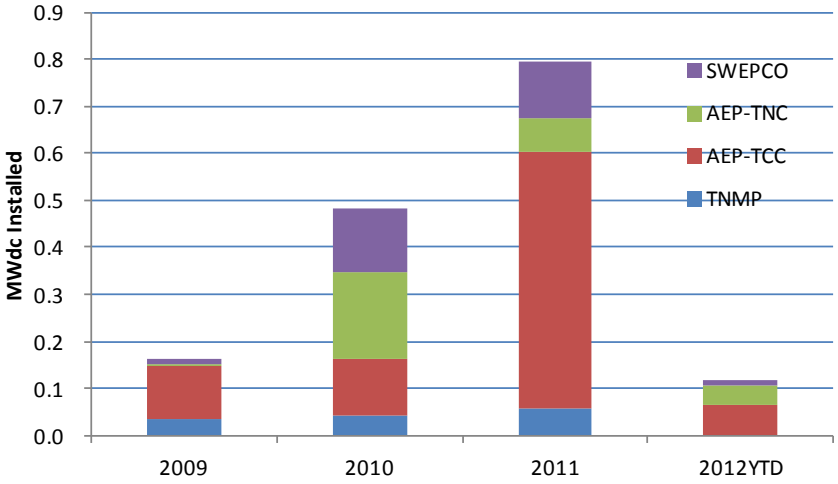
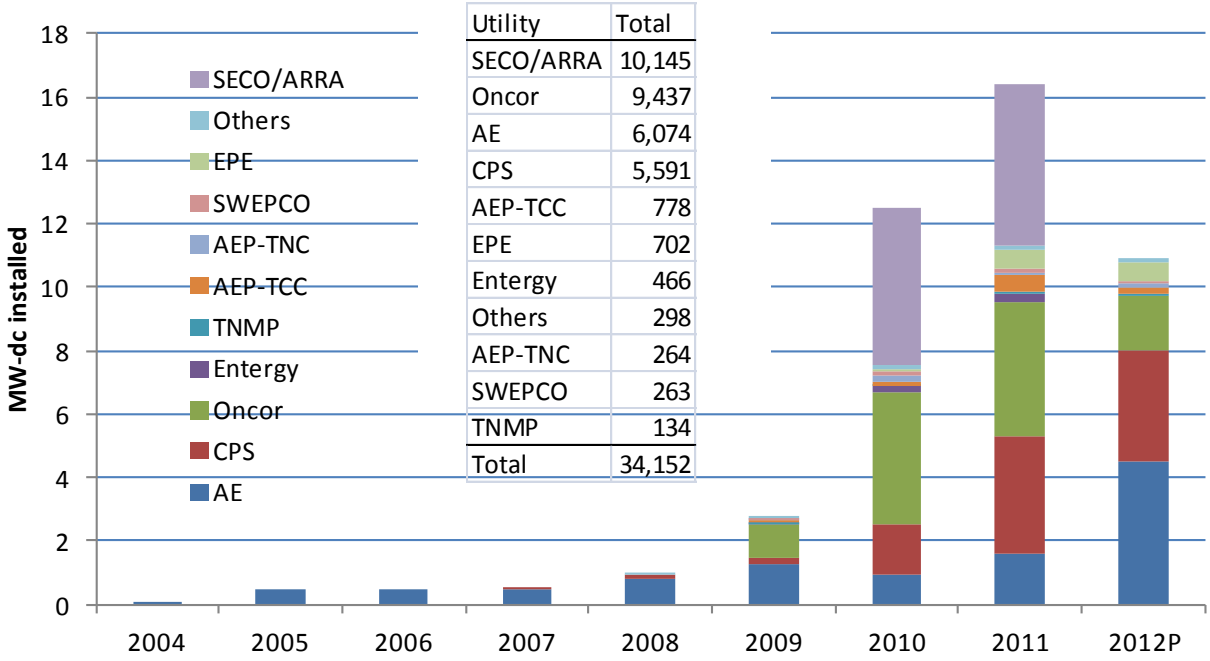


Figure 3 provides context for the AEP-TCC, AEP-TNC, SWEPCO and TNMP data above by showing the PV capacity installed annually through all Texas utility- and state-sponsored PV incentive programs from 2003-2012. Reconciliation of the data in Figure 3 with other published data sources[2] reveals that the vast majority[3] of PV installations in Texas occur through PV incentive programs, while only a tiny fraction of installations occur without assistance from these programs. While the Utilities had some experience with PV system interconnections prior to 2009, such requests were and remain infrequent and sporadic.

Figure 3. Annual Capacity Additions (MWdc) of PV Installations

(table shows cumulative total by program as of year-end 2011)



Utility	Total
SECO/ARRA	10,145
Oncor	9,437
AE	6,074
CPS	5,591
AEP-TCC	778
EPE	702
Entergy	466
Others	298
AEP-TNC	264
SWEPCO	263
TNMP	134
Total	34,152

Note: All data from Clean Energy Associates. 2012 data is projected based on available budgets. Actual capacity installed is likely to be less than projected.

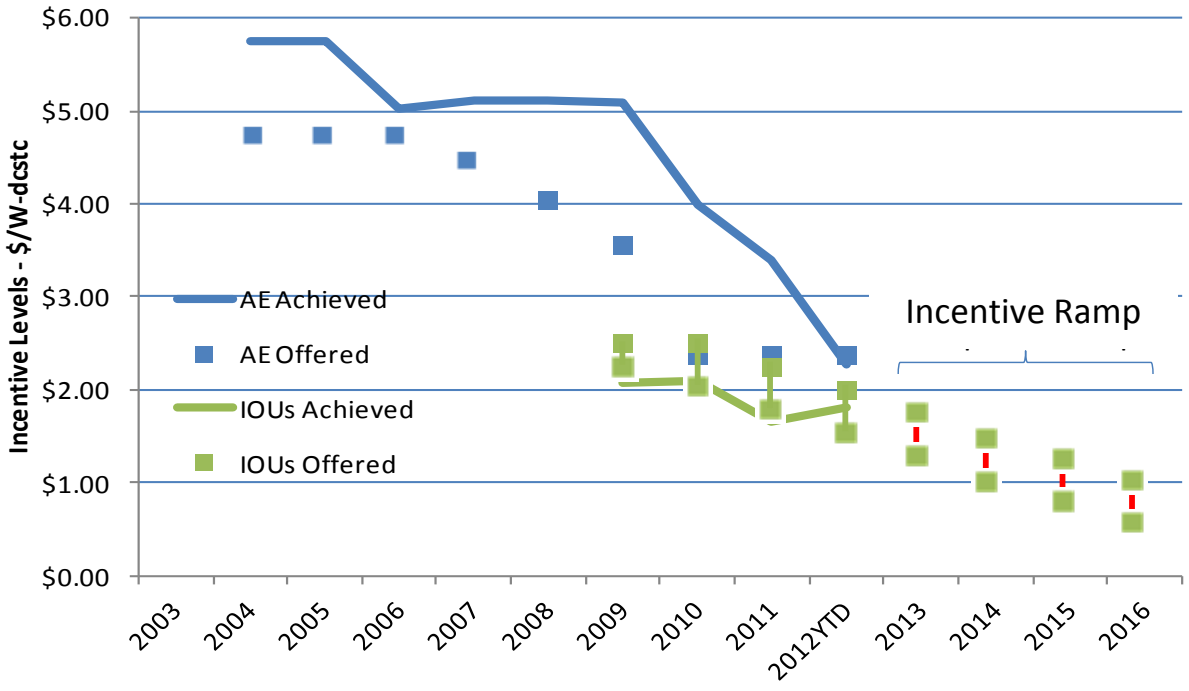
[2] Other data sources include NREL's Open PV Database and annual DRG interconnection reports filed by Utilities at the Public Utility Commission of Texas, as researched by Public Citizen in 2011.

[3] CEA estimates that 95% or more of PV installations have occurred through an incentive program.

Figure 4 compares the PV incentive levels offered and achieved annually by Texas investor-owned utility PV incentive programs against the benchmark program offered by Austin Energy. “Offered” incentive level refers to the range of published incentive levels in a given year, while “achieved” is calculated by dividing the total amount of incentives spent during a program year by the total capacity installed during that year. In the investor-owned utility programs, the achieved incentive level is typically less than the offered level because of program limits (some installations exceed published limits on the total incentive available to a project or customer) and because of the annual nature of the programs (projects and incentives are not carried forward at higher levels for completion in subsequent program years).

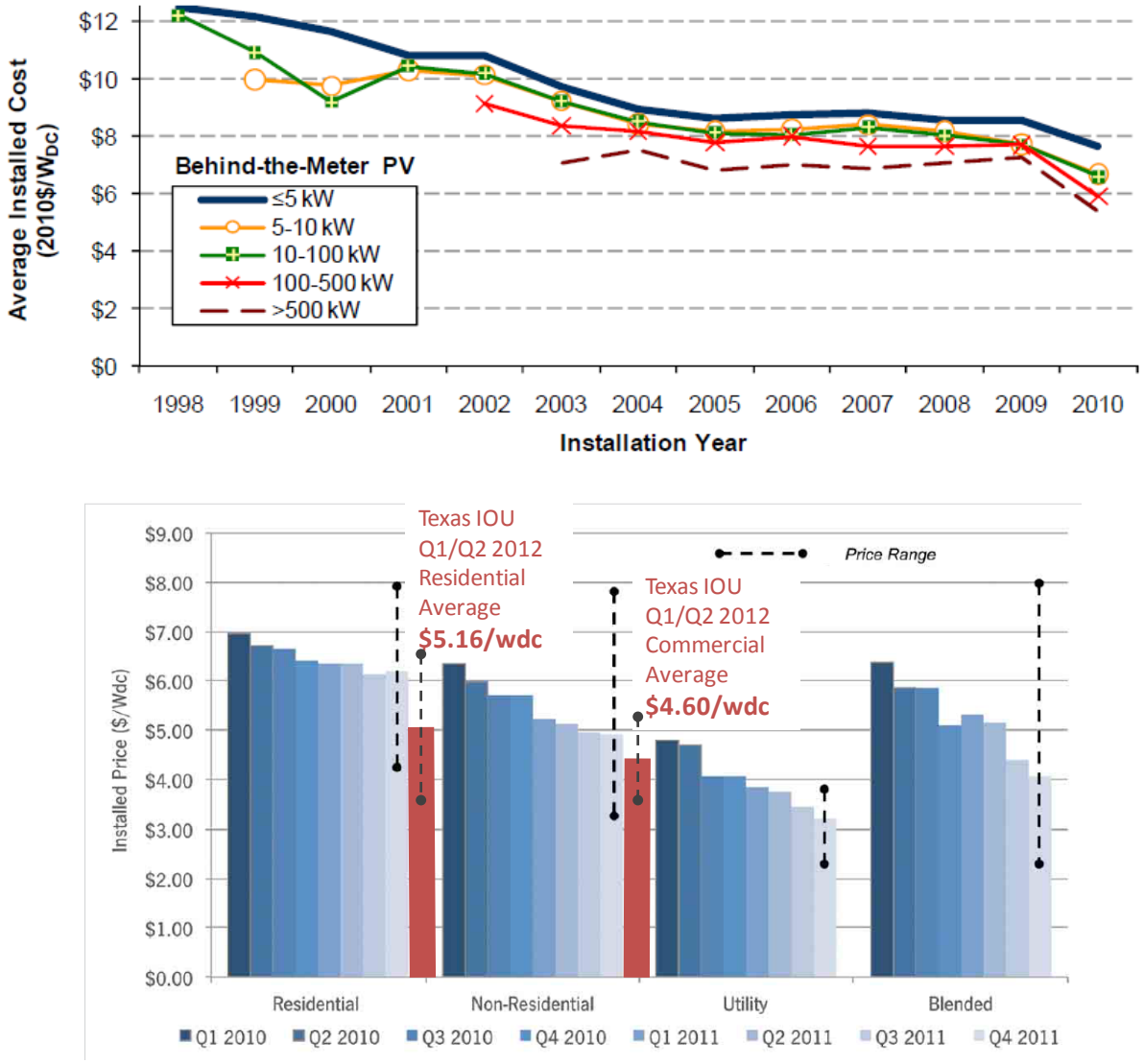
The figure also sets forth a sample forward-looking incentive ramp which projects a continued and predictably declining incentive structure through 2016.

Figure 4. Declining Incentive Levels



The rapidly declining incentive levels shown in Figure 4, above, are made possible by the rapidly declining costs of installed PV systems. Figure 5, below, presents installed costs within the current Texas PV programs in a national and historical context. The upper chart shows declining costs of installed PV systems in the US between 1998 and 2010. The lower chart provides an update, showing quarterly cost data for 2010 and 2011, as well as installed cost data from PV systems completed under the Texas investor-owned utility sponsored PV incentive programs in Q1 and Q2 2012. Installed costs of PV in Texas are less than reported national averages.

Figure 5. Declining Installed Costs



Note: Upper chart from Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010, Lawrence Berkeley National Laboratory, Galen Barbose, Naïm Darghouth, Ryan Wiser, Joachim Seel, September 2011. Lower chart from the U.S. Solar Market Insight Report, Q4 2011 & 2011 Year-In-Review, GTM Research, April 2012, with Texas overlays by Clean Energy Associates.

Table 1 on the next page summarizes annual Program budgets, spending, and project completions. It shows that the Programs to date have resulted in 111 distributed PV installations totaling more than 1.5 MWdc of PV generating capacity, and have achieved peak demand savings of more than 1.3 MWac and energy savings of nearly 2.5 million kWh.

Table 1. Solar PV Pilot Program Summary Statistics, 2009-2012

	TNMP	AEP-TCC			AEP-TNC			SWEPCO			Grand
Program Year 2009	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Total**
A. Budget	**$90,000**	$84,450	$275,550	**$360,000**	$90,000	$90,000	**$180,000**			**$90,000**	**$720,000**
D. Paid	**$88,464**	$12,950	$180,000	**$192,950**	$12,960	$0	**$12,960**			**$27,600**	**$321,974**
# of completed projects	**6**	1	2	**3**	1	0	**1**			**2**	**12**
kW-dc Installed	**35.530**	5.180	105.300	**110.480**	5.180	0.000	**5.180**			**11.040**	**162.230**
kWh savings	**56,848**	8,288	168,480	**176,768**	8,288	0	**8,288**			**17,664**	**259,568**
kW-ac savings	**30.556**	4.455	90.558	**95.013**	4.455	0.000	**4.455**			**9.494**	**139.518**
$/watt incentive level offered	**$2.50**	$2.50	$2.50	**na**	$2.50	$2.50	**na**			**$2.50**	**na**
$/watt incentive achieved	**$2.49**	$2.50	$1.71	**$1.75**	$2.50	na	**$2.50**			**$2.50**	**$1.98**
Program Year 2010	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Total**
A. Budget	**$108,000**	**$201,500**	**$325,550**	**$527,050**	**$167,040**	**$180,000**	**$347,040**			**$287,400**	**$1,269,490**
D. Paid	**$101,088**	$201,125	$95,550	**$296,675**	$166,313	$180,000	**$346,313**			**$207,475**	**$951,550**
# of completed projects	**6**	13	2	**15**	12	5	**17**			**9**	**47**
kW-dc Installed	**42.135**	83.042	38.430	**121.472**	67.085	117.775	**184.860**			**132.690**	**481.157**
kWh savings	**67,416**	132,867	61,488	**194,355**	107,336	188,440	**295,776**			**212,304**	**769,851**
kW-ac savings	**36.236**	71.416	33.050	**104.466**	57.693	101.287	**158.980**			**114.113**	**413.795**
$/watt incentive level offered	**$2.50**	$2.50	$2.50	**na**	$2.50	$2.50	**na**			**$2.50**	**na**
$/watt incentive achieved	**$2.40**	$2.42	$2.49	**$2.44**	$2.48	$1.53	**$1.87**			**$1.56**	**$1.98**
Program Year 2011	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Total**
A. Budget	**$108,000**	$180,375	$410,000	**$590,375**	$96,049	$84,679	**$180,728**	$137,414	$185,806	**$323,219**	**$1,202,322**
D. Paid	**$107,540**	$162,420	$360,000	**$522,420**	$69,656	$80,279	**$149,935**	$47,960	$185,806	**$233,766**	**$827,855**
# of completed projects	**8**	10	4	**14**	6	4	**10**	4	8	**12**	**36**
kW-dc Installed	**56.210**	88.965	456.920	**545.885**	32.778	41.100	**73.878**	22.315	96.746	**119.061**	**795.034**
kWh savings	**89,936**	142,344	731,072	**873,416**	52,445	65,760	**118,205**	35,704	154,794	**190,498**	**1,272,054**
kW-ac savings	**48.341**	76.510	392.951	**469.461**	28.189	35.346	**63.535**	19.191	83.202	**102.392**	**683.729**
$/watt incentive level offered	**$2.00**	$2.00	$1.75	**na**	$2.25	$2.00	**na**	$2.00	$1.75	**na**	**na**
$/watt incentive achieved	**$1.91**	$1.83	$0.79	**$0.96**	$2.13	$1.95	**$2.03**	$2.15	$1.92	**$1.96**	**$1.04**
Program Year 2012	**Total (Res Only)**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Res.**	**Non-Res.**	**Total**	**Total**
A. Budget	**$120,000**	$180,000	$180,000	**$360,000**	$90,000	$71,000	**$161,000**	$121,500		**$121,500**	**$762,500**
D. Paid	**$0**	$49,419	$53,370	**$102,789**	$72,990		**$72,990**	$17,500		**$17,500**	**$193,279**
# of completed projects	**0**	5	5	**10**	5		**5**	1		**1.00**	**16**
kW-dc Installed	**0.000**	27.365	35.580	**62.945**	43.560	0.000	**43.560**	10.000		**10.000**	**116.505**
kWh savings	**0**	43,784	56,928	**100,712**	69,696	0	**69,696**	16,000		**16,000**	**186,408**
kW-ac savings	**0.000**	23.534	30.599	**54.133**	37.462	0.000	**37.462**	8.600		**8.600**	**100.194**
$/watt incentive level offered	**$1.75**	$1.75	$1.50	**na**	$1.75	$1.50	**na**	$1.75		**$1.75**	**na**
$/watt incentive achieved	**na**	$1.81	$1.50	**$1.63**	$1.68	na	**$1.68**	$1.75		**$1.75**	**$1.66**

Notes:

2009 and 2012 data reflect partial years. The TNMP program opened in April 2009; the AEP-TCC, AEP-TNC, and SWEPCO programs opened in August 2009. Program year 2012 reflects program status as of May 25, 2012.

TNMP's program was open to residential and non-residential customers through 2011. In 2012 the program was limited to residential customers only.

In 2009-2010, SWEPCO's budget was designed as a single pool available to both residential and non-residential customers. In 2011, the program remained open to both residential and non-residential customers, but with separate budgets for each customer class. In 2012, the program was limited to residential customers only.

b. Changes Observed in the Residential and Non-Residential Markets

Three principal changes have been observed in the Texas market for distributed solar generation since the Programs' introduction in 2009: declining installed costs, increased quantity and quality of solar contractors, and the introduction of leasing models. Declining cost trends and trends in the number of installers (and certified installers) are documented above, and are not elaborated here.

The introduction of leasing models to the Texas solar market began in the Oncor program in 2010, when one registered service provider received thousands of calls from potential customers in response to favorable news coverage in the Dallas/Ft. Worth area. Rather than sell the solar energy system directly to the customer, this service provider offered to own and maintain the system while leasing the equipment to the customer. The leasing model was not new – it had been used in other states before – but it was new to Texas. The model leverages scale and available federal tax benefits to reduce overall costs, and exposes customers to a monthly cost profile that many found attractive or interesting in contrast to a large capital investment. The net result is that leasing, and other third party ownership models, potentially expands the market for PV systems to a broader set of customers.

Since 2010, the leasing model has gained traction principally in the DFW area, where sufficient concentrations of PV development opportunities exist. In 2011, the Texas Legislature passed SB 981, which further clarified and simplified regulatory interpretation of third party ownership models such as leasing, and in May 2012, the Public Utility Commission of Texas issued its final Order implementing SB 981. These actions are likely to increase the scope of leasing models in investor-owned utility areas throughout the state.

c. Opportunities and Barriers

Frontier and CEA have identified the following opportunities in the Texas market for solar PV systems:

- Distributed PV can be deployed quickly to help meet resource adequacy concerns in the short term (1-3 years).
- Progress made by the programs to date in lowering costs, reducing incentives, and increasing the number and experience level of PV installers can be continued by leverage volume and stability through several, coordinated multi-year incentive programs sponsored by utilities.
- Integration of PV systems with smart metering to enable time of use valuation of production can increase the value of PV energy for customers.
- Further development of third party ownership models, especially if connected to the utility bill, can expand the market for PV by making investment more affordable.

Barriers include the following:

- The installed cost of PV systems remains the largest barrier to wider adoption, particularly in the current context of historically low electricity prices.
- As equipment prices have come down, the relative impact of "soft costs", such as those associated with inconsistent local permitting processes, have become more important. These

costs are not likely to be reduced without coordinated efforts by authorities having jurisdiction, the state or utilities.

Solar energy produces public benefits – such as peak shaving, reduced water consumption – that are not always able to be monetized by the party making a decision to invest in solar. This lack of alignment continues to make justifying investments in PV more difficult.

3. Customer Attitudes

a. Incentives Influence Purchase Decisions

Figure 3 illustrated that the capacity of installed PV in Texas has increased from just a few MWdc at the end of 2008, prior to the administration of investor owned incentive programs in 2009, to over 34 MWdc by the end of 2011.[4] This is strong evidence that growth in the Texas PV market is highly correlated to the existence of utility incentives. Research conducted by Dr. Varun Rai and his team from the LBJ School of Public Affairs at the University of Texas at Austin takes this correlation one step further, demonstrating that incentive availability remains a strong factor contributing to customer decisions to purchase solar energy systems. His group conducted a survey in 2011 of participants in the utility sponsored incentive programs from 2009-2011, and found that although participants were willing to pay slightly more for their solar PV system (see Figure 5 below), the incentive played a major role in their investment decision.

Figure 5: Customer's Wilingness to Pay for Solar PV (All Utilites)

2. How much do you agree or disagree with each of these statements?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I would **not** have installed the PV system if it had cost me $1000 more	○	○	○	○	◉
I would **not** have installed the PV system if it had cost me $2000 more	○	○	○	◉	○
I would **not** have installed the PV system if it had cost me $3000 more	○	○	◉	○	○
I would **not** have installed the PV system if it had cost me $4000 more	○	◉	○	○	○
I would **not** have installed the PV system if it had cost me $5000 more	○	◉	○	○	○

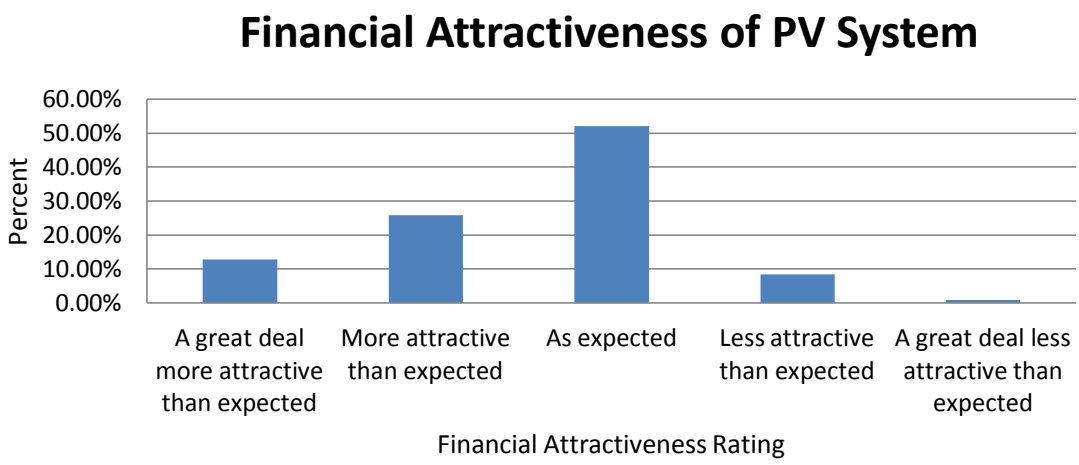
[4] Based on database of installations 2009-2012 from CEA and Frontier. Other data sources include NREL's Open PV Database and annual DRG interconnection reports filed by Utilities at the Public Utility Commission of Texas, as researched by Public Citizen in 2011.

b. Financial Analysis Drives Solar Investment Decisions

The LBJ School's research showed that 77% of customers who purchased solar rated their analysis of solar's financial investment value as either "very" or "extremely" important to their decision to install solar (see Figure 6, below), and that more than 85% felt the financial investment was as good as or better than they expected.

Figure 6: Importance on Decision to Install Solar PV (in percents)

	General interest	Financial investment	Environmental impact	Influence of neighbors	Influence of acquaintance
Not important at all	4.66%	3.83%	8.94%	79.49%	80.69%
Somewhat important	8.47%	5.11%	12.77%	9.83%	3.86%
Moderately important	15.25%	14.04%	17.87%	6.84%	8.15%
Very important	34.32%	32.34%	19.15%	3.42%	4.72%
Extremely important	37.29%	44.68%	41.28%	0.43%	2.58%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**



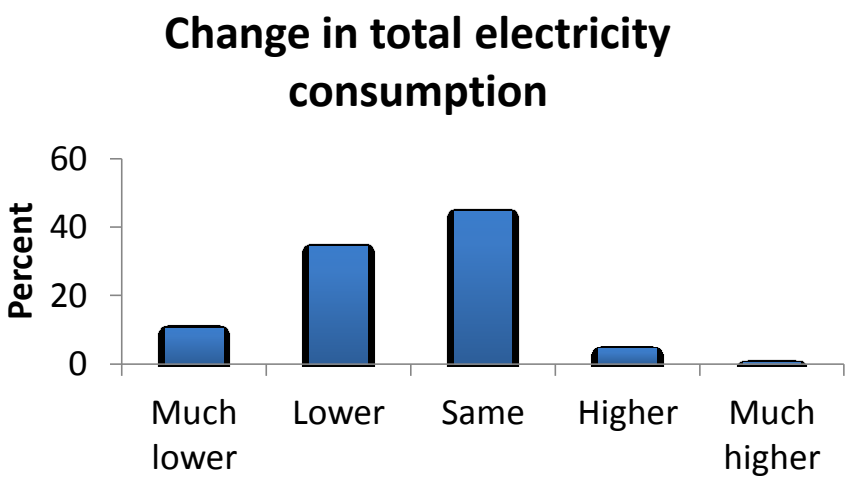
c. Secondary Effects on Electricity Consumption

There may be secondary effects on energy consumption that result from the installation of a PV system. The LBJ School's survey also found that participants in the incentive programs were more likely to report a change in the amount of electricity (PV and grid) they used, compared to their usage prior to the installation of their solar PV system (Figure 7). Customer responses included:

> "I am much, much, much, much, more aware of how much energy I use each month."
>
> "I try to "leverage" the array's input in relation to total electrical consumption so my array will provide 25% of all our power needs."
>
> "I am more apt to use power-consuming appliances (washer/drier, etc) when the sun is up, to take advantage of the cost offset."

These self-reported results are preliminary and are worthy of additional study and validation.

Figure 7: Change in Total Electricity Consumption

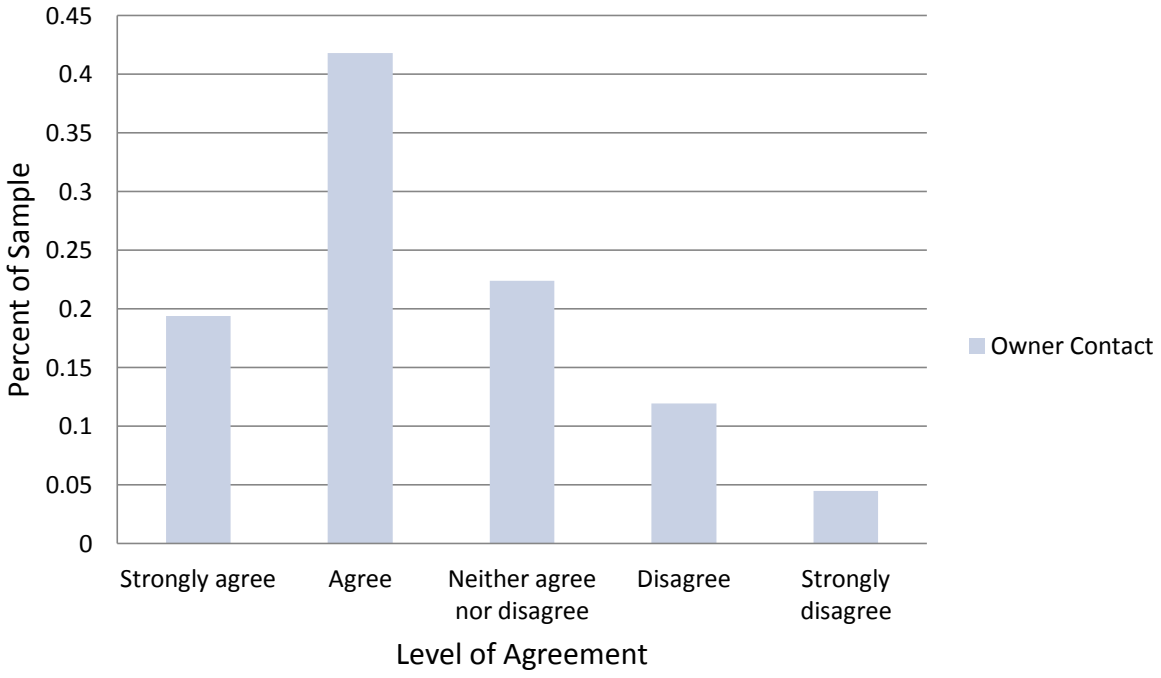


d. Information Network Development

Additionally, the solar PV incentive programs have created a large network of solar PV installers that were not present in Texas prior to the administration of the incentive programs. Between 2008 and 2012, the number of companies offering PV installations throughout Texas increased from approximately 20 to over 200. During the same period the number of NABCEP-certified PV installers in Texas has increased from 12 to 154. The incentive programs offered by the utilities have played the largest role in developing this network. Survey results show that customers rely on this network to influence their decisions to participate in the solar PV programs, both through access to information and help with financial analysis of solar PV for their home.

The survey also found that over 50% of respondents who participated in the solar PV programs were motivated to install solar on their home by other solar PV systems in their neighborhood. As the number of installations in neighborhoods in the utilities service areas increases, previous participants will likely influence additional projects.

Table 9: Existing PV Systems in Participants Neighborhoods Motivated Installation



4. Market Potential

Clean Energy Associates produced an estimate of the technical potential for rooftop solar generation in Austin Energy's service area in 2009. It utilized several data sources to estimate the total area available on rooftops of residential, commercial and industrial buildings. It then employed a stepwise approach to discount the available rooftop area due to shading, improper orientation, structural considerations, and other factors. Finally, the analysis estimated PV generation potential on the remaining rooftop spaces. The study concluded that if fully utilized, rooftop solar energy systems have the potential to produce between 16.1% and 27.6% of Austin Energy's 2008 annual electric energy generation, depending on the PV deployment scenario used. The study demonstrated that rooftops comprise potentially enormous energy generation potential, and that existing installations comprised only about one tenth of one percent of the total potential market.

Additionally, the LBJ School will be providing the results of their 2011 mail and online survey of participants in the utilities solar PV incentive programs. Dr. Rai's research will address the effect that information and perceptions of non-monetary costs of solar PV has on the adoption of solar. It also estimates consumer discount rates for the energy savings associated with installing solar and how this varies with income levels of the participants. This research will help develop further insight into customers' decision making processes in pursing solar PV projects.

5. Conclusions

The market for distributed PV systems in the Utilities' service areas and in Texas as a whole has undergone significant transformation as a result of the Programs.

However, the need for utility incentives remains justified. Despite the progress made over the past several years, without incentives PV installation costs remain too high, customer awareness of PV's long-term value remains too low, and some of the benefits provided by PV (zero emissions, zero water use, local job creation, on-peak or near-peak energy production) remain poorly aligned with customer interest in making the decision to invest in a PV system. Properly designed incentives, such as those provide by the Utilities since 2009, can help restore that alignment.

If current trends and programs continue along a predictable and recommended path, we expect these programs will be 2-5 times more cost-effective by 2016 than in 2009.