



Texas Solar Power Overview

CATEE Conference

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12/20/16



- The Texas Solar Power Association (TSPA) is a statewide industry trade association that promotes the development of solar electric generation in Texas.
- Member companies are investing in Texas, cost-competitively serving customers in both wholesale and retail markets.
- Our membership includes manufacturers, large-scale power plant developers, residential and commercial rooftop integrators, and other companies in Texas participating across the full solar photovoltaic supply chain.
- TSPA aims to be a resource for information on the Texas solar industry



Rummel Construction, Inc.





Outline

- National trends
- Texas market: foundations
- Texas market: current status and new developments
- Texas market: looking ahead



Solar Portfolio Options

- Solar power has multiple distinct applications:
 - Large scale power plants
 - Utility owned or contracted
 - Commercial & Industrial
 - Customer owned or contracted
 - Utility owned or contracted
 - Residential
 - Customer owned or contracted
 - Utility owned or contracted
 - Community Solar
 - Utility owned or contracted
- The solar portion of a portfolio can itself be a portfolio
- The solar industry is active in each of these areas so utilities and other customers will find eager partners and support for all of the paths chosen



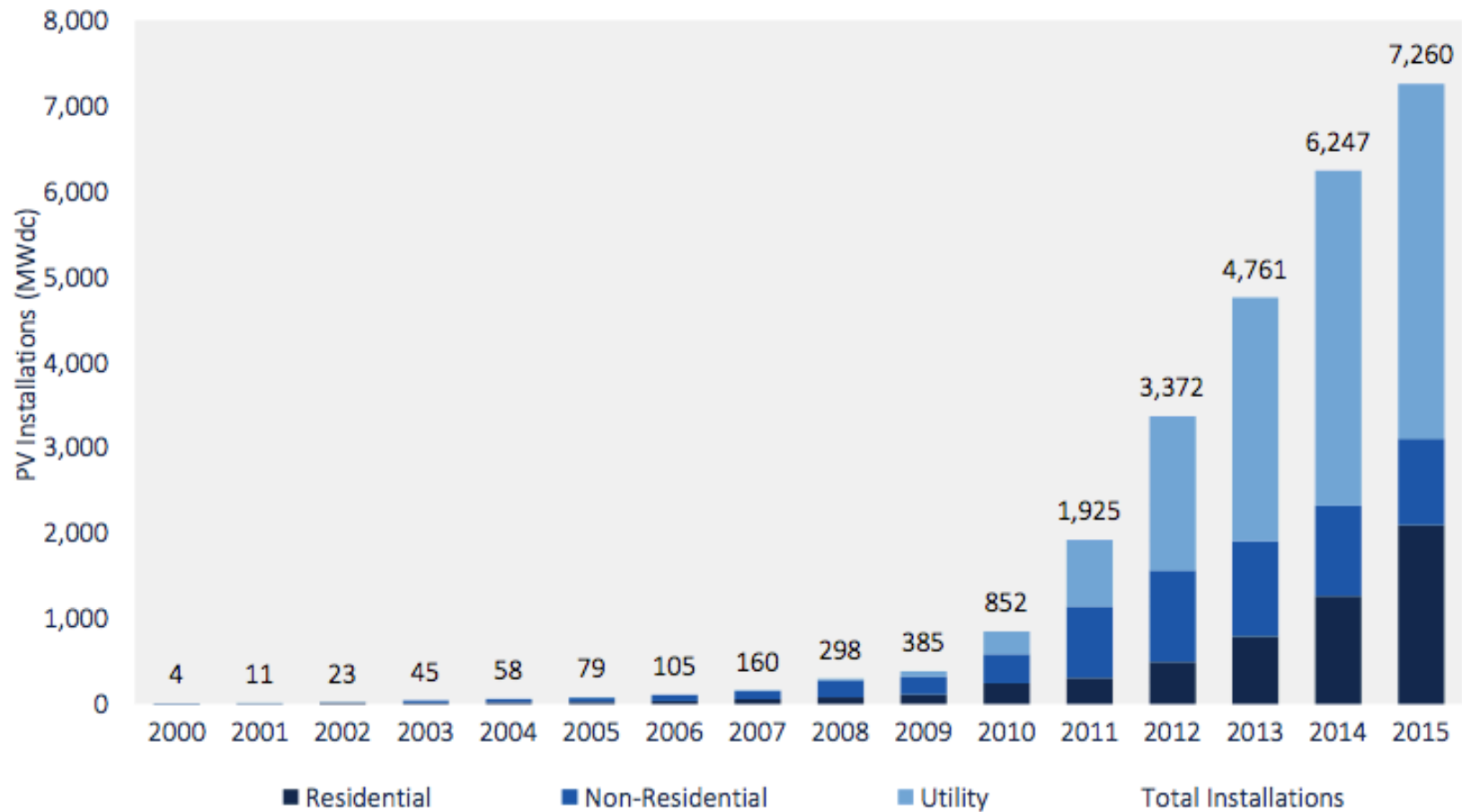


National Trends

- Through Q3 2016, the total U.S. operating solar capacity is over 33 GW-dc with the cumulative number of solar installations surpassing one million
- The U.S. installed 4,143 MW-dc of solar PV in Q3 2016, our largest quarter ever – that’s an average of one new megawatt of solar PV capacity coming online every 32 minutes
- Solar accounted for 39% of all new electric generating capacity brought on-line in the U.S. between Q1 and Q3 2016
- 14.1 GW-dc total additions projected in 2016, 88% growth over 2015
- The U.S. solar industry employs nearly 209,000 workers as of November 2015, 20% growth in past year and up 123% in the past 6 years



Annual U.S. PV Installations 2000 - 2016

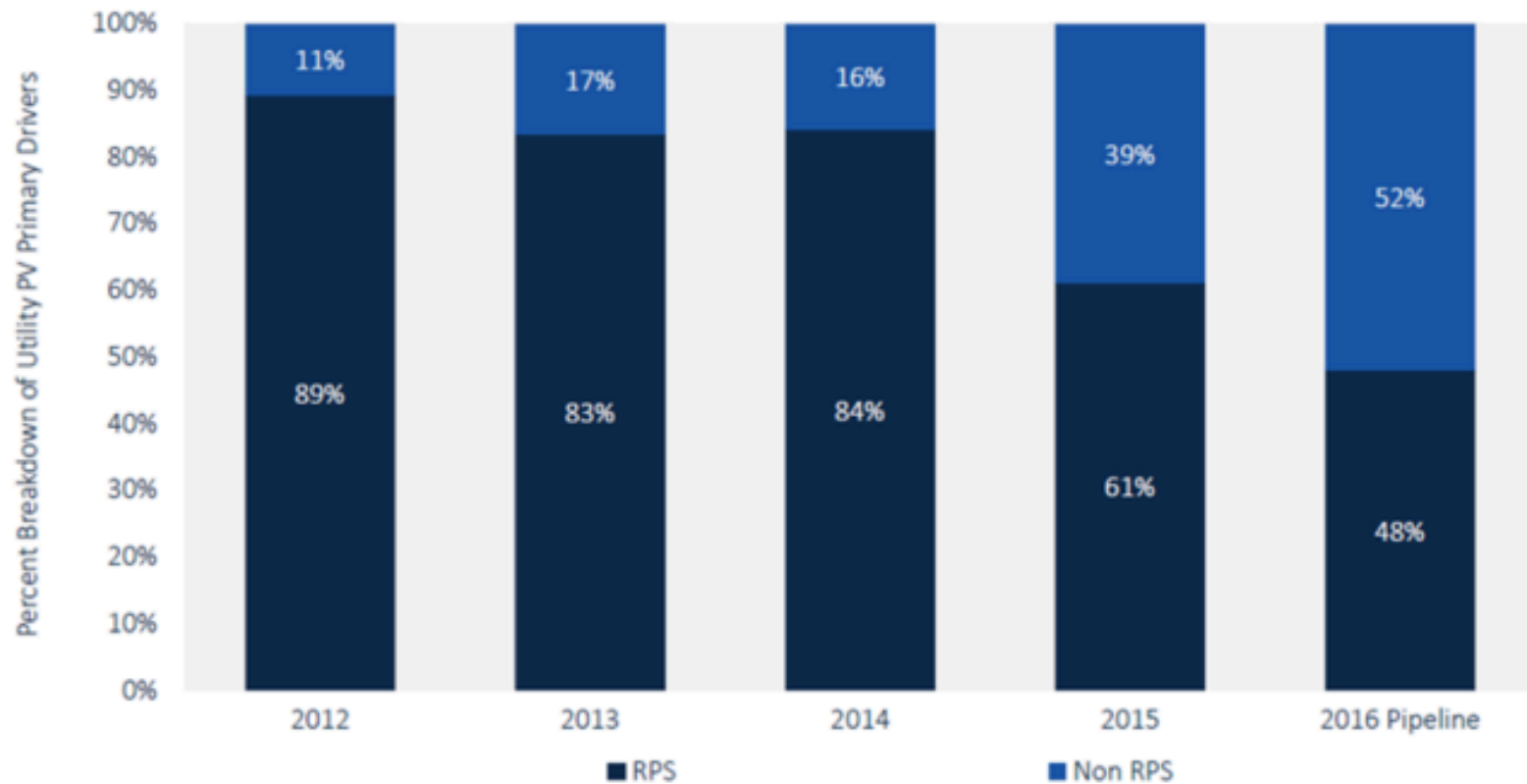


Source: GTM Research/SEIA: U.S. Solar Market Insight®



Mandates no longer the key driver

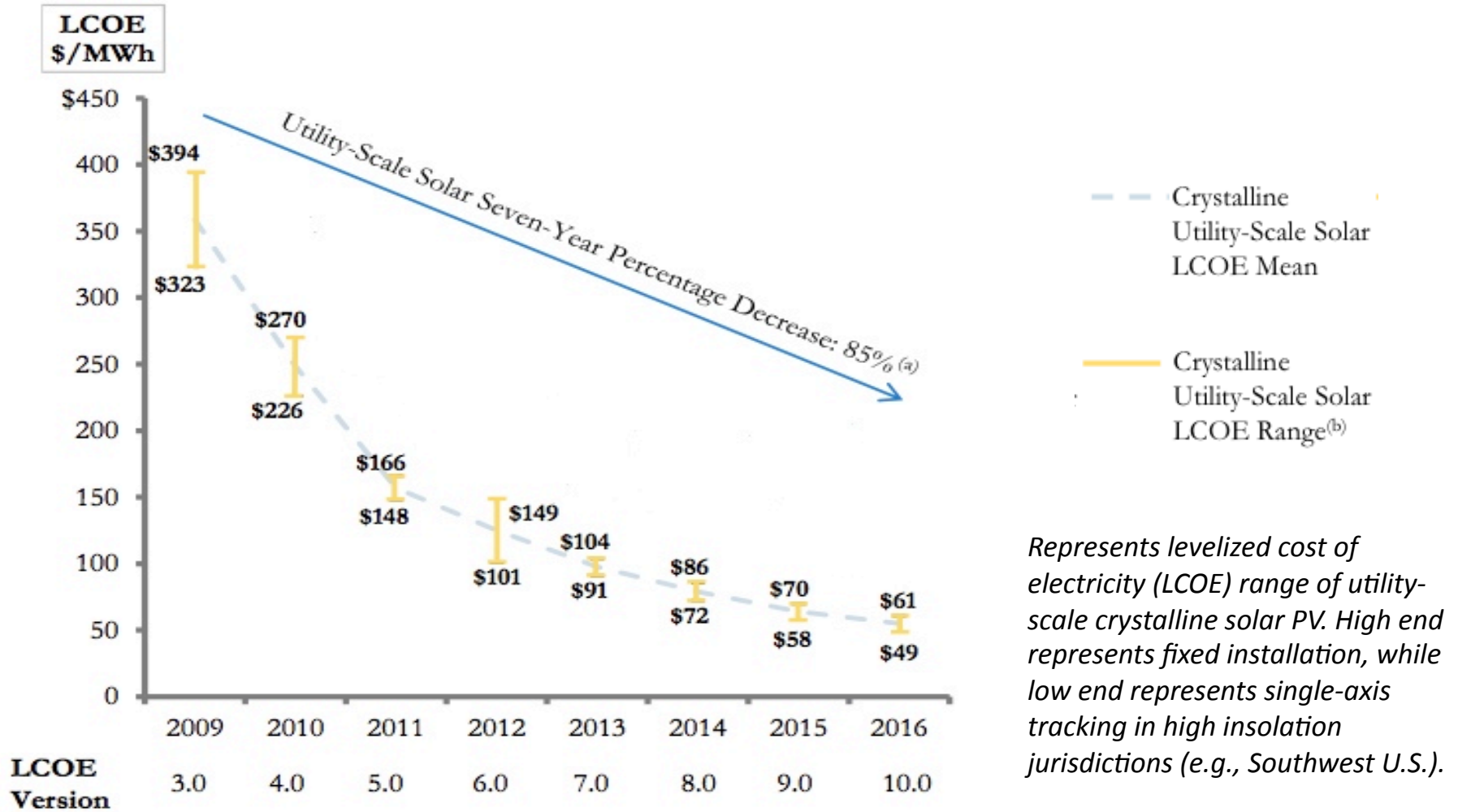
Percent Breakdown of Utility PV Driven by RPS and Non-RPS Mechanisms



Source: GTM The Next Wave of U.S. Utility Solar



Solar costs fell 85% from 2009-2016



Source: Lazard Levelized Cost of Electricity Ver. 10.0



The Case for Solar in Texas is Strong

Texas has:

- Growing energy demand
- Peak energy needs
- Sustained drought
- Air quality constraints
- Largest solar resource in US
- Largest energy market in US
- Public support in polling

Solar offers:

- High value electric supply
- Zero fuel costs
- Minimal to no water use
- Rapid deployment
- Economic development & jobs
- Environmental benefits
- Trillion dollar global industry
- Unprecedented affordability





Market-specific Benefits for Texans

Retail: *Residential & Comm.*

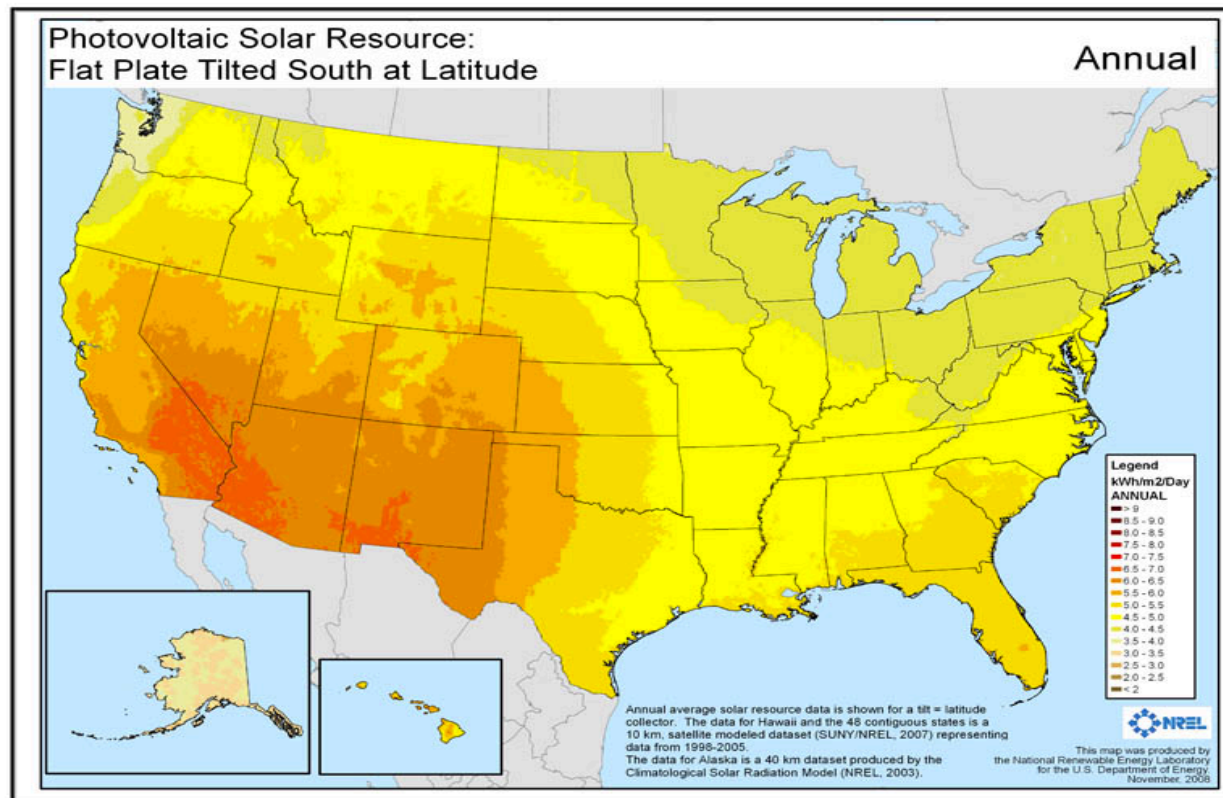
- Solar offers customers the choice to self-generate
- Provides an opportunity to reduce electricity bills, control future costs and earn attractive financial returns
- Provides generation where it's needed, reducing grid line losses and congestion

Wholesale: *Power plants*

- Cost-competitive peak power
- Rapidly deployable, delivering better cost certainty and alignment with load needs
- Minimal viewshed impact – typically no taller than 10 feet off the ground



Abundant Supply

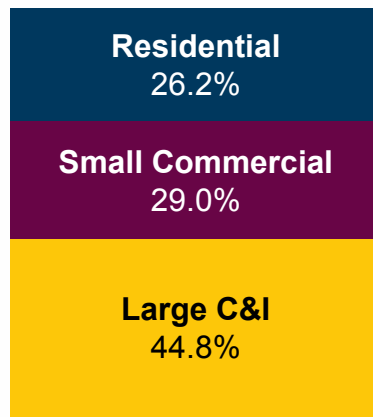


Texas has the largest total solar potential in the U.S. on account of our intense sunshine and very large land area

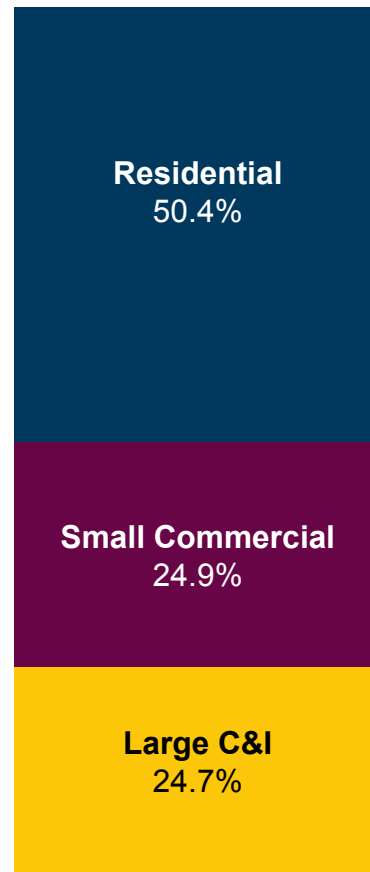


Residential A/C use drives peak needs and follows the sun

Thursday,
March 12, 2015
5:00 PM
ERCOT Load: 32,955 MW
Temperature in Dallas: 69°




3/16/2015 IE 17:00



8/10/2015 IE 17:00

Mon., Aug. 10, 2015
5:00 PM
ERCOT Load: 69,659 MW
Temperature in Dallas: 107°



~37,000 MW of
weather-sensitive
load -- 53% of peak

- Customer class breakdown is for competitive choice areas; percentages are extrapolated for munis and co-ops to achieve region-wide estimate
- Large C&I are IDR Meter Required (>700kW)
- 15-minute settlement interval demand values

Credit: ERCOT



Solar in Texas Today: State of the State

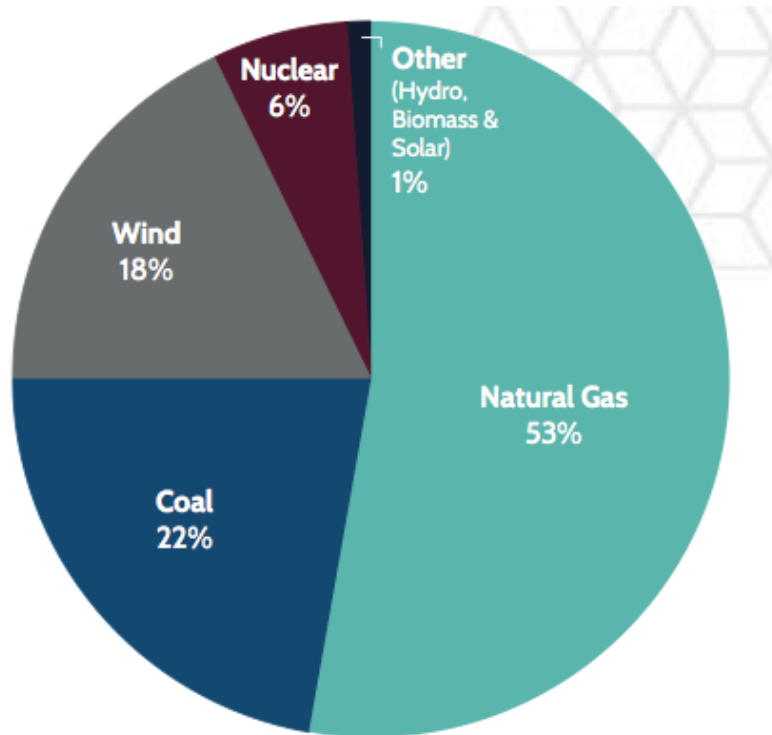
- 965 MW installed through Q3 2016
- Texas had the 3rd best quarter of any state and is now ranked 8th in cumulative capacity
- Texas is a unique and complex market
- We have started slower than states with intentional solar policy but are beginning to develop our enormous potential based on market drivers

State	Rank		
	Cumulative	2015	Q3 2016
California	1	1	1
Utah	7	8	2
Texas	8	9	3
Georgia	10	6	4
Colorado	11	12	5
North Carolina	2	2	6
New Mexico	14	16	7
Arizona	3	5	8
Oregon	19	21	9
New York	9	7	10
Idaho	39	39	11
Massachusetts	6	3	12
New Jersey	4	10	13

Source: GTM Research/SEIA: U.S. Solar Market Insight[®]



Solar in Texas: ERCOT Capacity and Energy Use

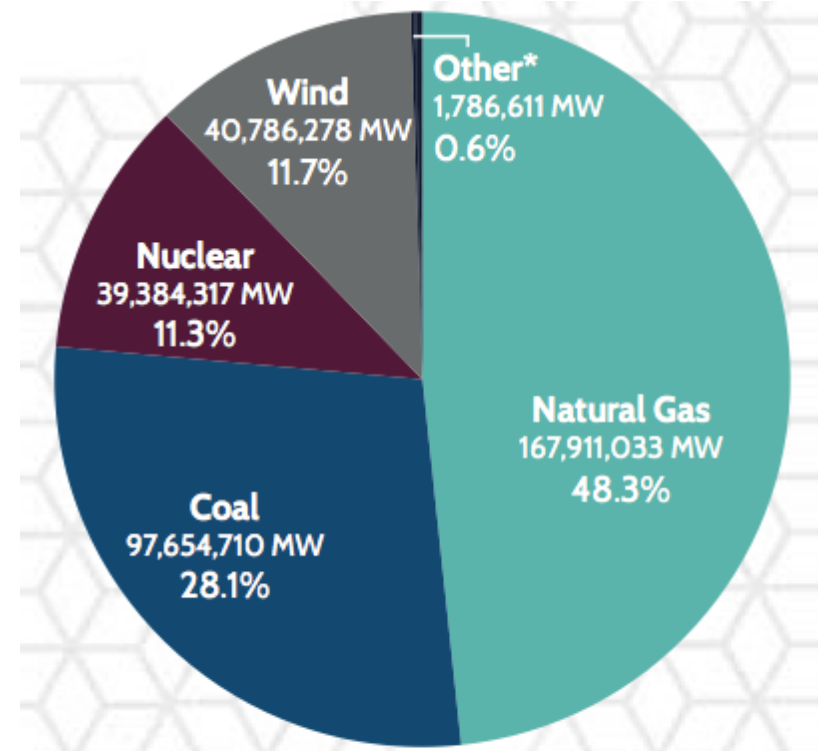


2015 Generation Capacity

(Total Installed Summer Capacity as of December 31, 2015)

77,000+ MW capacity for peak demand

1 MW powers ~ 200 homes at peak demand



Energy Use 2015

347 billion kWh used in 2015

Source: ERCOT Quick Facts, 2/2016



Texas Solar Jobs

- The solar industry is making an economic impact with 7,030 jobs through 2015
- An additional 3,900 workers are spending up to half-time on solar: traditional industries such as construction and electrical product manufacturing are now adding new solar revenue streams to existing business lines
- 12.7% growth expected in 2016 *Source: The Solar Foundation: Texas Solar Jobs Census 2015*

THE WALL STREET JOURNAL.

BUSINESS

As Oil Jobs Dry Up, Workers Turn to Solar Sector

Burgeoning solar projects offer opportunities for out-of-work rig hands, roustabouts and pipe fitters

By LYNN COOK

April 21, 2016 7:16 p.m. ET



Workers install massive racks that will hold solar panels at the Alamo 6 solar farm under construction in McCamey, Texas, about 300 miles northwest of San Antonio. *PHOTO: JENNIFER BOOMER FOR THE WALL STREET JOURNAL*



Texas Market Activity: Retail



- Capacity through Q3 2016:
 - 128 MW Residential
 - 81 MW Non-Residential C&I
- Managed programs
 - CPS Energy
 - Austin Energy
 - T&D utilities, e.g. Oncor
 - Various other municipal and co-op utilities
- Competitive markets
- Off-grid / special applications



Competitive Retail Market Innovation

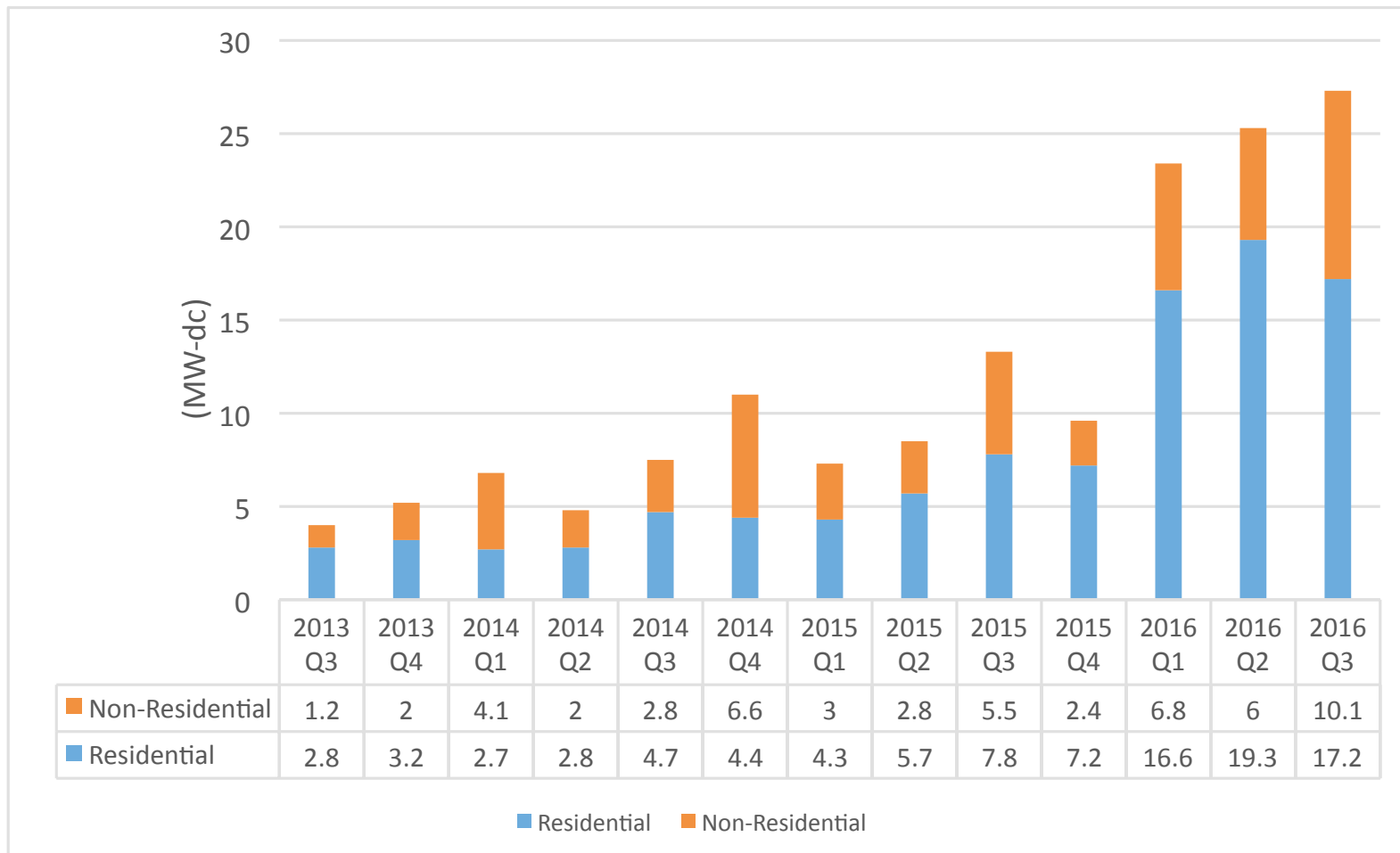
- In the deregulated Texas market, Retail Electricity Providers are not required to buy excess solar generation from customers
- However, leading REPs are now competing for solar customers by voluntarily offering rate plans that credit customer solar generation

Company	Plan Name	Rate / kWh	Rate Type	Term
Reliant	Reliant Solar Sell Back Plan	\$0.113	Variable	Month-to-Month
TXU	Clean Energy Credit Program	\$0.075	Variable	Month-to-Month
Green Mountain	Renewable Rewards®	\$0.122	Variable	Month-to-Month
	Renewable Rewards® 12	\$0.116	Fixed	12 Months
	Renewable Rewards® 24	\$0.116	Fixed	24 Months
MP2 Energy	MP2 Solar Buyback Program	\$0.106-0.114	Fixed	12 Months
	MP2 Net Energy Metering Program	\$0.106-0.114	Fixed	24 Months
		\$0.081-0.102	Variable	24 Months
		\$0.117-0.125	Fixed	60 Months
		\$0.096-0.106	Variable	60 Months

Sources: Power to Choose website, company materials. Rates as of April 2016



Texas Residential & Commercial PV Installations



Source: GTM Research/SEIA: U.S. Solar Market Insight®



Texas Market Activity: Wholesale

- **756 MW of power plants online through Q3 2016, including:**
 - Recurrent Energy / Southern Power (157 MW)
 - Alamo Solar 7 (105 MW)
 - Alamo Solar 1 + 4 + 5 (39.2 + 38 MW + 95 MW)
 - Barilla Solar I (30 MW)
- **More than 800 MW under contract / construction, including:**
 - First Solar / Southern Power (120 MW)
 - OCI Solar Power (110 MW)
 - Hanwha Q Cells (170 MW)
 - ConEdison Development (150 MW)
 - RES Americas (200 MW)

Total = over 1,500 MW



Courtesy of CPS Energy

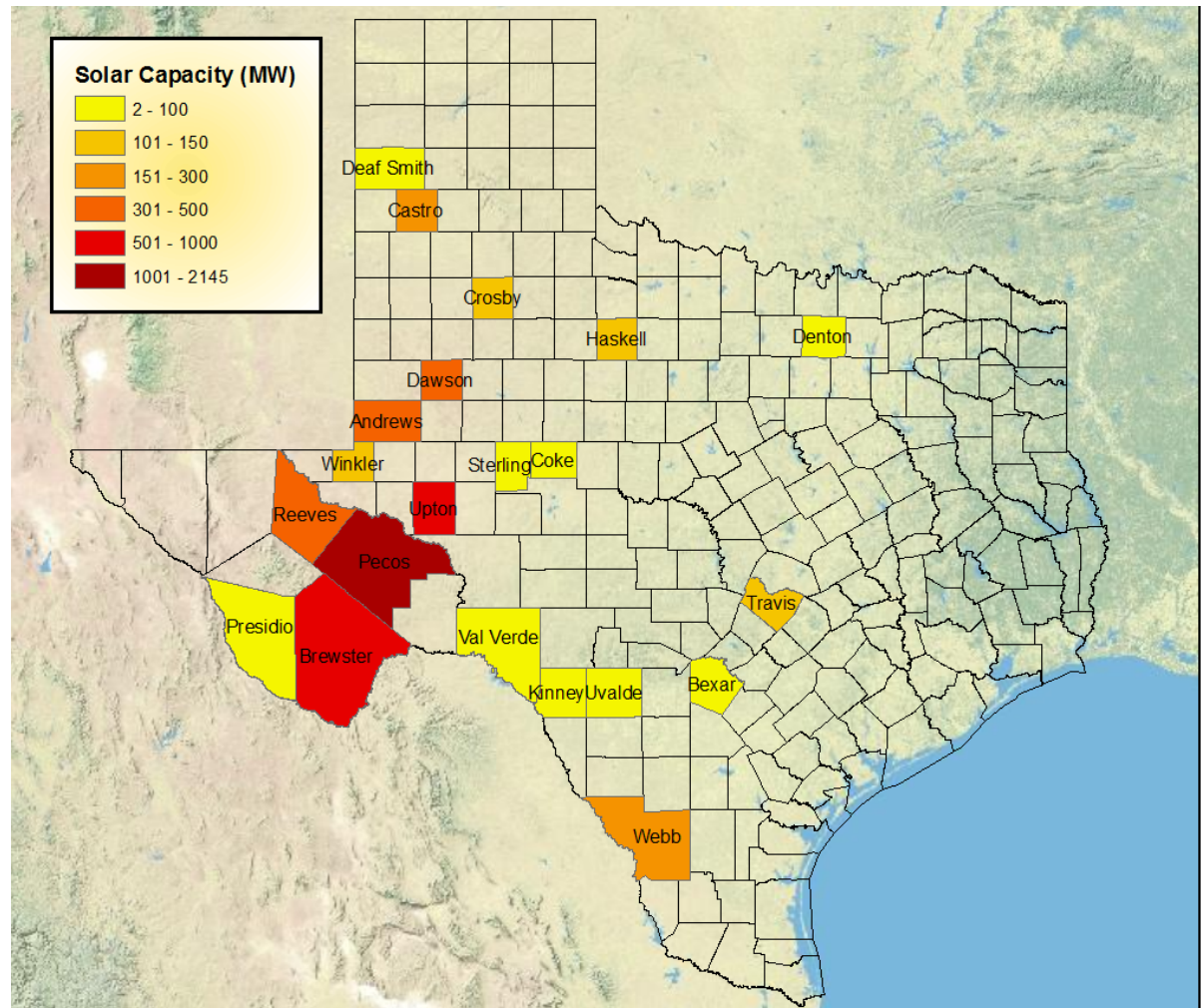


Looking Ahead: Power Plant Development Pipeline

- Through November 2016, there are 12,439 MW of solar projects in development in ERCOT
- 2,019 MW with signed interconnection agreements
- 20 counties have projects online or in development

Source: ERCOT

Note: map includes projects online and those with executed interconnection agreements or under full study



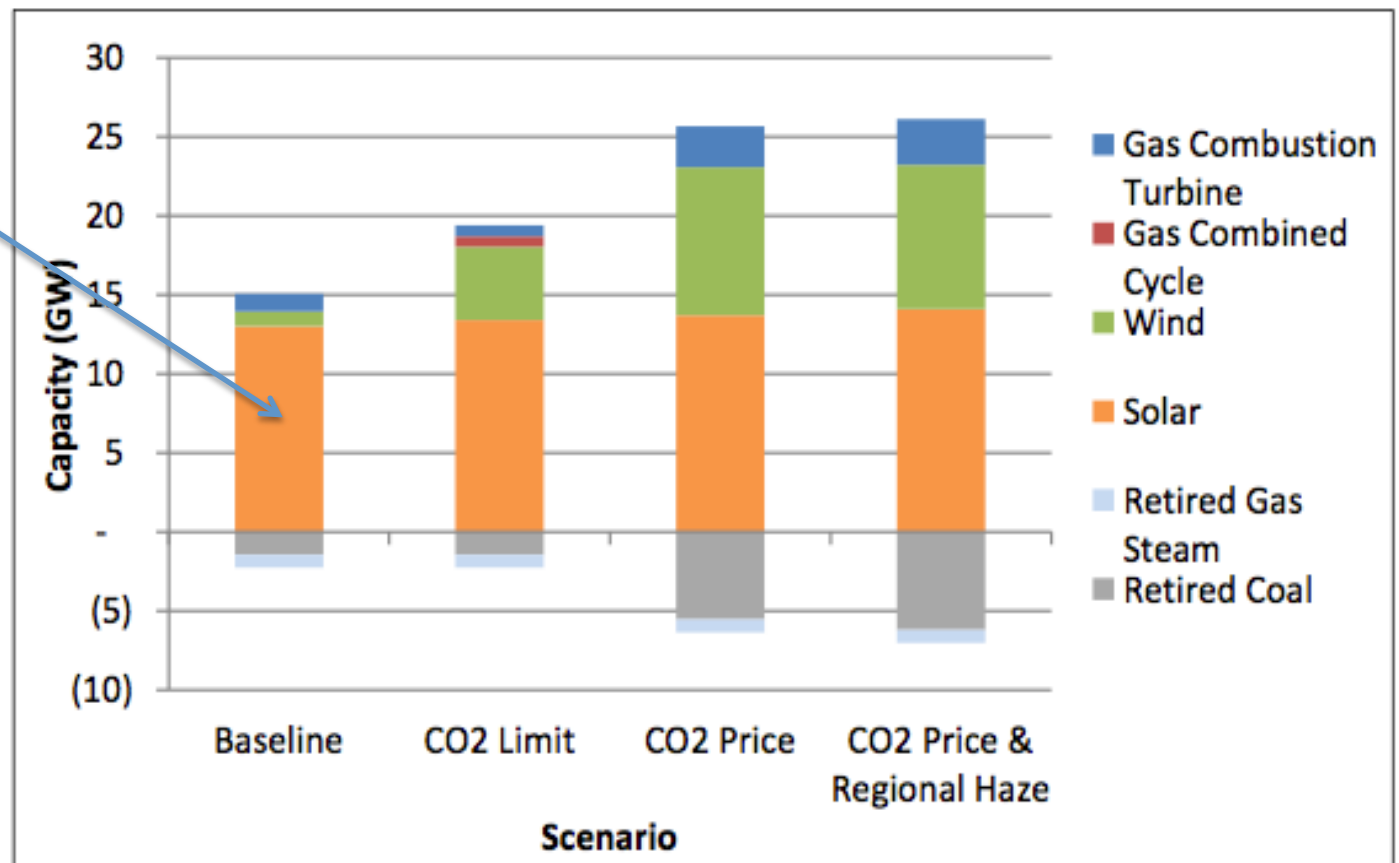


Looking Ahead: ERCOT Projections

Capacity Additions and Retirements by 2030

13,000 MW solar with “business as usual”

* Prior to ITC extension



Source: ERCOT Analysis of the Impacts of the Clean Power Plan



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