The Solar Industry and the HERS Index – A New Marriage

Troy Bevilacqua | February 18th, 2015

Today's presentation

- SunPower
- Current state of solar
- Product Performance
- Solar and the HERS Index
- Going Solar

KB Home – Net Zero w/ Energy Storage

Please ask questions along the way

Innovation distinguishes between a leader and a follower.

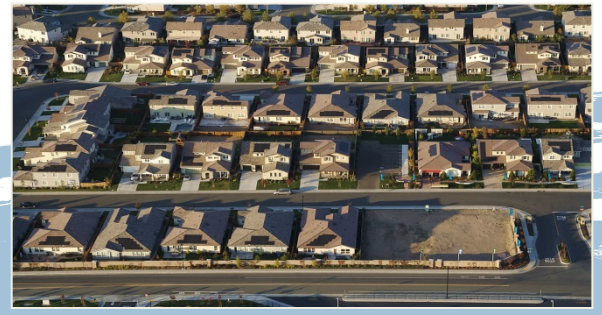
Steve Jobs

SunPower Corporation Overview

We manufacture, design and build the world's highest performing solar electric systems

- Worldwide footprint – US Based
- Publicly traded (NASDAQ), $4.5B Market Cap
- In business for 30 years
- 6,000+ global employees
- World record solar efficiency
- Residential, commercial, utility scale
- Committed to innovation: nearly 300 patents
- Parent Company – Total S.A., 11th largest company in the world[1]

Established and Proven. Technology Leaders.



[1]2012 Fortune 500 Global Ranking

An Unmatched Product Lineup

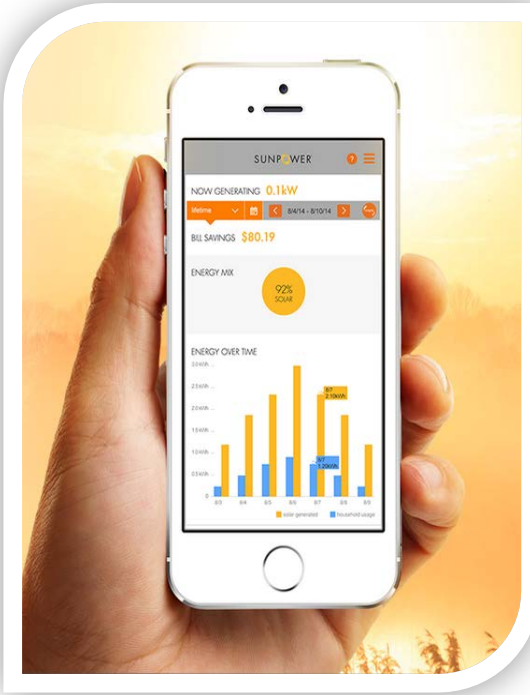
Highest quality and efficiency – most attractive – customer friendly

SunPower All-Black X-Series Panels

SunPower Low Profile Mounting Systems

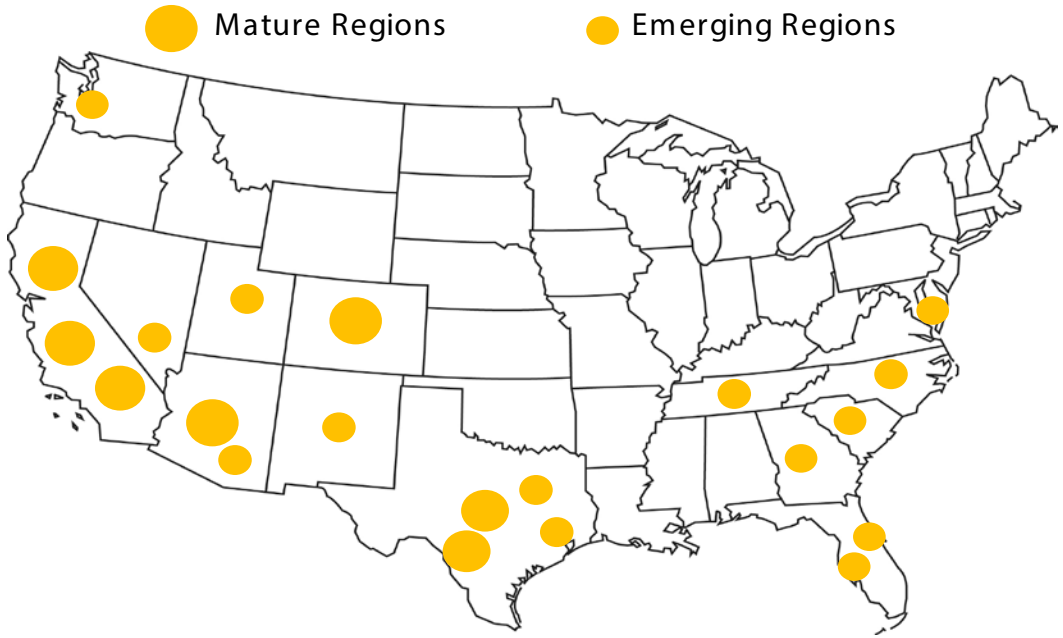
Secure Power Supply High Efficiency TL Dual MPPT Inverter

SunPower Active Performance Monitoring



One brand, one company – SunPower

SunPower New Homes Division



- Market Leader
  - First to market, installing in production homes
  - First manufacturer to offer turnkey builder program
  - Credited for creating the CA New Home solar market
    - Innovative business model
    - Driver of public policy
- Experience since 2005
  - Installations in more than 700 communities
  - >17,000 systems installed in production homes
  - >70% CA market share of new homes
- Footprint
  - Compelling value proposition
  - Suitable policy environment
  - Production homebuilding

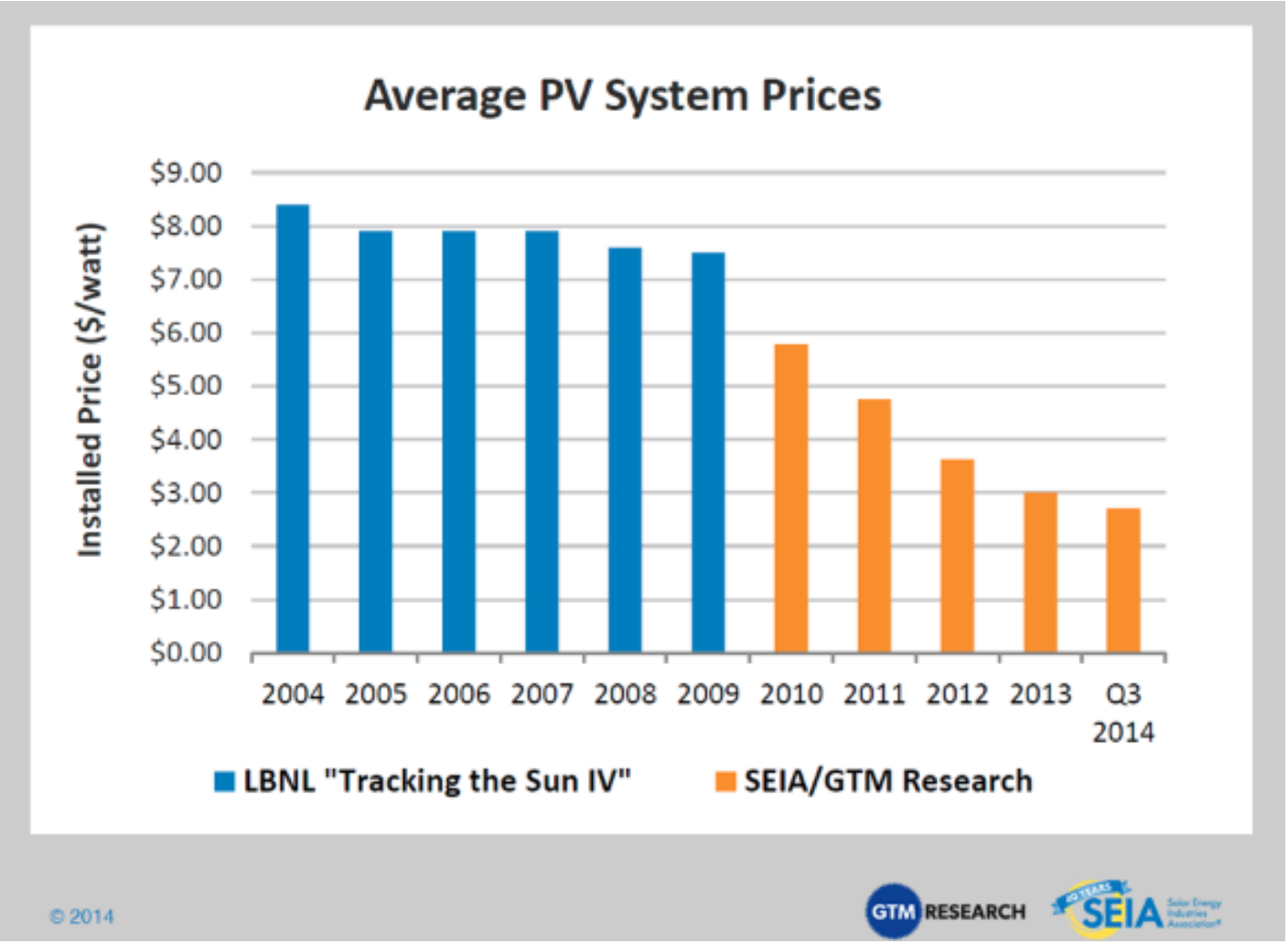
Our Builder Partners

Combining for more than 150,000 homes built annually

Current state of solar

SUNPOWER®

Falling prices



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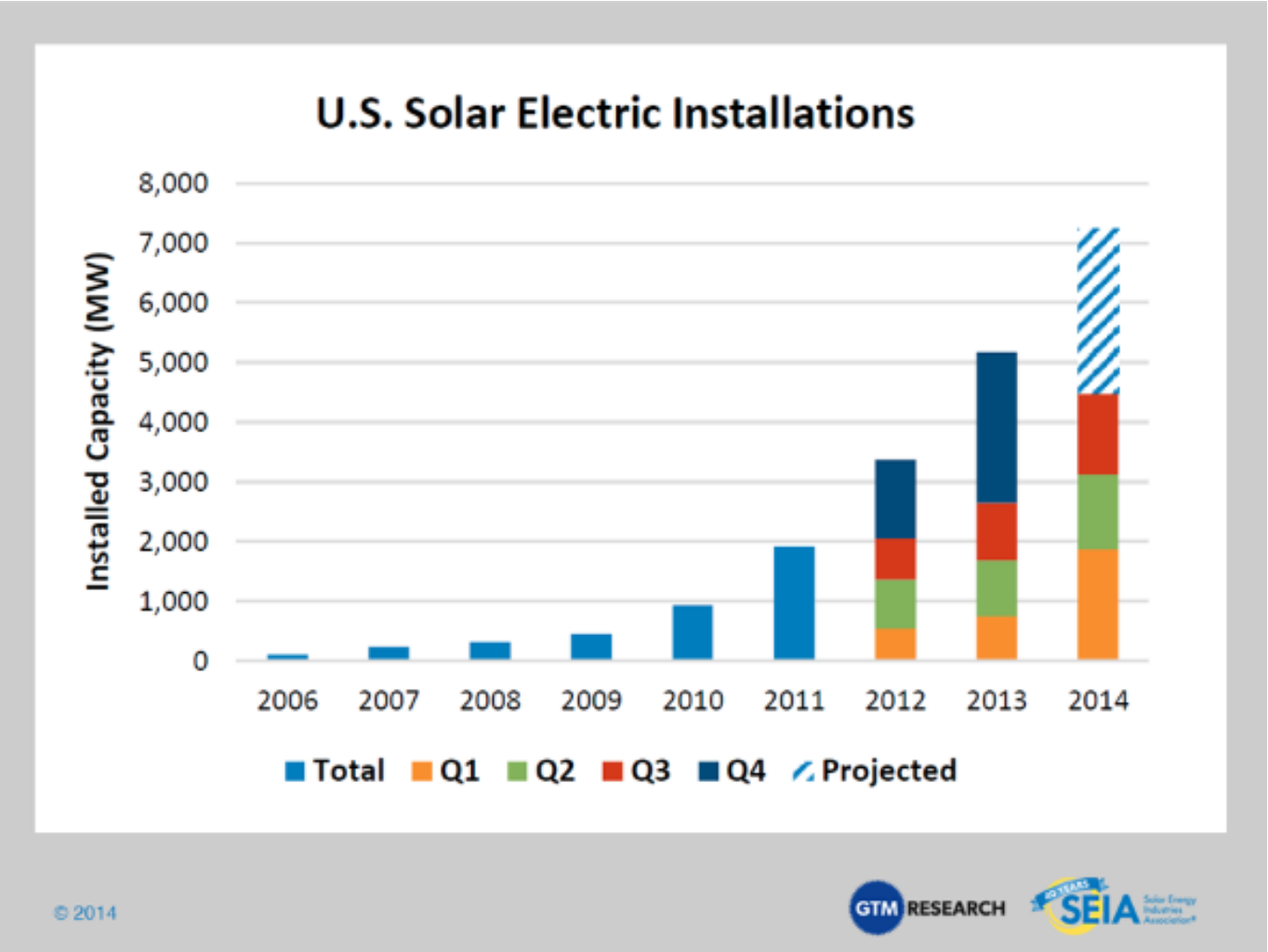
Significant growth



Wohlgemuth, J. "Reliability of PV Systems." Proceedings of SPIE, Aug, 2008.

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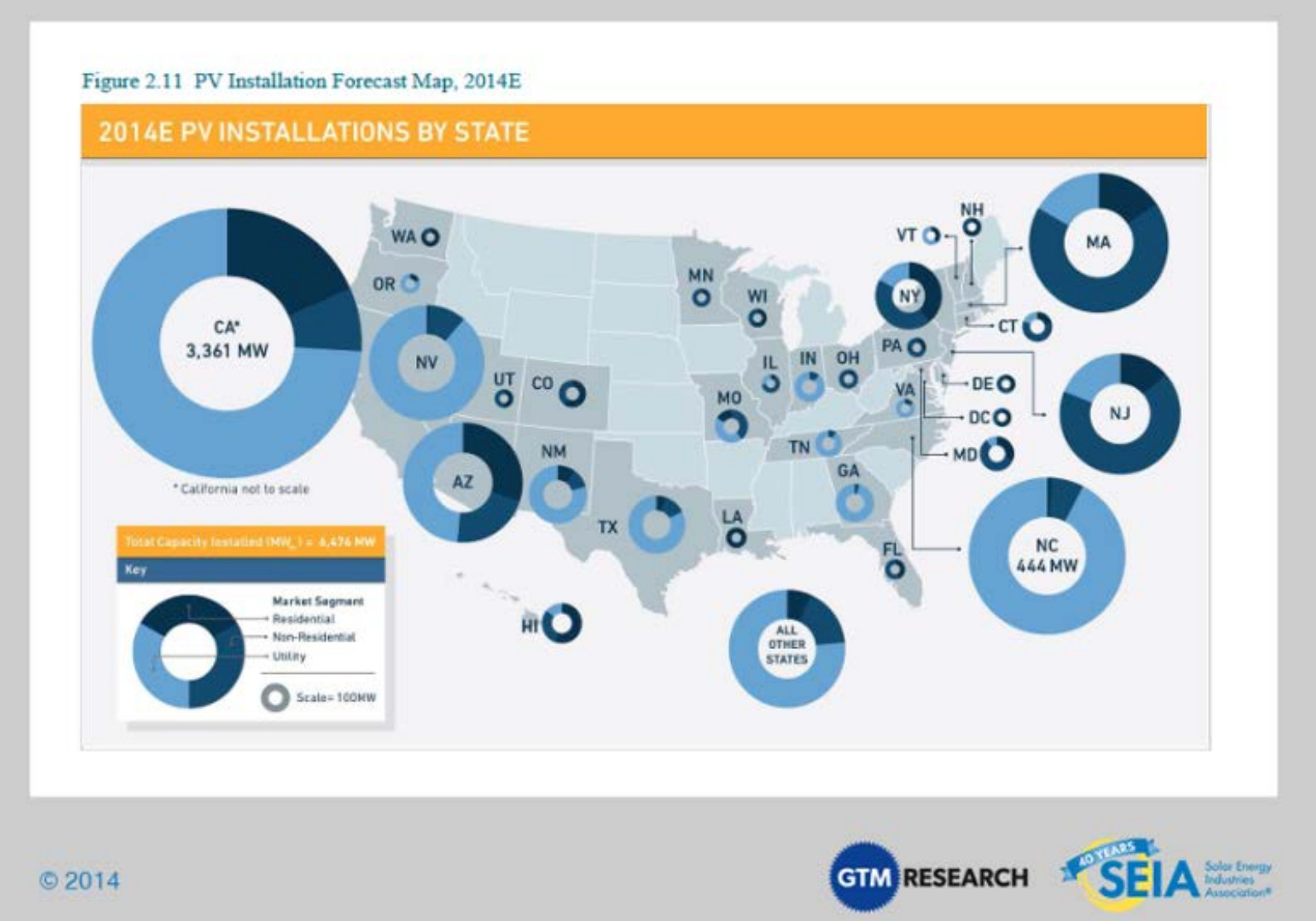
Solar by state



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Product Performance

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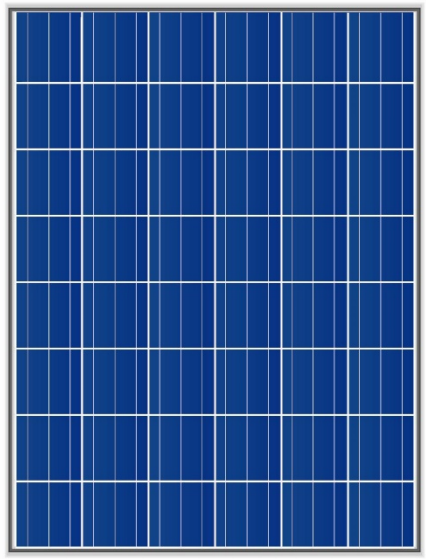
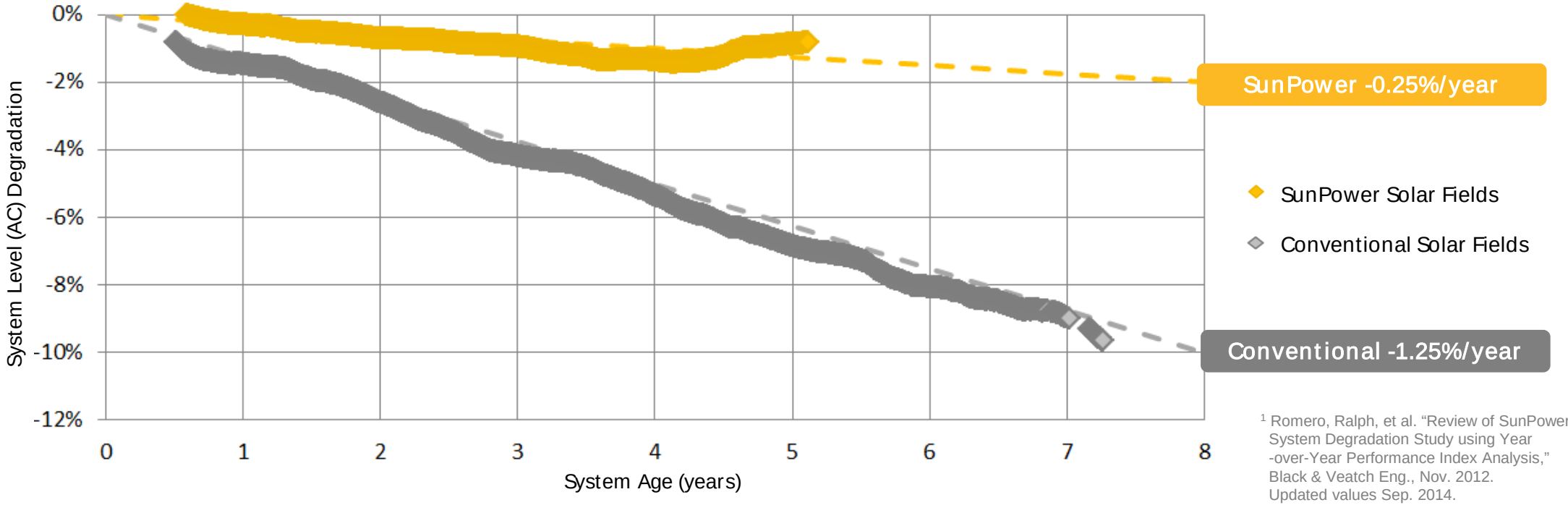
Products Performance and Reliability

- Not all products perform the same
- Solar is no exception
  - Wide range of appearance
  - Wide range in performance
  - Wide range of reliability



System-Level Degradation from Field Data

- The most comprehensive degradation study ever done: more than 800,000 panels from over 400 monitored inverters across 144 sites, for time spans averaging 6 years.
  - SunPower systems: 86MW, age 3.5-7.5 years
  - Non-SP systems: 42MW, age 4.5-13.5 years
- SunPower degradation rate affirmed by Black & Veatch[1], one of the most experienced Independent Engineering firms in solar power plants, with over 2,000 MW of utility scale projects



[1] Romero, Ralph, et al. "Review of SunPower Fleet-Wide System Degradation Study using Year -over-Year Performance Index Analysis," Black & Veatch Eng., Nov. 2012. Updated values Sep. 2014.

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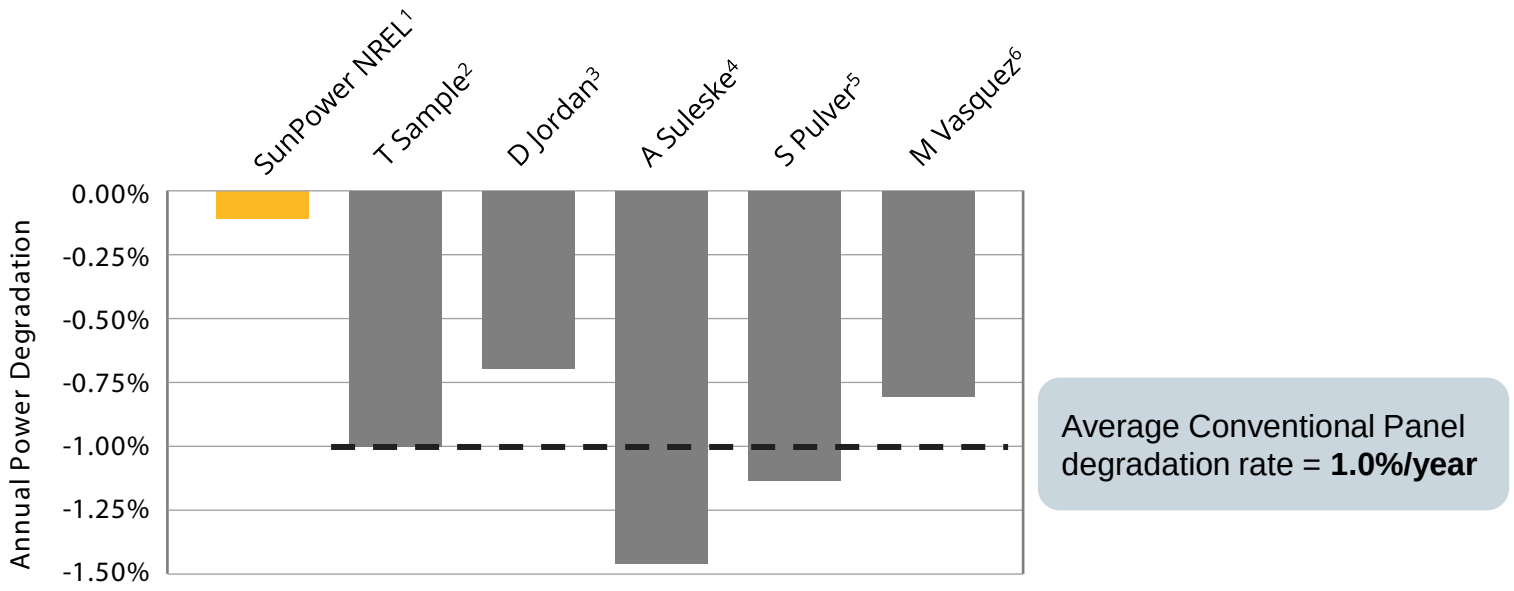
Third-Party Studies: Lower Degradation Rate

- National Renewable Energy Lab (NREL) has been measuring SunPower panel degradation in Colorado since May 2007: -0.10%/yr.
- Large research studies of Conventional Panels indicate a degradation rate of approximately -1.0%/yr.



Lower degradation = more energy over the life of the system

[1] Jordan, Dirk "SunPower Test Report," National Renewable Energy Laboratory, June 2014
[2] Sample, T. "Failure modes and degradation rates from field-aged crystalline," Feb 2011
[3] Jordan, D., et al. "Photovoltaic Degradation Rates – an Analytical Review," Progress in Photovoltaics. Jan 2013. Vol 21, p 12-29. Average degradation rate show in plot.
[4] Suleske, A. "Performance Degradation of Grid-Tied Photovoltaic Modules in a Desert Climatic Condition," Nov, 2010.
[5] Pulver, S. "Measuring Degradation Rates without Irradiance Data" Jun, 2010
[6] Vazquez, M. "Photovoltaic Module Reliability" 2008

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Solar and the HERS Index

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Solar and the HERS Index

Code changes are forging the relationship

- In California, the 2013 code provided homebuilders credit for solar energy production, in most regions
- The 2016 code is expected to expand on this credit
- By 2020, all new homes in California are to be Net Zero, per the CEC
- The 2015 IECC provides builders credit for solar energy production, as part of a performance path to compliance

KB Home – Fiora at Blackstone, El Dorado Hills, CA

Case Study: Standard home has HERS of 64

- Reduced HERS by 19 w/ EE – cost of $1,000/pt.
- Reduced HERS by 45 w/ PV – cost of $550/pt.

Low hanging EE fruit is getting harder to find

Cost effectiveness – EE vs. Solar

Third party study

SunPower commissioned of study to better understanding how the cost effectiveness of solar compares to widely used EE features.

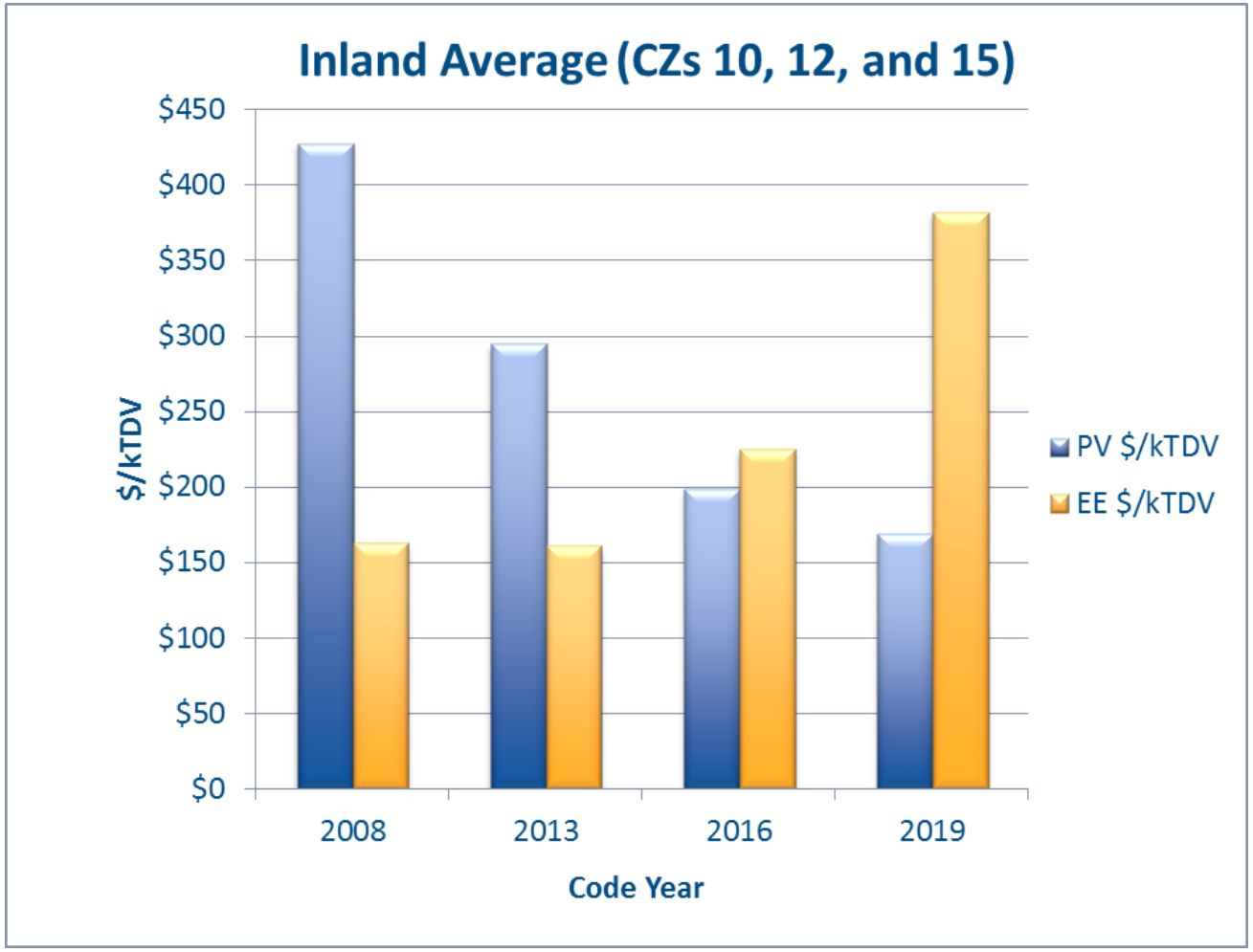
The study was performed by ConSol, a well respected firm that has been providing energy solutions for builders, government agencies, utilities, trade associations and developers since 1983.

The study evaluated both codes, Title-24 and IECC, and over multiple code cycles.

Contact information;
ConSol
800-526-6765
www.consol.ws

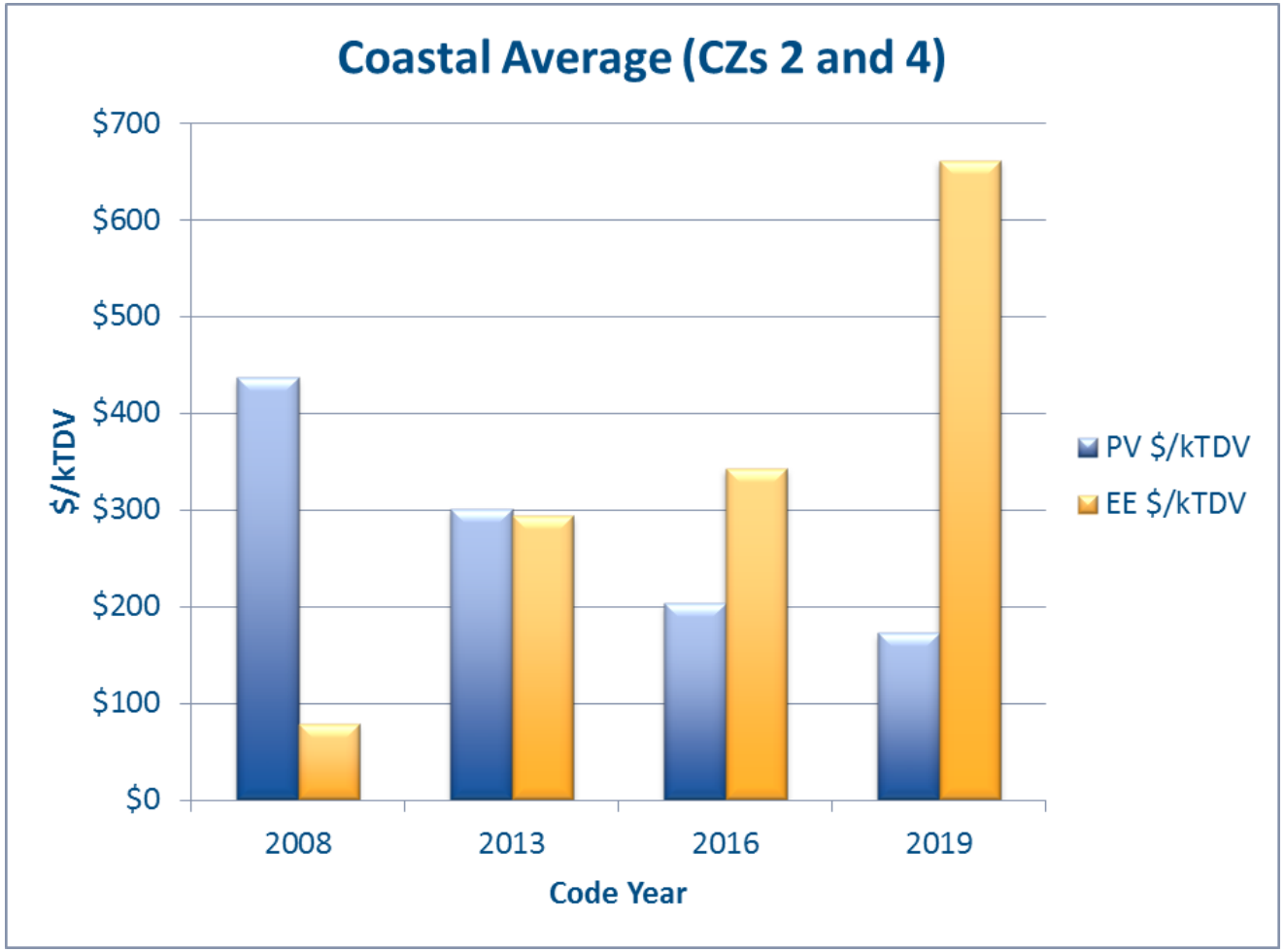
Changing California code

Cooling climates



Changing California code

Temperate climate



Changing California code

EE cost comparatives

Itemized Incremental Compliance Costs using EE to meet changes between 2013 and 2016 Standards (for select CA Climate Zones)

2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 2		
Energy Efficiency Measure	**From**	**To**	Incremental Cost
Attic Insulation	R-30	R-38	$262
Air Infiltration	5 ACH50	3 ACH50	$610
Windows	.35 U-factor/.30 SHGC	.31 U-Factor/.22 SHGC	$611
Furnace	.80 AFUE	.92 AFUE	$598
Refrigerant Charge Test	None	Verified	$127
Water Heater	.62 Storage	.82 Tankless	$654
		TOTAL	**$2,862**

Changing California code

EE cost analysis across al CZ's

2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 4		
Energy Efficiency Measure	From	To	Incremental Cost
Furnace	.80 AFUE	.92 AFUE	$598
Water Heater	.62 Storage	.82 Tankless	$1,217
Quality Insulation Installation (QII)	None	Verfied	$843
Space Cooling	14 SEER	15 SEER	$559
		TOTAL	**$3,217**

2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 10		
Energy Efficiency Measure	From	To	Incremental Cost
Furnace	.80 AFUE	.92 AFUE	$598
Water Heater	.62 Storage	.82 Tankless	$1,217
Space Cooling	14 SEER	15 SEER	$609
Air Infiltration	3.5 ACH50	3.0 ACH50	$420
Whole House Fan	None	Fan Installed	$520
Garage Ceiling Insulation	R-19	R-30	$55
		TOTAL	**$3,419**

2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 12		
Energy Efficiency Measure	From	To	Incremental Cost
Furnace	.80 AFUE	.92 AFUE	$598
Water Heater	.62 Storage	.82 Tankless	$1,217
Space Cooling	14 SEER	15 SEER	$559
Air Infiltration	3.5 ACH 50	3.0 ACH50	$420
Whole House Fan	None	Fan Installed	$520
		TOTAL	**$3,314**

IECC solar credit

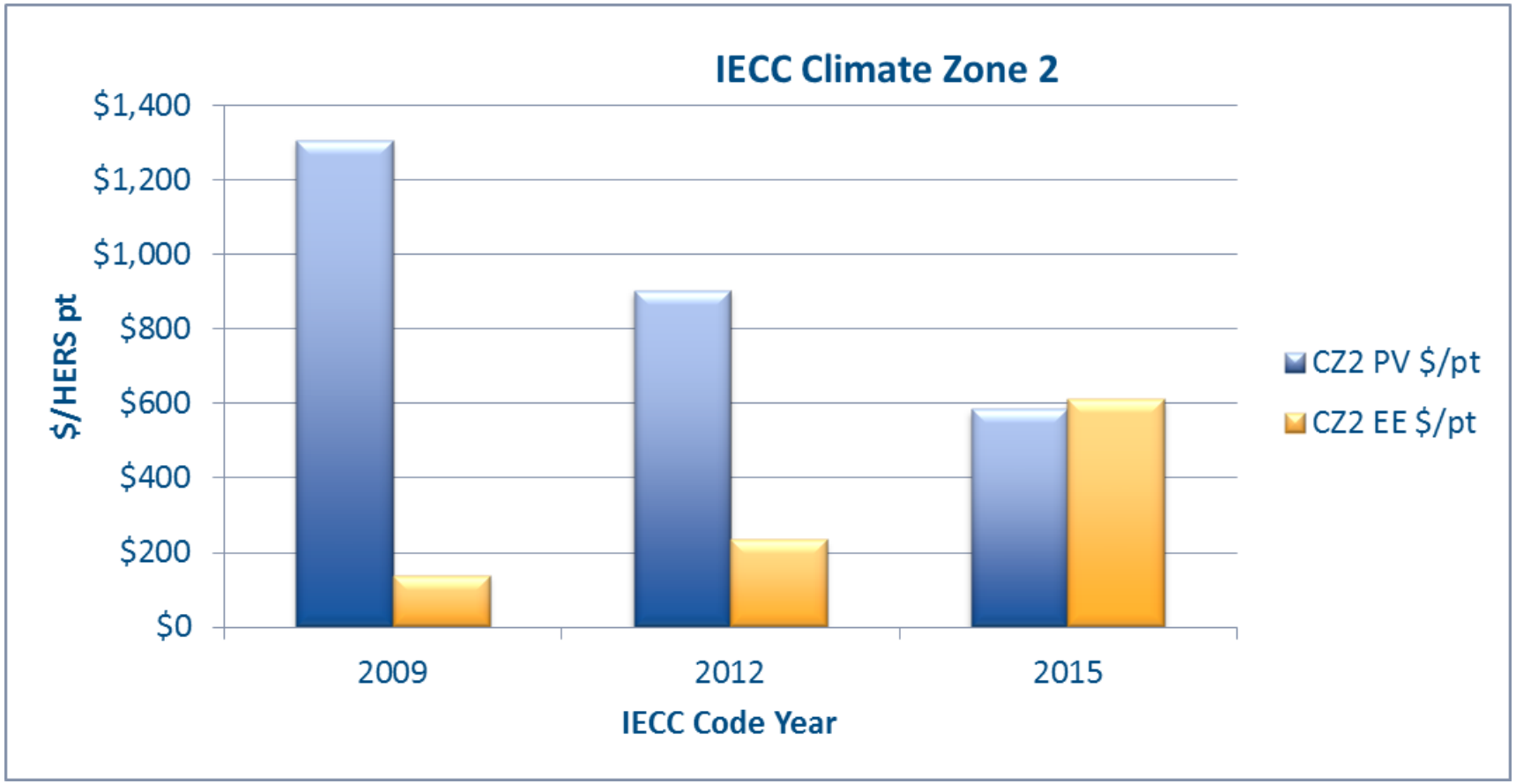
Sunbelt / production homebuilding strongholds

HERS Credit from 3kW System under IECC 2012 (REM/Rate)

IECC Climate Zone 2		IECC Climate Zone 3		IECC Climate Zone 4	
PV System Size (watts)	HERS Score Credit (Δ)	PV System Size (watts)	HERS Score Credit (Δ)	PV System Size (watts)	HERS Score Credit (Δ)
3000	18	3000	21	3000	16

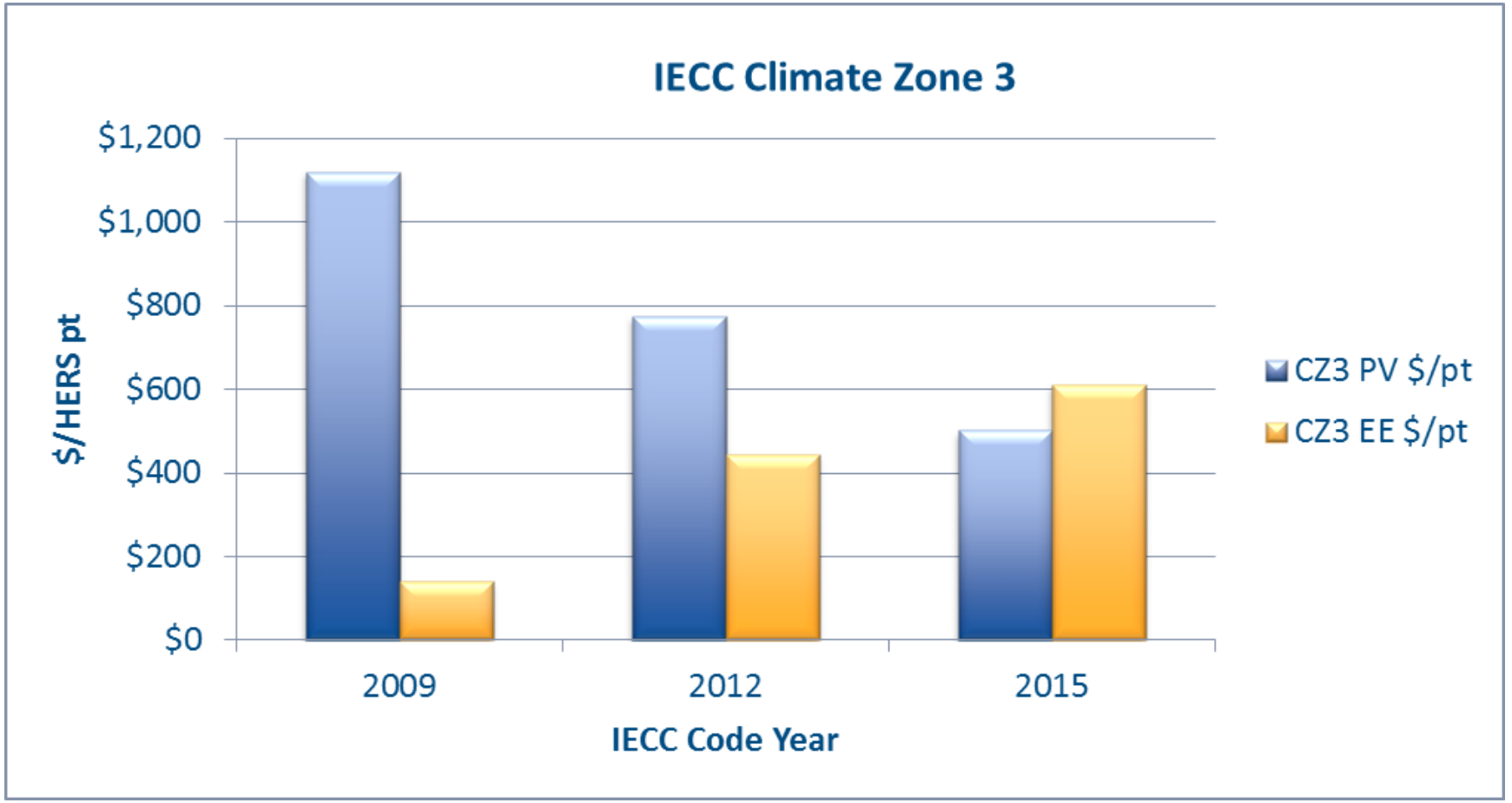
Changing IECC

Cost competitiveness



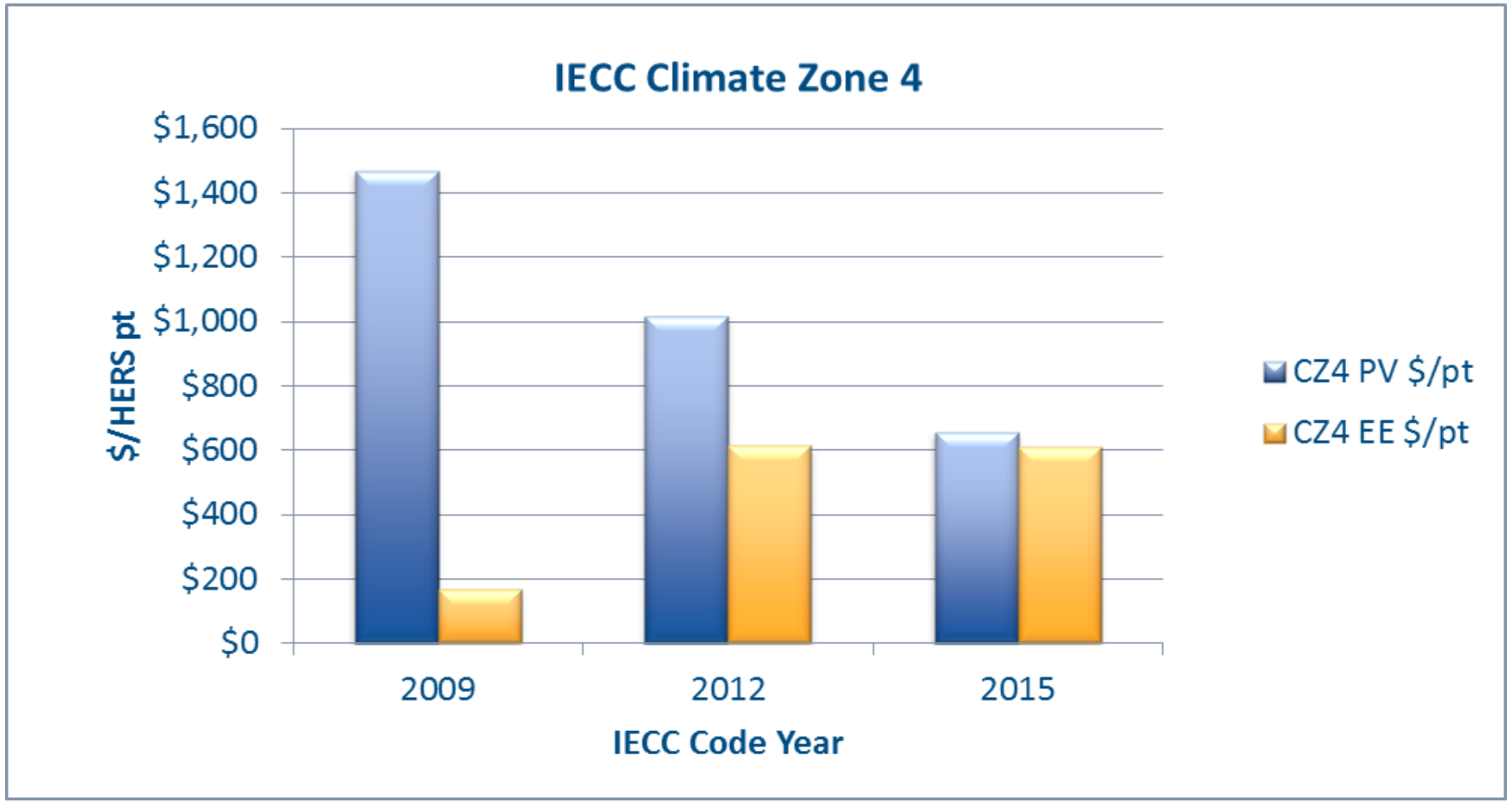
Changing IECC

Cost competitiveness



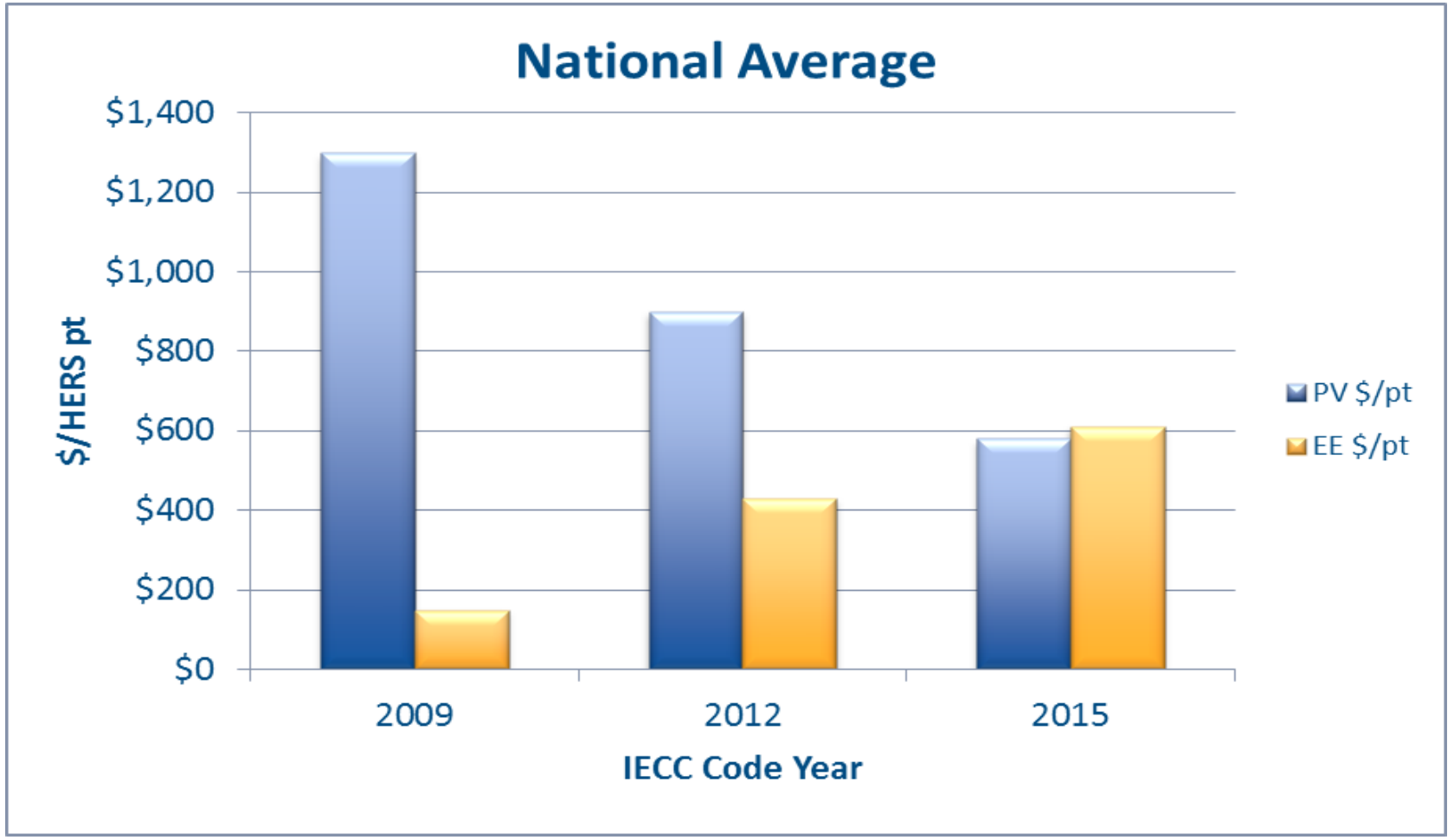
Changing IECC

Cost competitiveness



Changing IECC

Cost competitiveness



Going Solar

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What's the best way to live in a solar home?

What's best for the customer

- There are four primary ways homeowners go solar
  1. Secured and Unsecured loan programs
  2. Leasing or Power Purchase Agreements (PPA)
  3. Cash purchase
  4. Mortgage finance (New Homes only)

- The Facts
  - Mortgages offer the lowest cost of capital. Mortgage interest deduction and best terms, resulting in the #1 way to finance solar
  - Leases were initially launched to help existing home owners go solar because solar loans did not exist, home equity was at all time low and solar was much more expensive
  - Loan (not lease/PPA) programs are the fastest growing area for solar financing

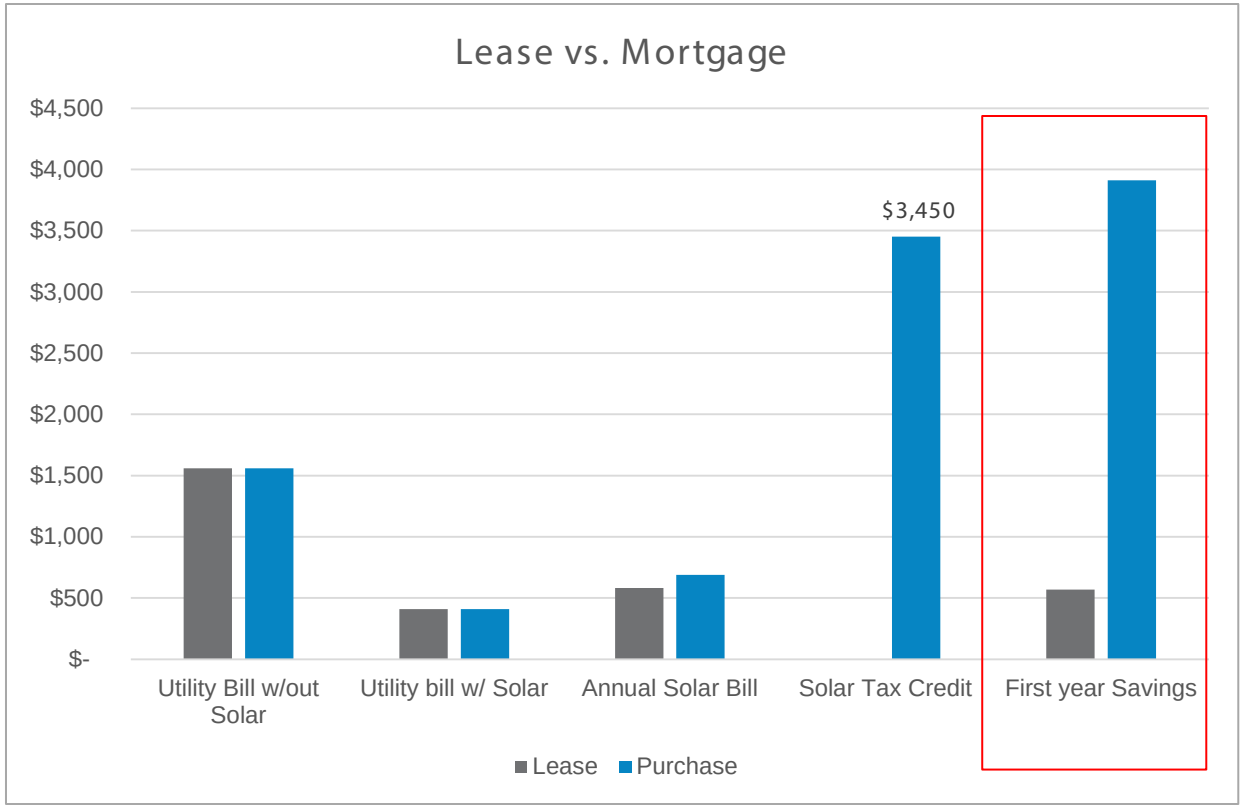
SunPower is one of the largest global solar companies, providing US residential customers with innovative lease and purchase programs

Comparison

Ownership vs. Lease Economics

- Lease; saves $48/mo, no tax credit, two electric bills per month
- Owned; saves $39/mo, 30% Federal tax credit, possible state tax credit, one bill per month
- The Leased system saves ≈$108 more per year
- However, because Owned gets the Federal tax credit, it will take this Leased system 31.9 years to save as much at the owned system
- Owning the system provides the greatest benefit to the Homeowner, and is by far THE BEST WAY TO GO SOLAR IN THE US

Based on 3 kW system, price of $11,500, 8,000 kWh annual consumption, $0.13 lease $/kWh, $0.20/kW offset



Homeowners can lease solar anytime they want, however they can only finance solar through their mortgage once

- SunPower end-mounted panel withstanding 11,000 Pa (230 psf)
- 1,400 kg (3,000 pounds)
- The glass did not break.

Thank You!

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Appendix

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2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 10		
Energy Efficiency Measure	From	To	Incremental Cost
Furnace	.80 AFUE	.92 AFUE	$598
Water Heater	.62 Storage	.82 Tankless	$1,217
Space Cooling	14 SEER	15 SEER	$609
Air Infiltration	3.5 ACH50	3.0 ACH50	$420
Whole House Fan	None	Fan Installed	$520
Garage Ceiling Insulation	R-19	R-30	$55
		TOTAL	**$3,419**

2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 12		
Energy Efficiency Measure	From	To	Incremental Cost
Furnace	.80 AFUE	.92 AFUE	$598
Water Heater	.62 Storage	.82 Tankless	$1,217
Space Cooling	14 SEER	15 SEER	$559
Air Infiltration	3.5 ACH 50	3.0 ACH50	$420
Whole House Fan	None	Fan Installed	$520
		TOTAL	**$3,314**

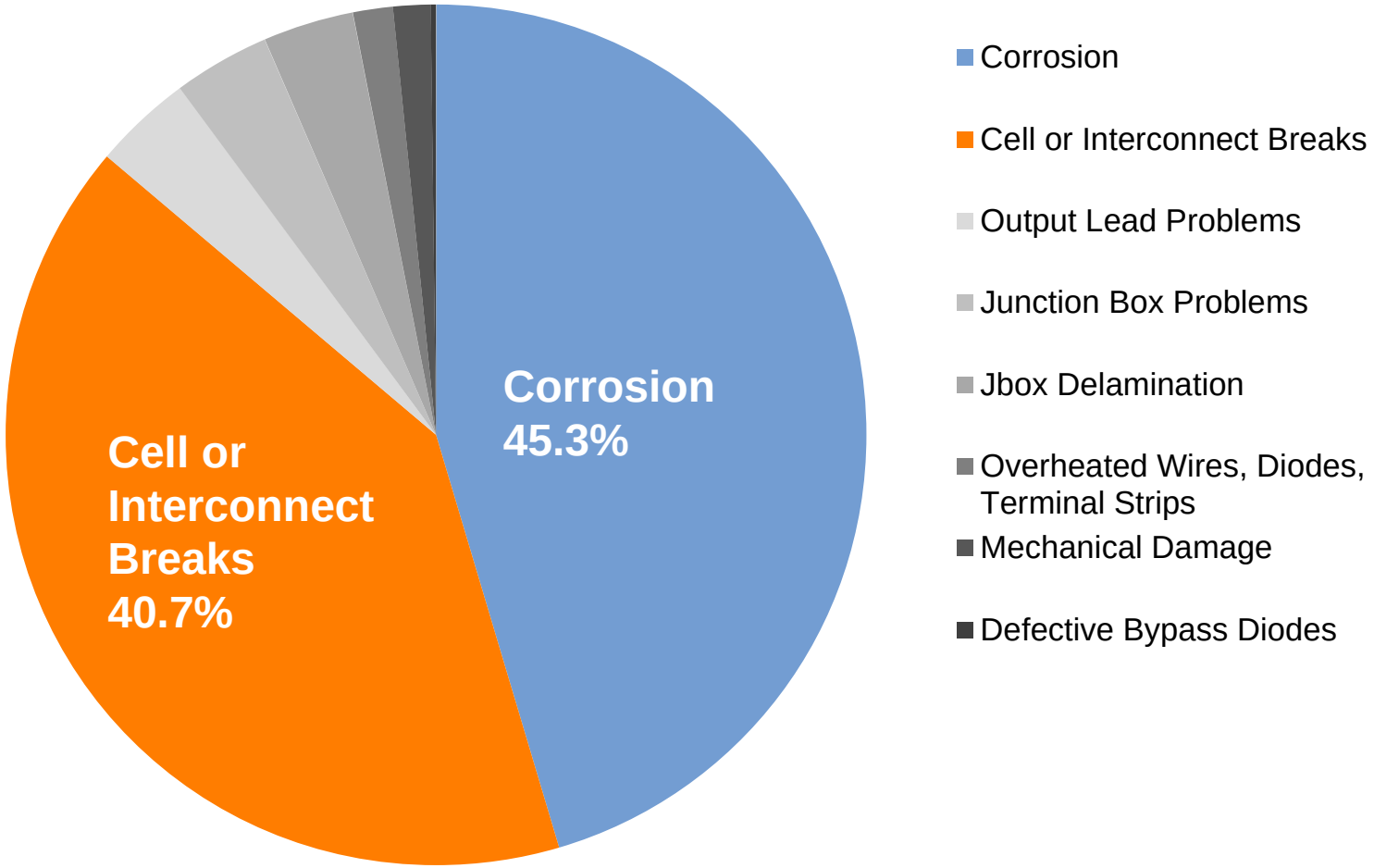
2013 to 2016 T-24 Compliance - Incremental Measures and Costs	Climate Zone 15		
Energy Efficiency Measure	From	To	Incremental Cost
Water Heater	.62 Storage	.82 Tankless	$1,217
Space Cooling	14 SEER	15 SEER	$609
Air Infiltration	3.5 ACH50	3.0 ACH50	$610
Garage Ceiling Insulation	R-19	R-30	$55
Low Leakage Air Handler	None	Verified	$108
		TOTAL	**$2,599**

Difference in HERS Scores Caused by Prescriptive Changes to IECC

CZ 2			CZ3			CZ4		
Year	HERS score	Δ from Previous IECC Code (Prescriptive)	Year	HERS score	Δ from Previous IECC Code (Prescriptive)	Year	HERS score	Δ from Previous IECC Code (Prescriptive)
2006	87	N/A	2006	86	N/A	2006	90	N/A
2009	79	8	2009	78	8	2009	82	8
2012	73	6	2012	71	7	2012	76	6
2015	71	2	2015	69	2	2015	74	2

PV System Costs w/o Incentives	
Year	$-per-Watt
2008	$7.09
2013	$4.89
2016	$3.30
2019	$2.80

Common Ways Conventional Panels Degrade



Wohlgemuth, J. "Reliability of PV Systems." Proceedings of SPIE, Aug, 2008.

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Global Quality Survey

- IHS is a 50 year old company that provides critical information to key decision makers
- Global EPC and system integrators, distributors, and installers were surveyed on buying preferences, brands, and panel suppliers.
- These experts from over 30 countries rated SunPower[1]

  #1 in Panel Quality

  #1 Most Requested Brand

- Module reliability and high quality were ranked as the two most important attributes when selecting a panel

SunPower is globally recognized as a quality leader by industry experts

[1] Gilligan, C., et al. 2014 *PV Module Customer Insight Survey.* IHS Consulting.

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Third-Party Reliability Testing

Fraunhofer

- Fraunhofer is one of the world's largest organizations for applied research, with a staff of more than 20,000 people and an annual research budget exceeding $2 billion. It is world-renowned for its expertise in solar power technology.
- Fraunhofer CSE selected 5 of the top 8 silicon PV manufacturers' panels to rank based on their reliability …SunPower and 4 others (anonymous to participants)
- 20 panels per manufacturer were purchased directly by Fraunhofer either from distributors or on the open market
- The PDVI Test Protocol included: PID testing (damp heat exposure with bias), temperature cycling, humidity-freeze cycling, ultra-violet light exposure, static and cyclic mechanical load testing
- In 2013, three more panels were tested - SunPower maintained its leadership with 6 times less power loss[2]

Manufacturer	Average Power Drop	Max Power Drop
SunPower	1.3%	2.3%
Four out of the top eight crystalline silicon panel manufacturers in 2012 (*SunTech, Yingli, Trina, Canadian Solar, Sharp, Hanwha SolarOne, Kyocera*) Three anonymous panels in 2013.	7.8%	94%

SunPower panels came out #1, with an average power drop of 1.3% across all panels[1]

[1] Meakin, D. H., et al. (2013). Fraunhofer PV Durability Initiative for Solar Modules. Photovoltaics International, 77–87.
[2] Ferrara, C., et al. (2014). Fraunhofer PV Durability Initiative for solar modules: Part 2. Photovoltaics International, 77–85.

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Third-Party Reliability Testing

PV EVOLUTION LABS
ADVANCING SOLAR

- PV Evolution Labs is an independent testing lab specialized in performance and characterization testing on PV panels owned by the independent engineering firm, DNV-GL.
- The Potential Induced Degradation Certification Program tests a panel's susceptibility to voltage stress, which can cause rapid power loss.
- Panels were tested at maximum voltage rating in all grounding configurations.
- SunPower panels degraded negligibly during this test.

Manufacturer	Pass Rate	Average Power Drop
SunPower	100%	0.2%
Conventional Panels	50%	4-5% for panels that passed the test

SunPower panels are exceptionally resilient against PID in any grounding configuration.

[1] Based on independent testing and analysis performed by PV Evolution Labs in 2013. To pass, panels must have less than 5% power loss at 100 hours and 10% power loss at 600 hours.

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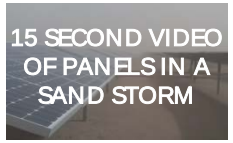
Third-Party Reliability Testing

TÜV Rheinland PTL

- TÜV is a 130 year old organization founded in Germany and is recognized as global leader in validating the safety of products and determining their robustness against environmental hazards.
- Desert conditions present harsh stresses:
  - Intense UV exposure breaks down materials
  - Blowing sand and dust erode surfaces
  - Fine dust infiltrates seals and connectors
- TÜV's Sandstorm Testing is based on military and IEC specifications for desert environments and goes well beyond conventional panel certification programs. For example:
  - UV dosage is 8x IEC requirement
  - Quartz particles are shot at 108 kph (67 mph) against the panel surfaces
- SunPower is the first and only manufacturer to pass this stringent test.[1]



SunPower panels are robust against state of the art desert stress tests

[1] "SunPower Successfully Passes TÜV Rheinland's Rigorous Sand and Dust Testing". TÜV press release. May-14.

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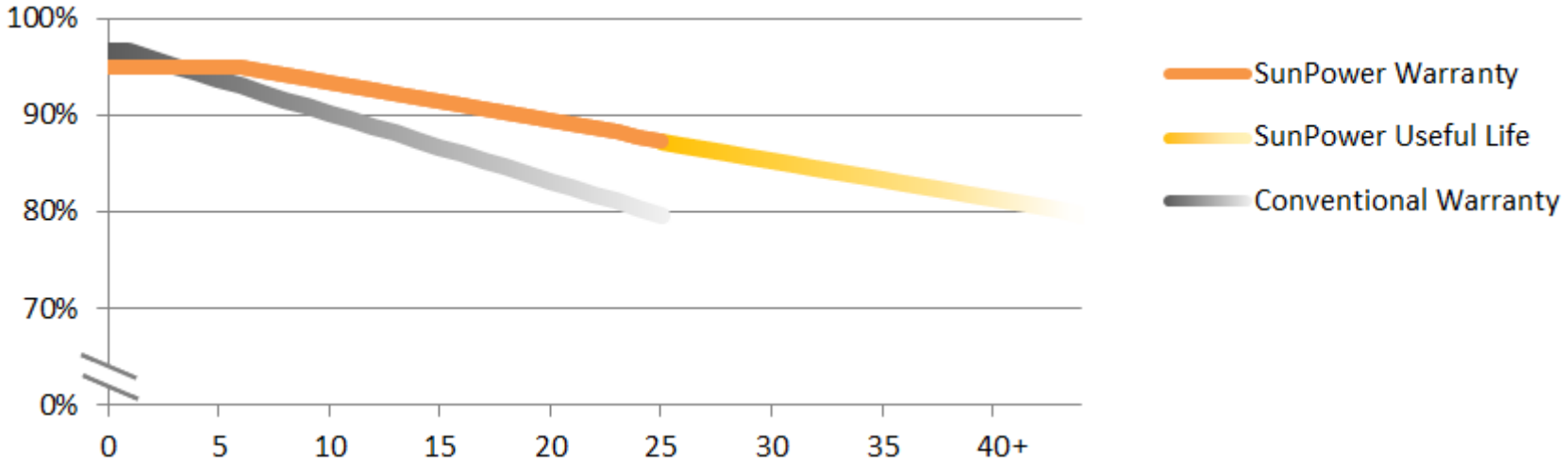
Useful Life Beyond 25 Years

SunPower panels are designed for at least 40 years of service

Useful Life is defined as 99% of the panels producing at least 70% of their rated power.

- SunPower's robust design and industry leading research on accelerated ageing shows SunPower panels are expected to last well beyond their warranty period – at least 40 years.
- This is the same in other industries: home electronics and automobiles have a useful life well in excess of their warranty



Much more energy for same upfront cost, higher potential resale value.

[1] SunPower Module 40-year Useful Life. SunPower whitepaper. 2013.

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