

Challenges to the Greater Penetration of Solar PV

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Yellow Canary

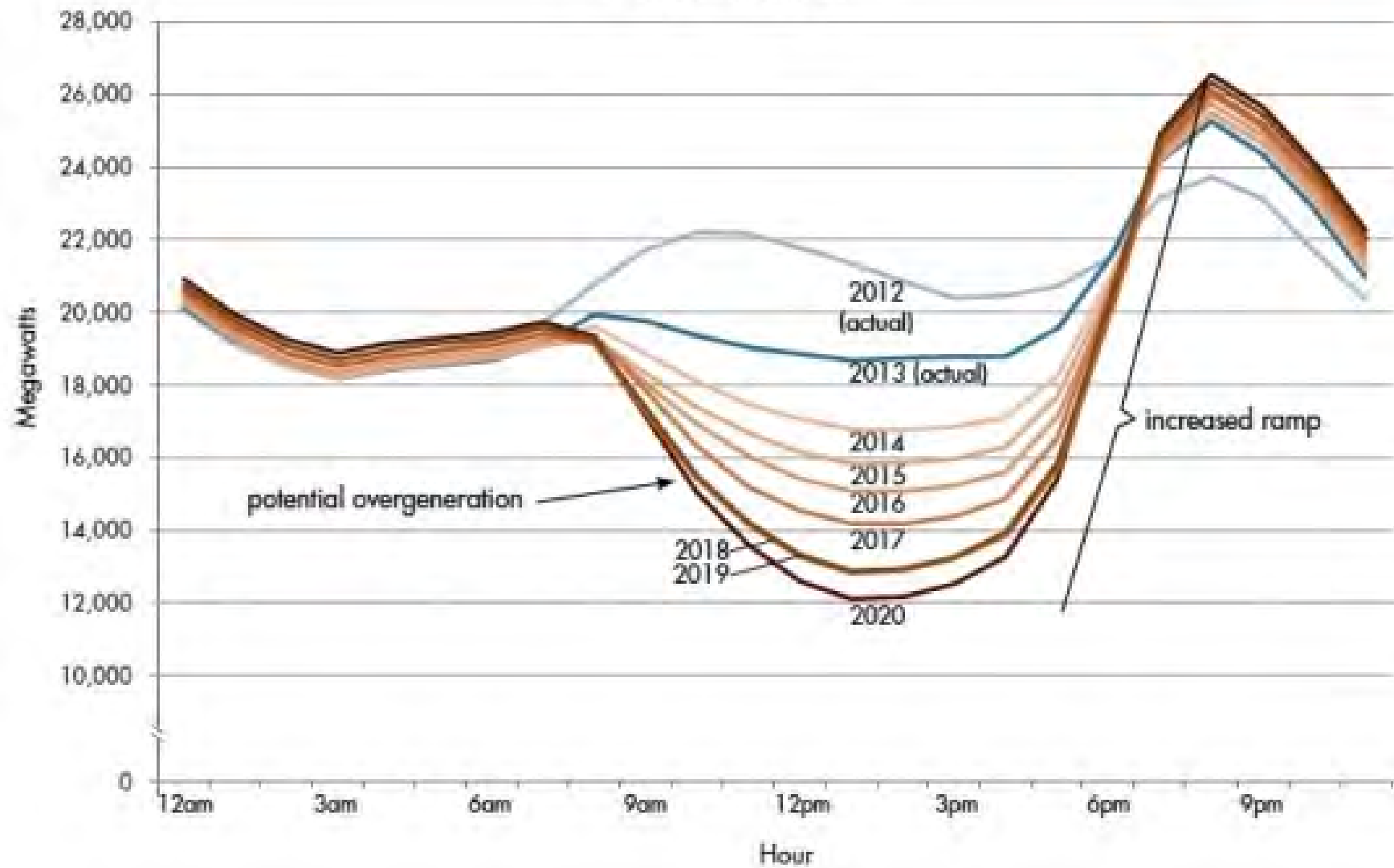


Canary in a Coal Mine



CAISO Duck Curve

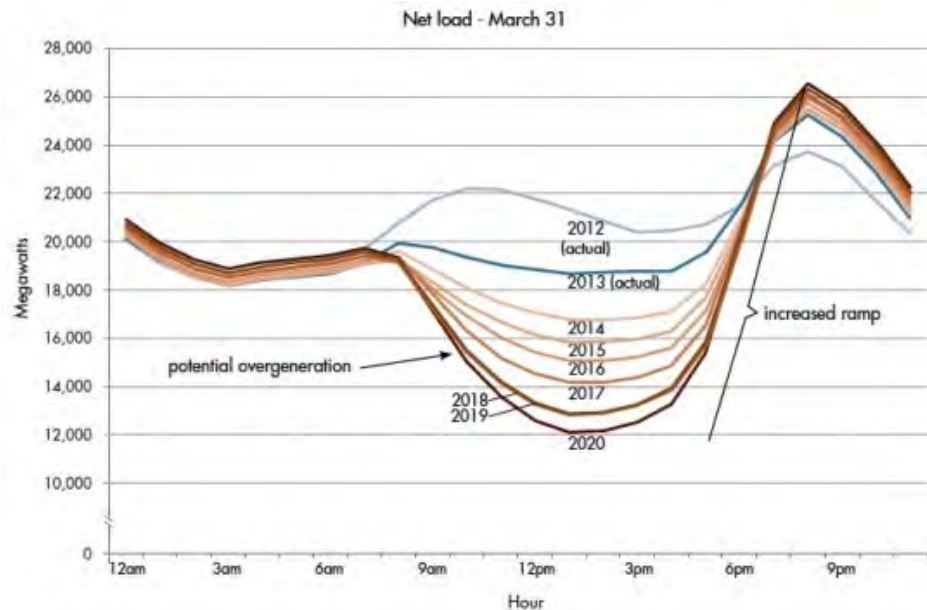
Net load - March 31



CAISO Duck Curve

Effects on Grid

- Steep Ramps
- Over-Generation Risk
- Decreased Frequency Response



ISO Requires

- Sustain Ramps (Up / Down)
- Respond for a Defined Time
- Store Energy or Modify Use
- Start with Short Notice from Zero Energy
- Stop and Start Multiple Times
- Forecast Operating Capability

CAISO Duck Curve

Renewable Performance
Standard (RPS) of 33% by 2020

Gov. Jerry Brown calls for 50%

AB 2514 calls for 1.3GW of
Storage by 2022

PREPA MTR

Irradiación Global Horizontal

Puerto Rico



Mandated Renewable Generation

12% by 2015

15% by 2020

20% by 2035

Power Purchase Agreement

\$0.15/kWh escalating by \$0.02/year

\$0.35/kWh Renewable Energy Credit

PREPA MTR

National Renewable Energy Labs - DOE

6 Frequency Response / Regulation

“For large frequency deviations (in excess of 0.3Hz), the PV facility shall provide an immediate (less than 1 second) real power primary frequency response of at least 10% of the maximum AC active power capacity for a time period no less than 10 minutes.

#7 Ramp Rate Control

“The PV facility shall be able to control the rate of change of power output during some circumstances, includes but not limited to:
1) rate of increase of power, 2) rate of decrease of power, 3)
rate of increase of power when a curtailment of power is released”
“A 10% per Minute rate limitation shall be enforced”

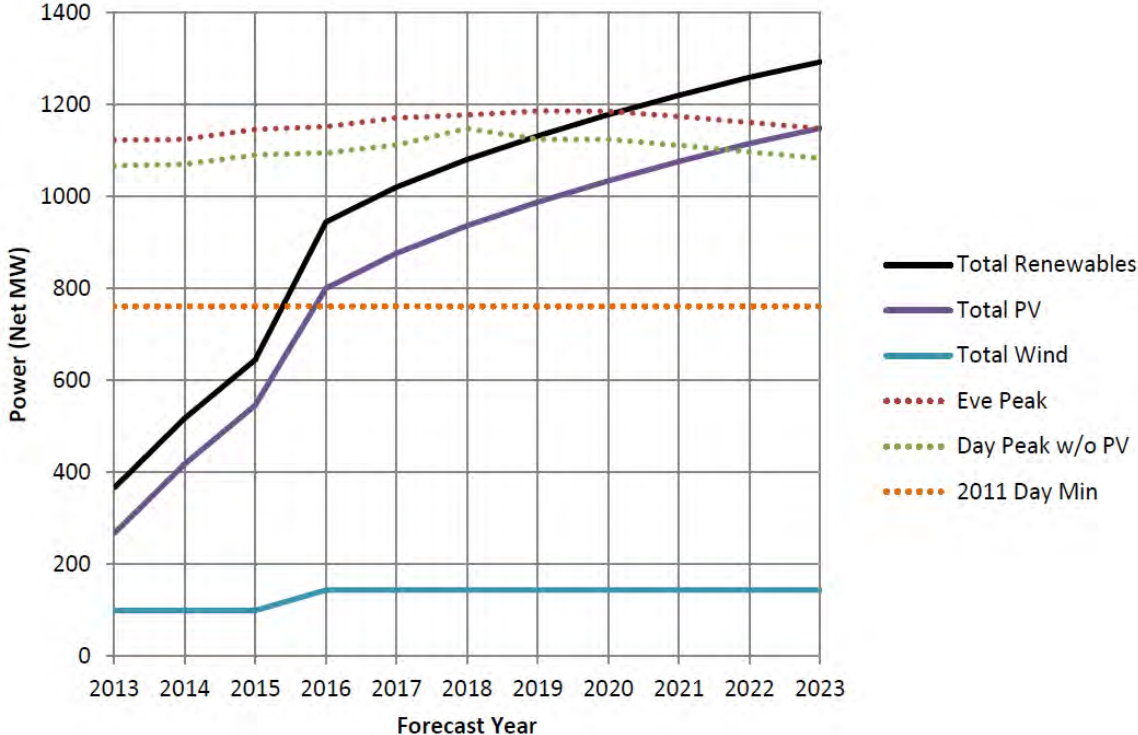
PREPA MTR

Peak Load in 2012 is 3,159MW.

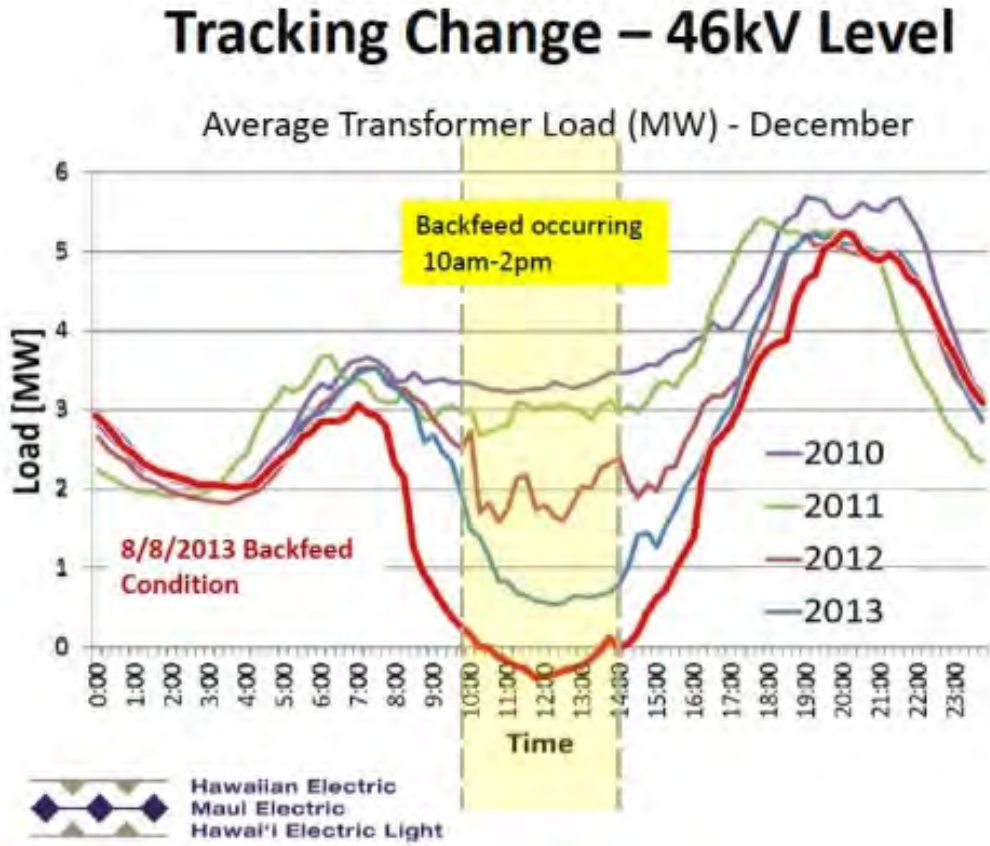
Between 2009 and 2012, 64 projects
totaling 2,200MW
70% of peak

HECO Solar

HECO Forecasts



HECO Solar



The “Nessie Curve”

HECO Solar



HECO Stats

1200MW Evening Peak

800MW Minimum daytime load

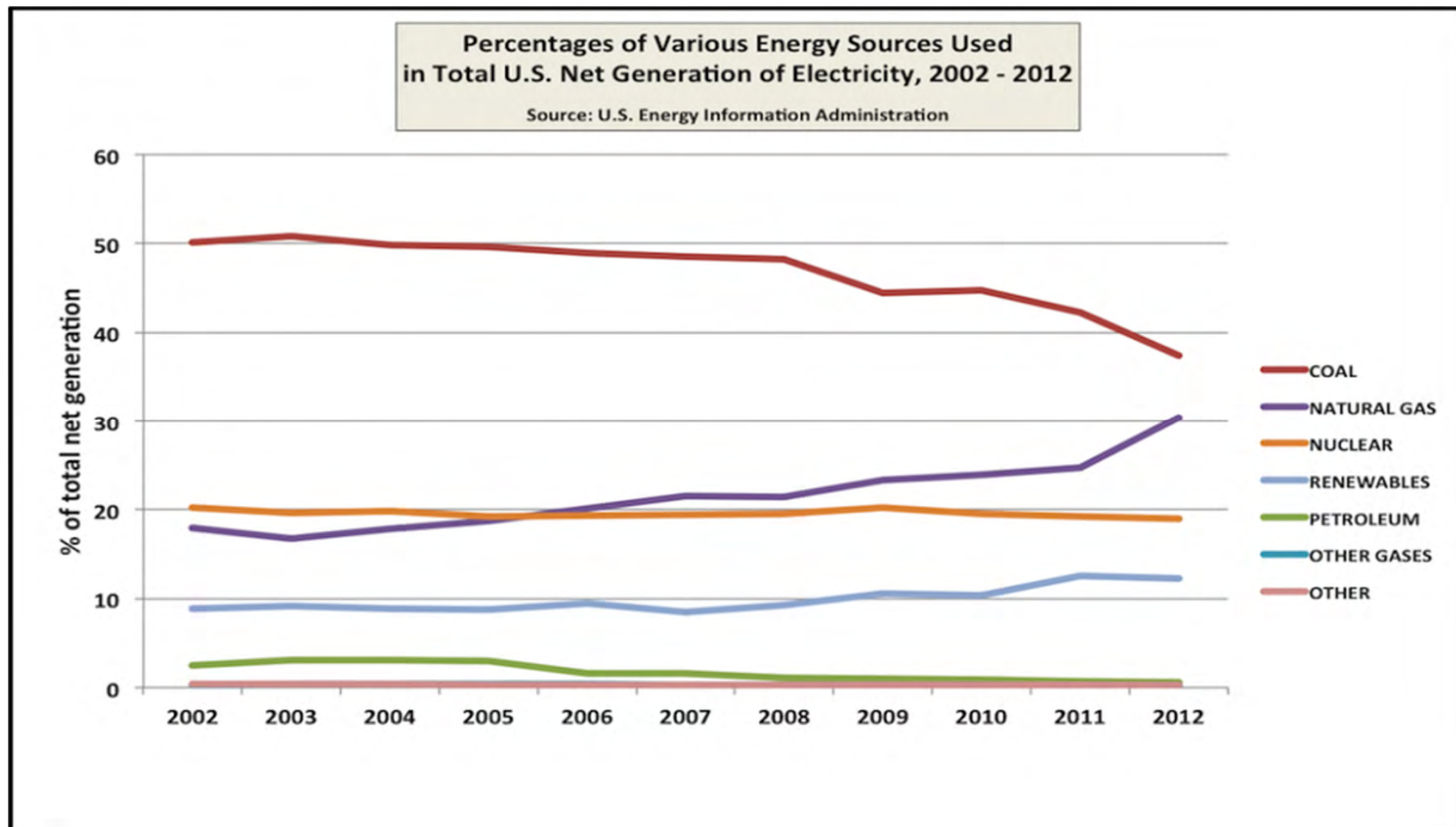
2013 250MW solar PV (mostly rooftop)
 100MW wind

Recent RFP for 60 – 200MW of Energy storage, 30 minute minimum

Canary in a Coal Mine

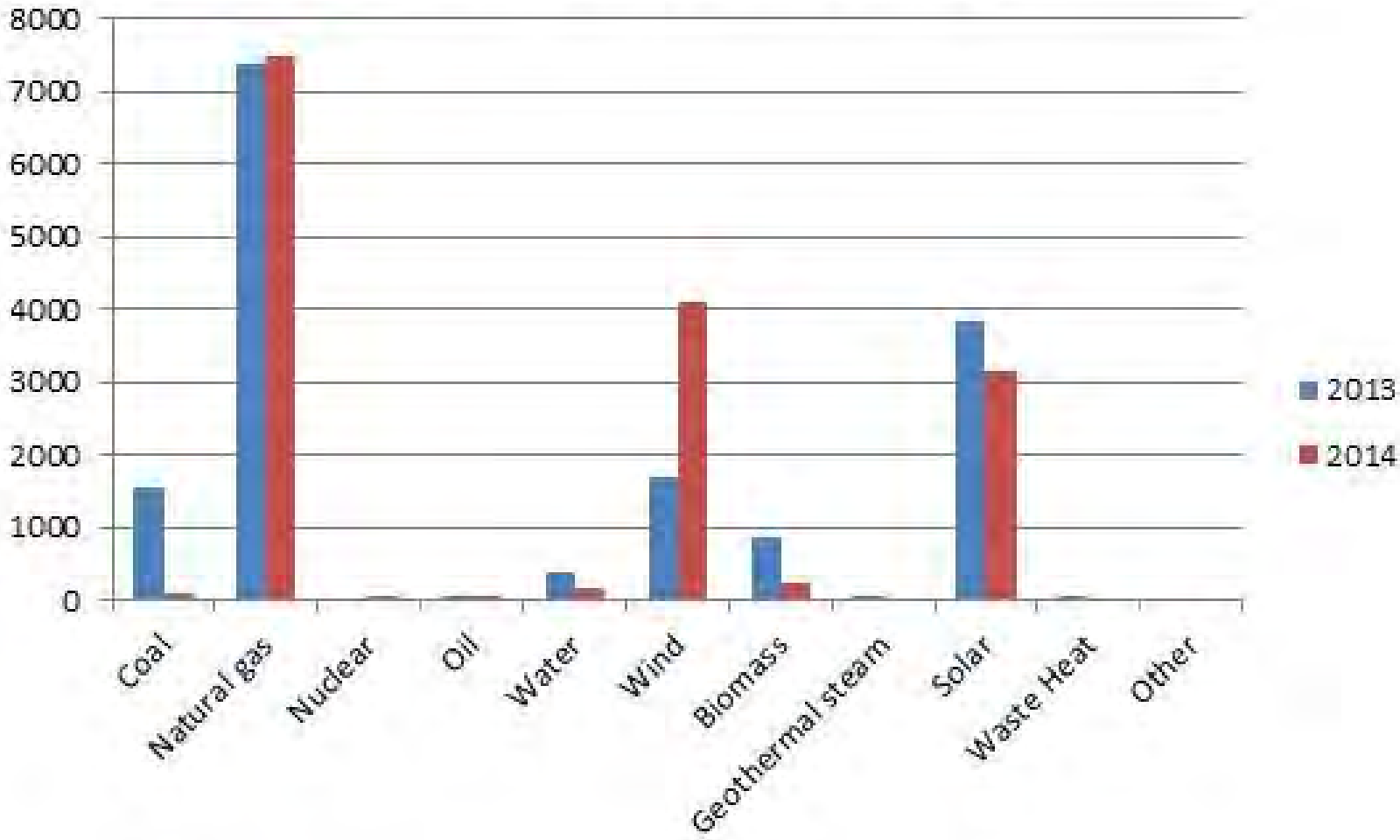


Solar is 2% of Total US Generation



FERC 2013/2014

New Generation In-Service

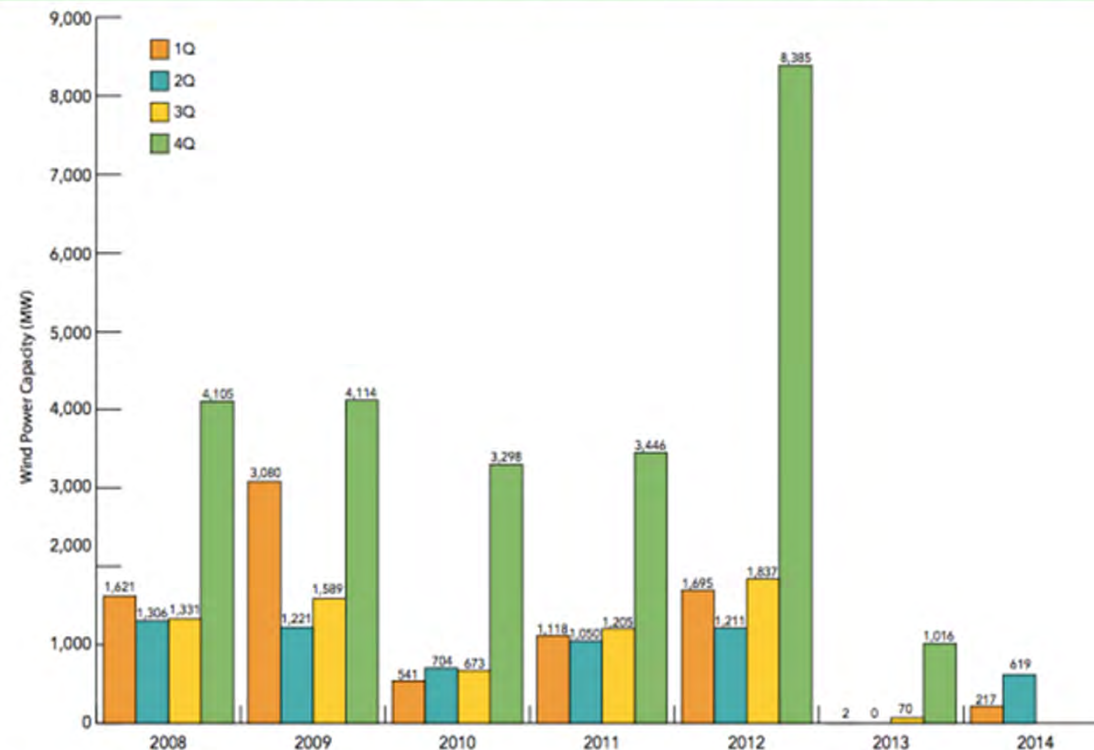


Investment Tax Credit

30% Tax Credit for Solar Projects Installed thru Dec 31, 2016

“A dollar-for-dollar reduction in the income taxes that a person or Company claiming the credit would otherwise pay the federal government.

U.S. Wind Power Capacity Installations, by Quarter



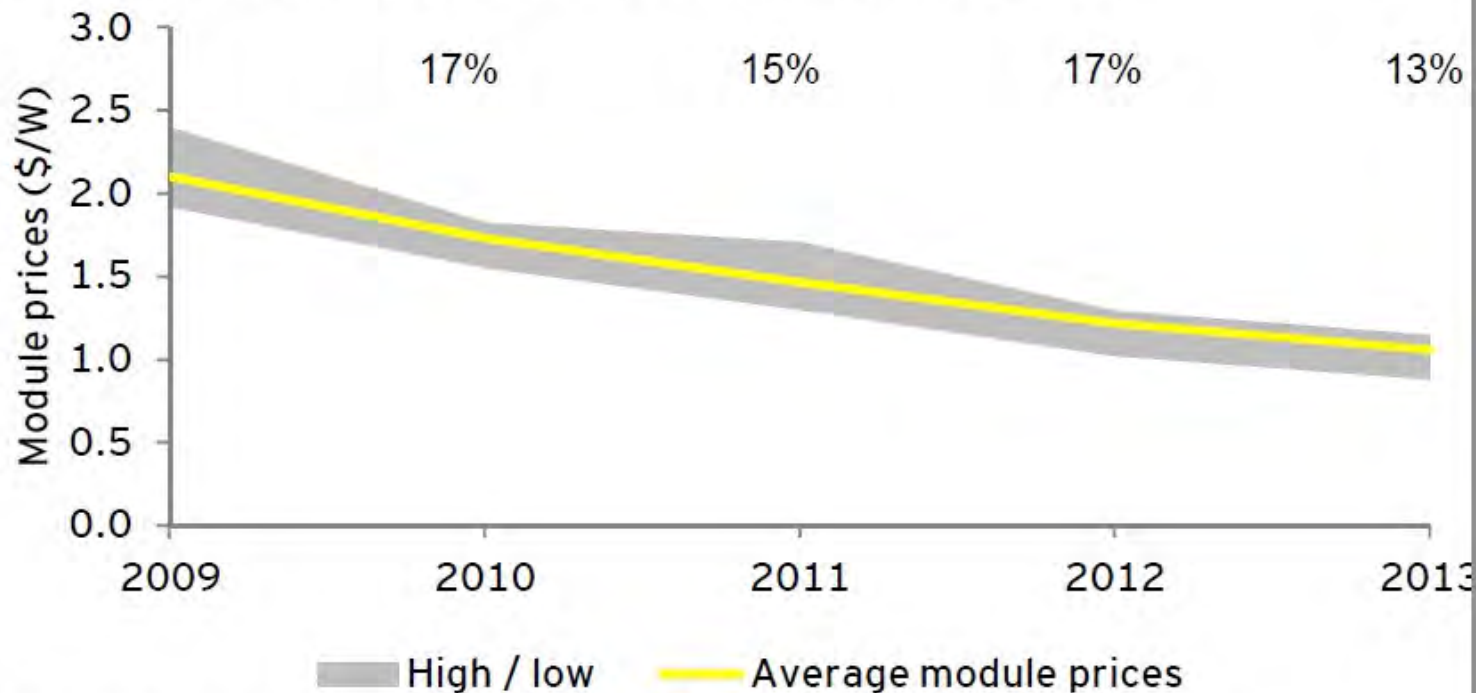
American Wind Energy Association | U.S. Wind Industry Second Quarter 2014 Market Report | AWEA Public Version

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Prices of PV Panels

Module price evolution

- ▶ Analysis of broker reports shows range of expectations of module average selling price (ASP) to 2013.
- ▶ Average year on year percentage reductions are also shown.
- ▶ We note that modules are priced in US dollars and we have not included the impact of future foreign exchange movements in our analysis.



Source: HSBC, Numora, Morgan Stanley, Rolf, JP Morgan, EY analysis

YieldCo's

TerraForm Power, Inc.
(TERP)

- NASDAQ

\$31.390.06(0.19%)

4:00 PM, 02/10

Today **5d** 1m 3m 1y 5y 10y

52wk high:34.74

52wk low:21.58

EPS:-0.18

PE (ttm):N/A

Div Rate:1.08

Yield:3.44

Market Cap:\$3.17b

Volume:320,730



		Market Cap
NRG Energy	NYLD	\$4.09B
Pattern Energy	PEGI	\$1.81B
Solar City	SCTY	\$4.61B

Solar Generation Incentive Program

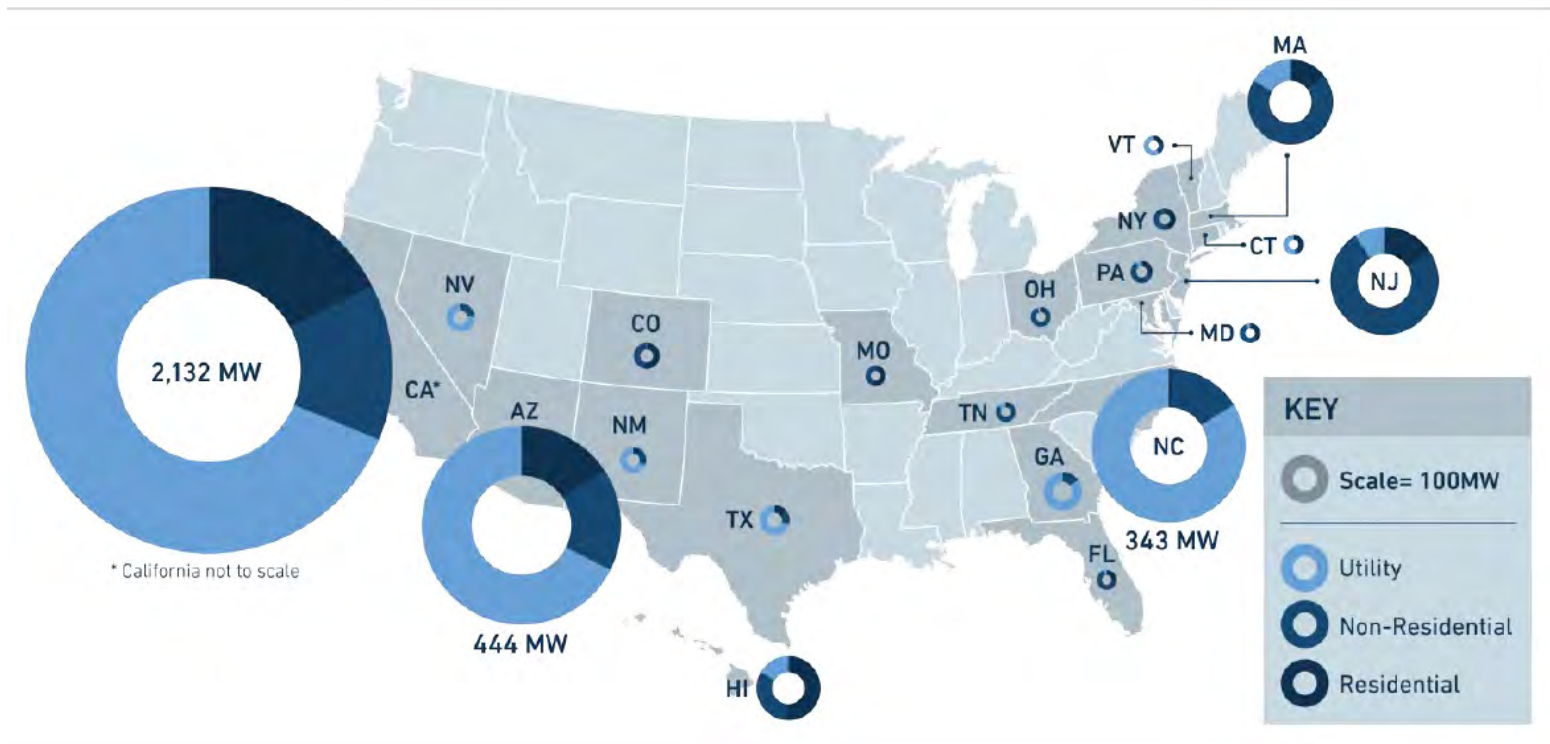
SMUD \$2.5 / Residential Watt Installed
 New Jersey \$1.55 - \$1.75 / Watt Installed
 Illinois \$0.135 / kWh generated
 MA Too many to list
 CA

Step	Statewide MW in Step	EPBB Payments (per Watt)			PBI Payments (per kWh)		
		Residential	Non-Residential		Residential	Non-Residential	
			Commercial	Government/ Non-Profit		Commercial	Government/ Non-Profit
1	50	n/a	n/a	n/a	n/a	n/a	n/a
2	70	\$2.50	\$2.50	\$3.25	\$0.39	\$0.39	\$0.50
3	100	\$2.20	\$2.20	\$2.95	\$0.34	\$0.34	\$0.46
4	130	\$1.90	\$1.90	\$2.65	\$0.26	\$0.26	\$0.37
5	160	\$1.55	\$1.55	\$2.30	\$0.22	\$0.22	\$0.32
6	190	\$1.10	\$1.10	\$1.85	\$0.15	\$0.15	\$0.26
7	215	\$0.65	\$0.65	\$1.40	\$0.09	\$0.09	\$0.19
8	250	\$0.35	\$0.35	\$1.10	\$0.05	\$0.05	\$0.15
9	285	\$0.25	\$0.25	\$0.90	\$0.03	\$0.03	\$0.12
10	350	\$0.20	\$0.20	\$0.70	\$0.03	\$0.03	\$0.10

Net Metering

Feed In Tariffs

State of the Solar Market



Scale of Solar Installations

