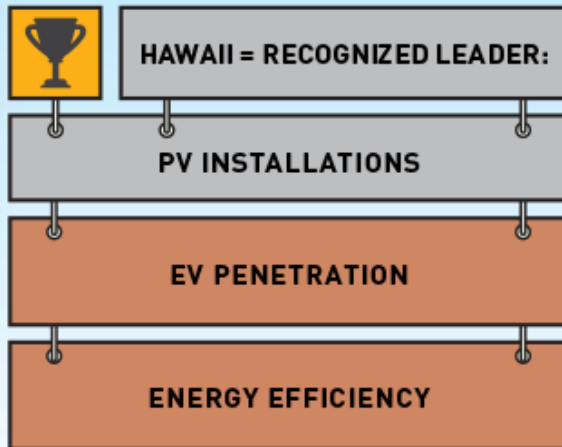


# • Hawaii National Rankings



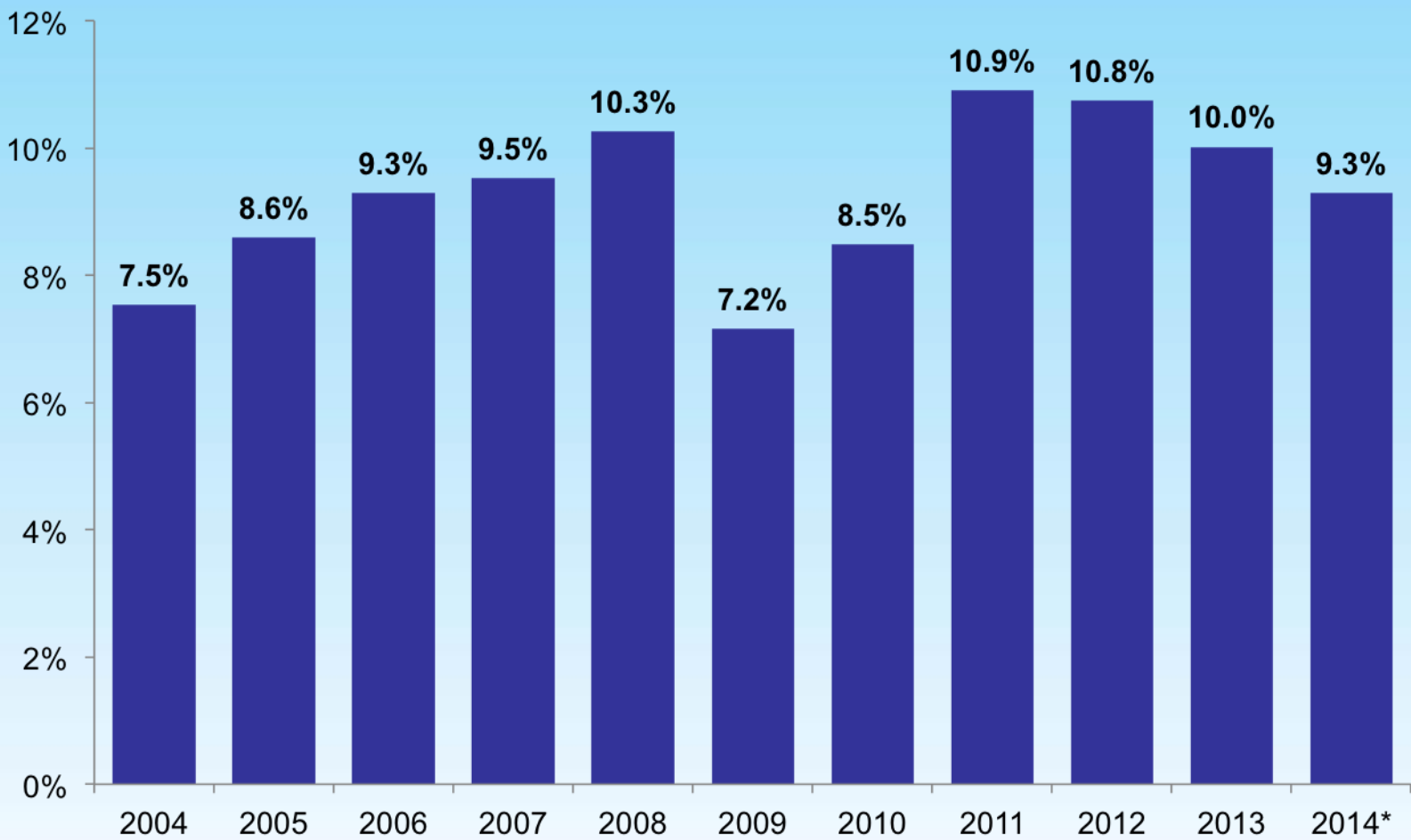
- 1<sup>st</sup> per capita grid connected PV installations (2013)
- 1<sup>st</sup> (Honolulu) solar PV capacity per person (2014)
- 1<sup>st</sup> installed solar PV capacity (2014)
- 1<sup>st</sup> energy performance contracting (2014)
- 2<sup>nd</sup> EV penetration (2014)
- 6<sup>th</sup> PV installations by state (2013)
- 6<sup>th</sup> LEED green building (2014)

# • Breaking Our Addiction to Oil

- Most oil dependent state in the U.S. – imported 93% of our energy in 2014
- Pays the highest electricity rates in the U.S.
- Oil use for electricity generation down over 20% since 2008



- **Energy Cost as Percent of GDP: It's Less About Climate Change and More About Economics!**

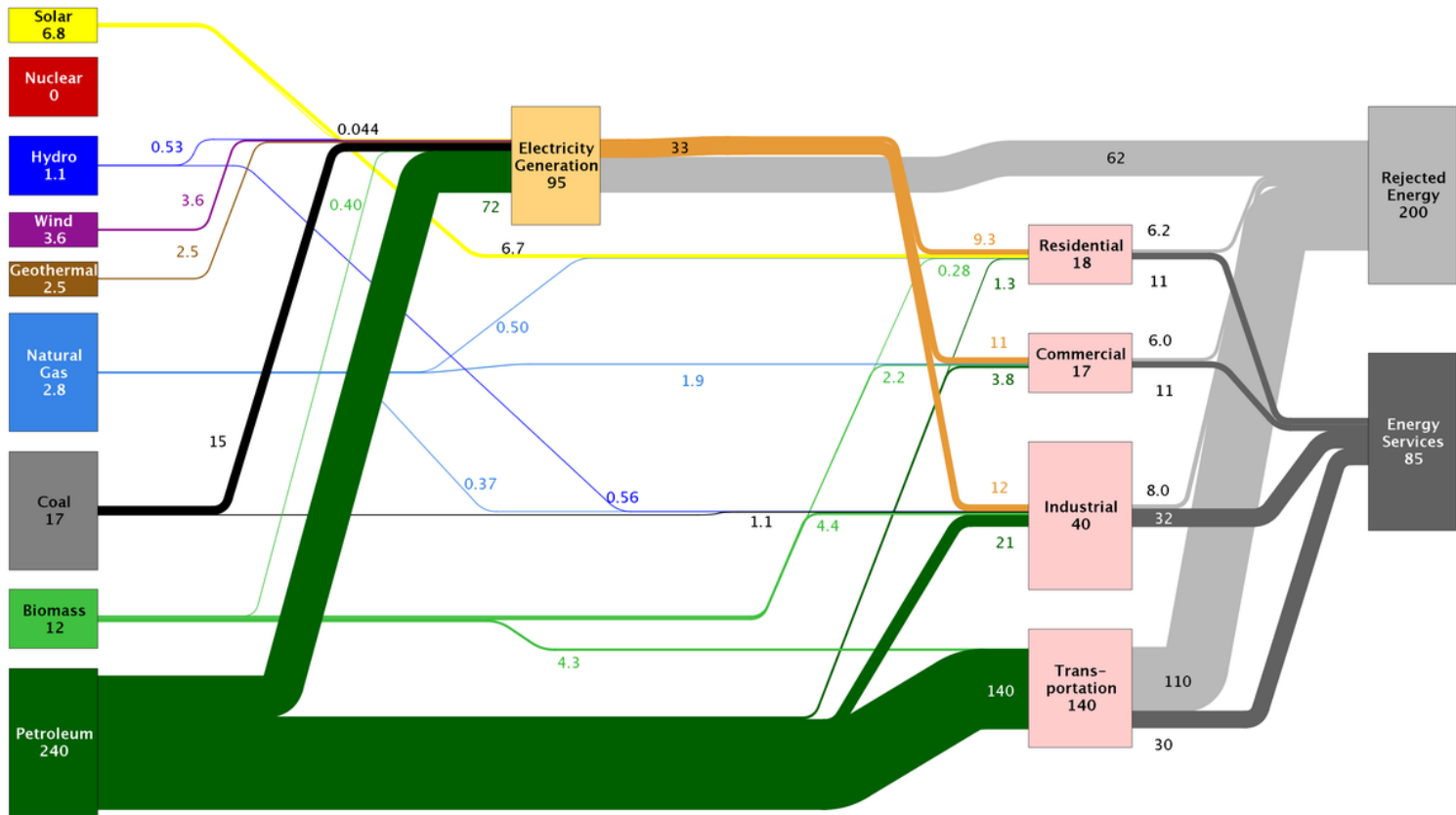


Source: Research & Economic Analysis Division, DBEDT

\*estimated

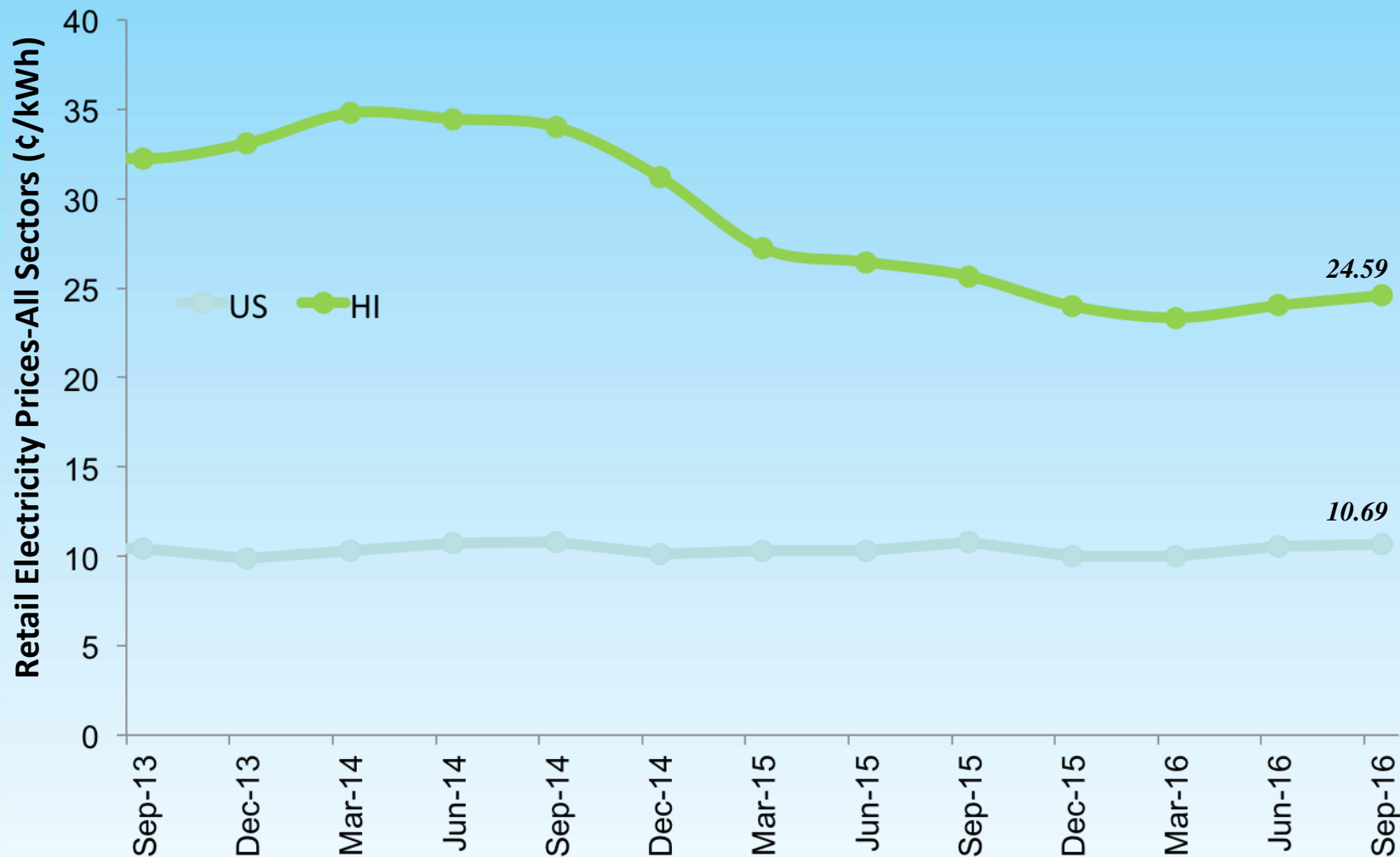
# • Understanding Hawaii's Energy Eco-System

Estimated Hawaii Energy Use In 2012  
~280 Trillion BTU



Source: LLNL 2013. Data is based on DOE/EIA-0214(2011), June 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources (i.e., hydro, wind and solar) in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. Interstate and international electricity trade are lumped into net imports or exports and are calculated using a system-wide generation efficiency. End use efficiency is estimated for each sector as 65% residential, 65% commercial, 80% industrial and 21% transportation. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

- Hawaii Electricity Prices Are a Driver for Innovative Technology: U.S. vs. Hawaii



Source: Energy Information Administration

# • Hawaii Clean Energy Initiative (HCEI) - 2007

- 100% Renewable (electricity sector) by 2045
- Reduce 4,300 Gwh by 2030 - since 2008, Hawaii has reduced energy consumption by 8%
- New Energy in Transportation Road Map



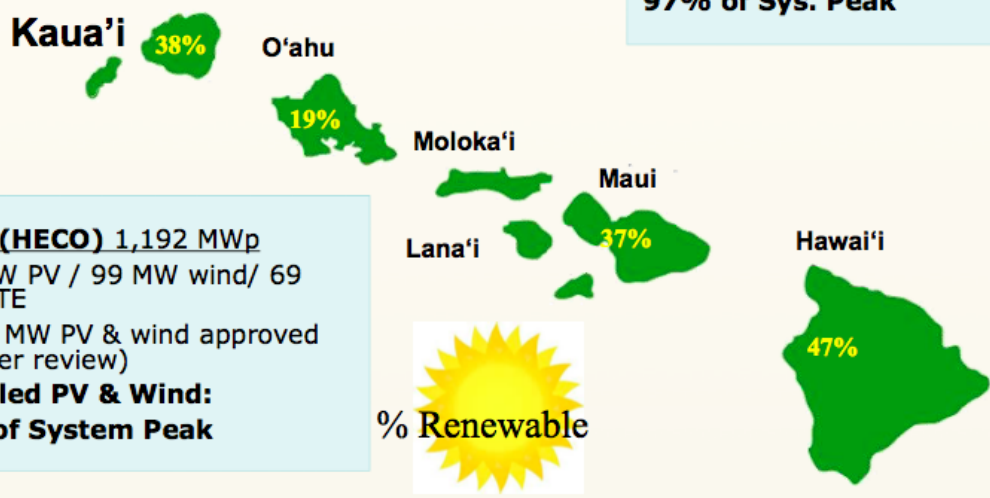
# Status of Electricity and Renewables in Hawaii

**Kaua'i (KIUC): 78MWp**  
66 MW PV / 7 MW biomass / 9 MW hydro  
(+34.6 MW PV under review)  
**Installed PV: 85% of System Peak**

**Maui (MECO) 201 MWp**  
99 MW PV / 72 MW Wind  
(+30 MW PV approved or under review)  
**Installed PV & Wind: 97% of Sys. Peak**

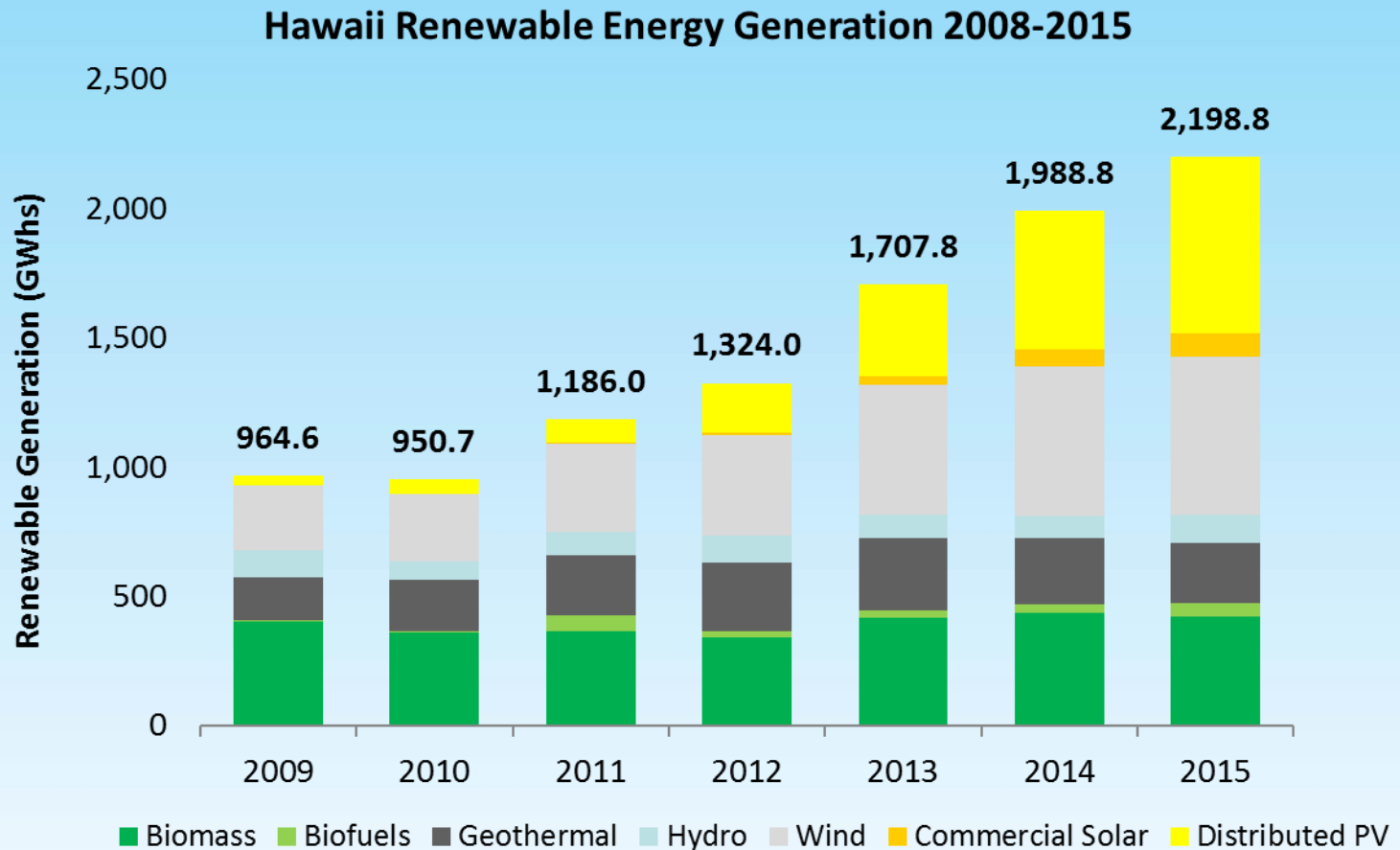
**Oahu (HECO) 1,192 MWp**  
415 MW PV / 99 MW wind/ 69 MW WTE  
(+300 MW PV & wind approved or under review)  
**Installed PV & Wind: 43% of System Peak**

**Hawai'i (HELCO) 192 MWp**  
86 MW PV / 30 MW wind / 38 MW geothermal / 16 MW hydro  
(+26 MW PV approved or under review)  
**Installed PV & Wind: 60% of System Peak**



Total PV (installed, approved, under review) ~ 950 MW , ~ 60% peak.  
Peak occurs after solar production stops

# • Hawaii renewable energy generation by source

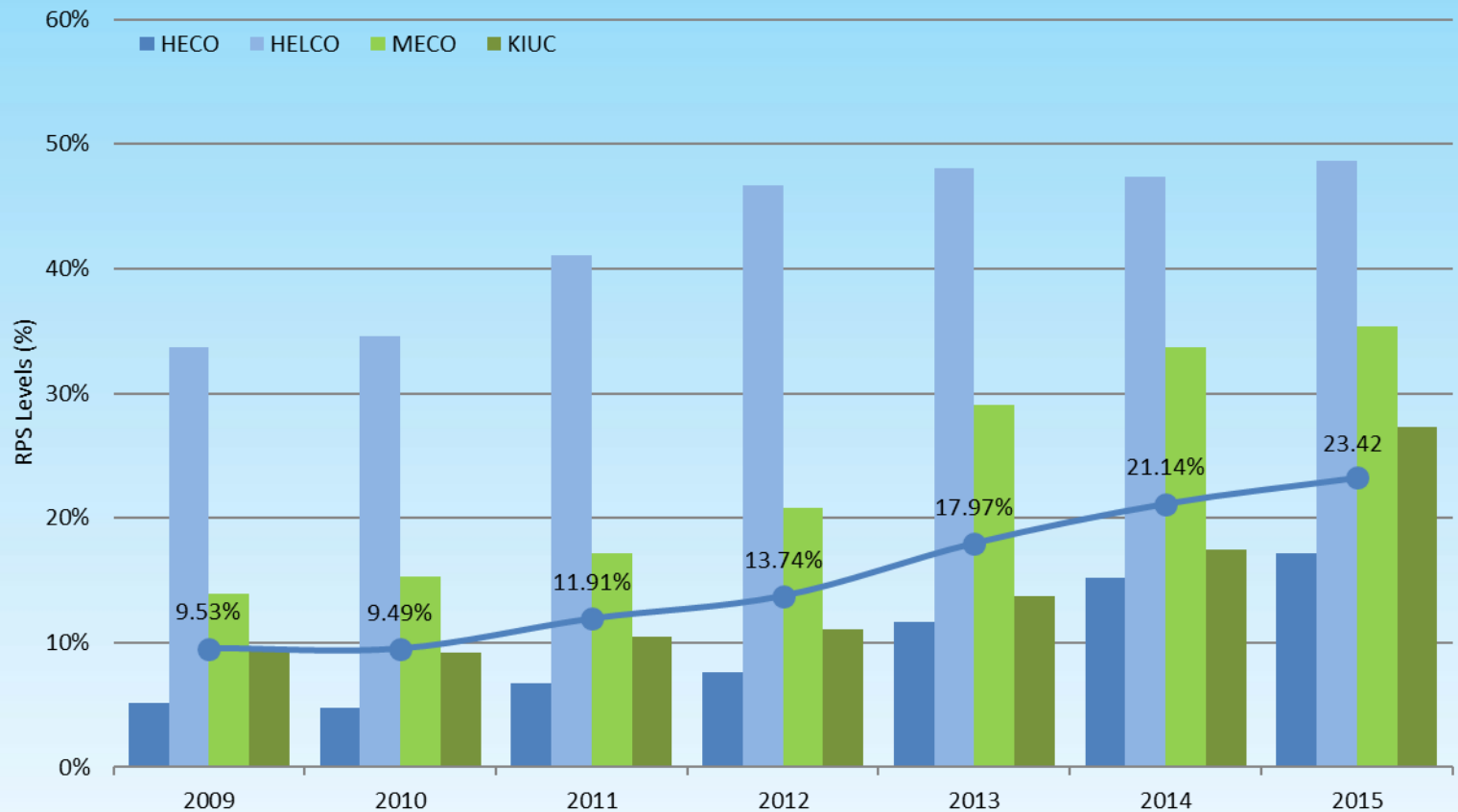


Source: *Renewable Portfolio Standards Status Reports, 2005-2015* (Hawaii Public Utilities Commission)



- **RPS: Ahead of Interim Target**

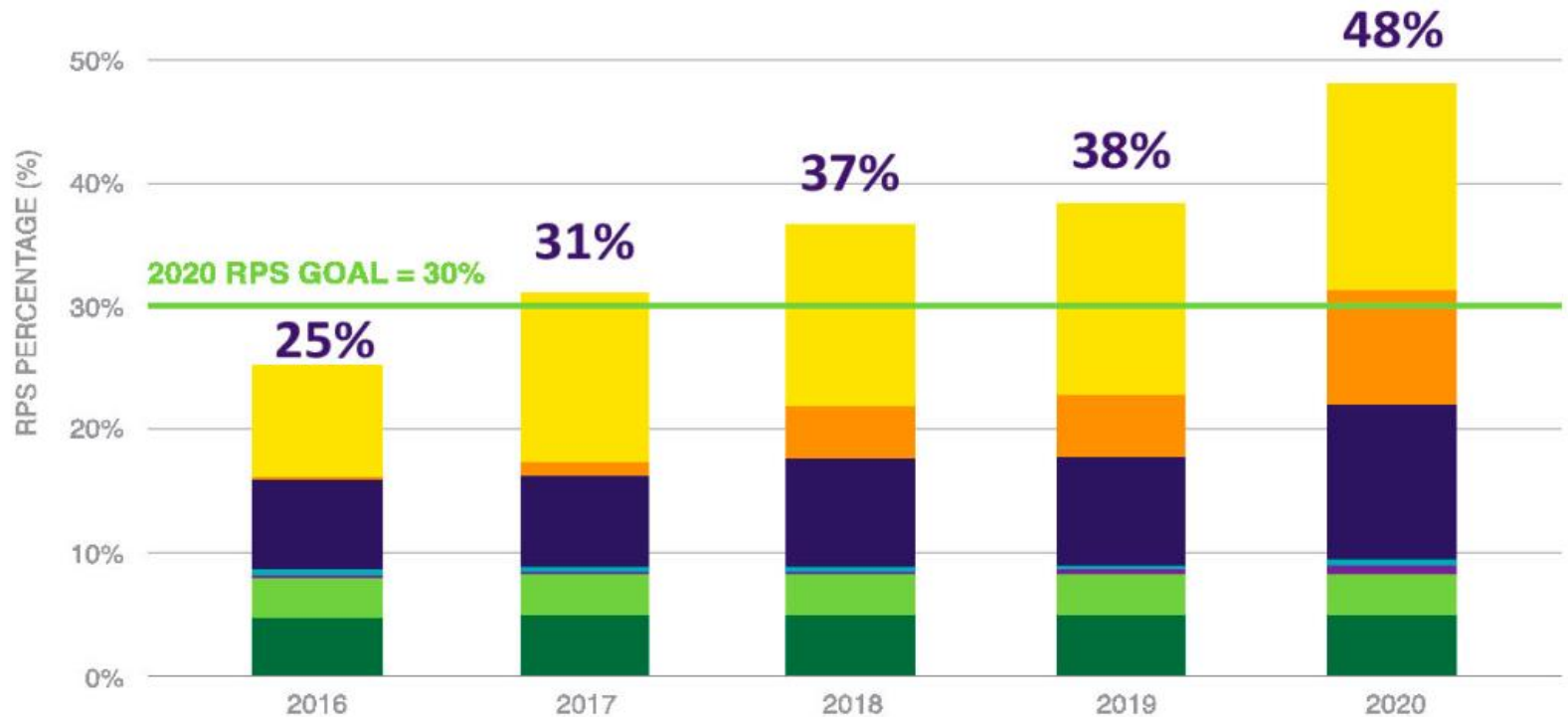
**Hawaii Renewable Portfolio Standard (RPS) Levels 2009-2015**



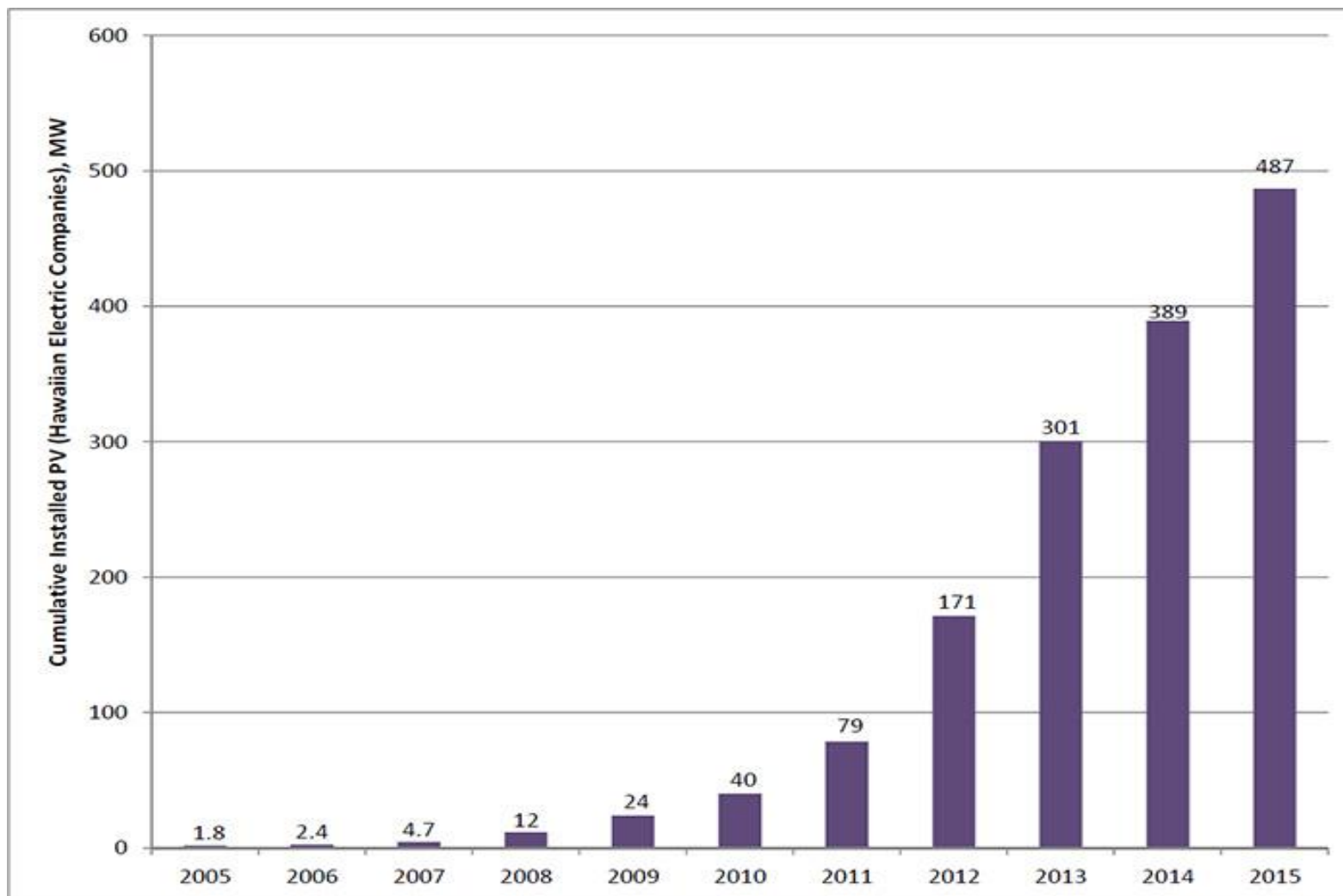
Source: *Renewable Portfolio Standards Status Reports, 2009-2015* (Hawaii Public Utilities Commission).

# HECO Projections for Meeting 2020 RPS

**On track to exceed 2020 goal in 2018**



# Hawaii Residential and Commercial (BTM) Solar Continues to Grow



- **Solar-Related Jobs – Drop in construction related to changes in NEM Rules**



Source: Research & Economic Analysis Division, DBEDT

# • Hawaii EEPS Levels

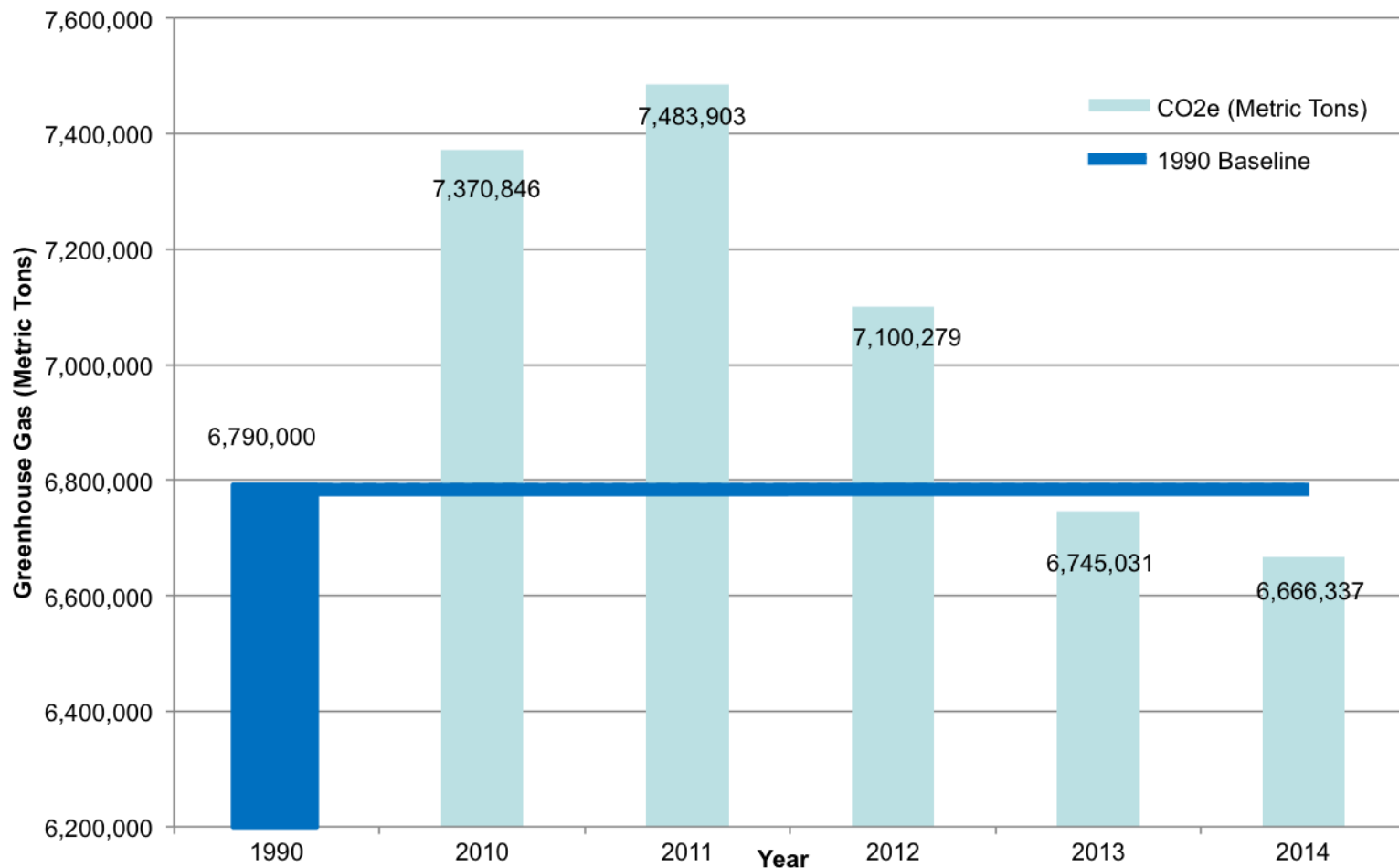
## Hawaii Energy Efficiency Portfolio Standards (EEPS) Levels 2008-2014



Source: Renewable Portfolio Standards Status Reports, 2008-2014 (Hawaii Public Utilities Commission)

# Power Sector Emissions Now Below 1990 Emissions – Met Legislative Goal Early!

## CO<sub>2</sub>e Emissions from Power Sector

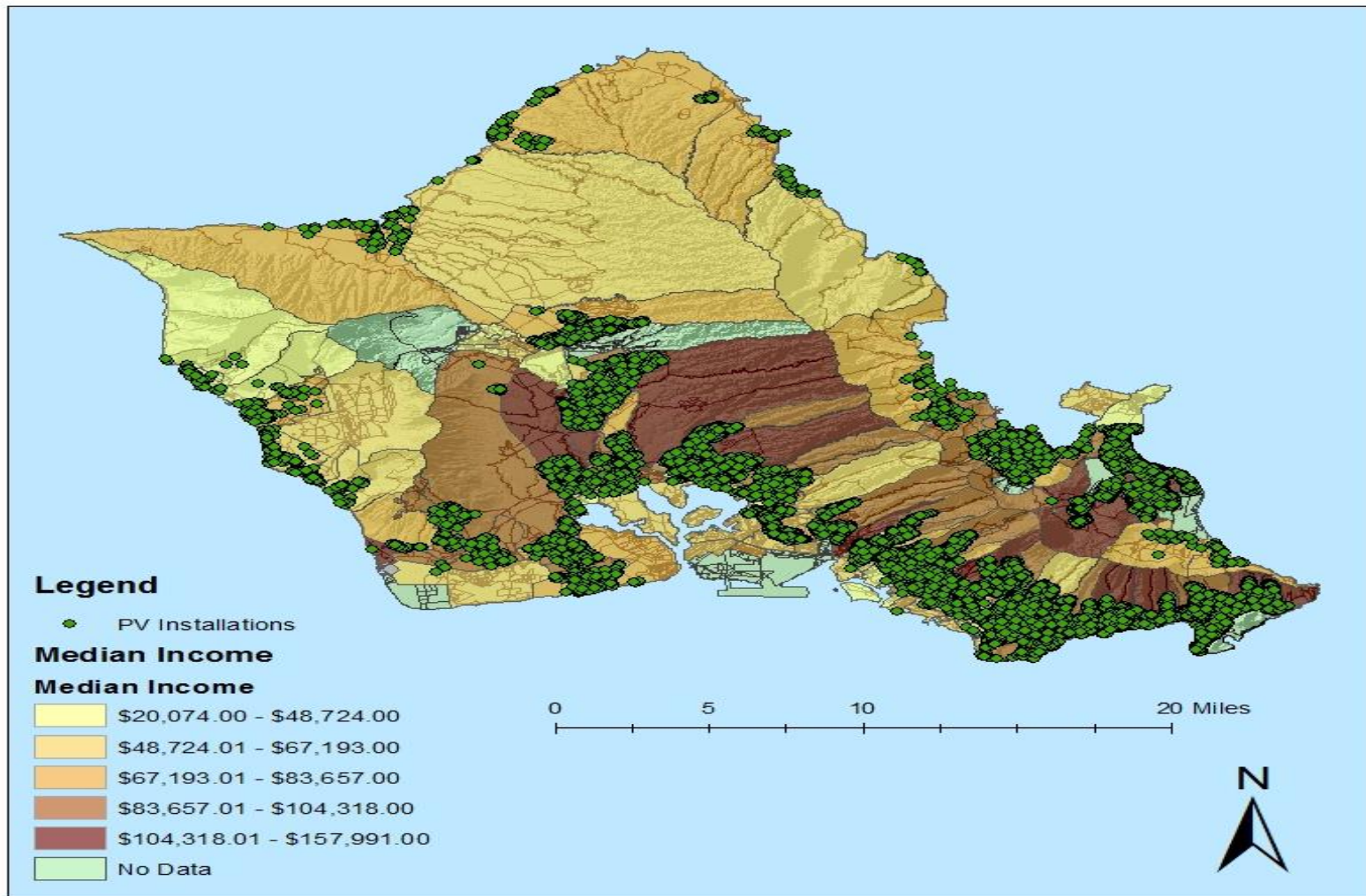


- For Hawaii, Wind and Solar Cost Less Than Oil – Must Address Utility “Stranded Assets”



Sources: Renewable energy pricing 2004 to 2014 from Open Energy Information's Transparent Cost Database: [en.openei.org/apps/TCDB/](http://en.openei.org/apps/TCDB/). Renewable energy pricing 2015 to 2016 from NREL's 2016 Annual Technology Baseline: [nrel.gov/analysis/data\\_tech\\_baseline.html](http://nrel.gov/analysis/data_tech_baseline.html). Crude oil pricing from Energy Information Administration (EIA): [eia.gov/dnav/pet/pet\\_pri\\_spt\\_s1\\_d.htm](http://eia.gov/dnav/pet/pet_pri_spt_s1_d.htm).

# PV Installation Across Household Income Groups Can Be Considered a Regressive Tax



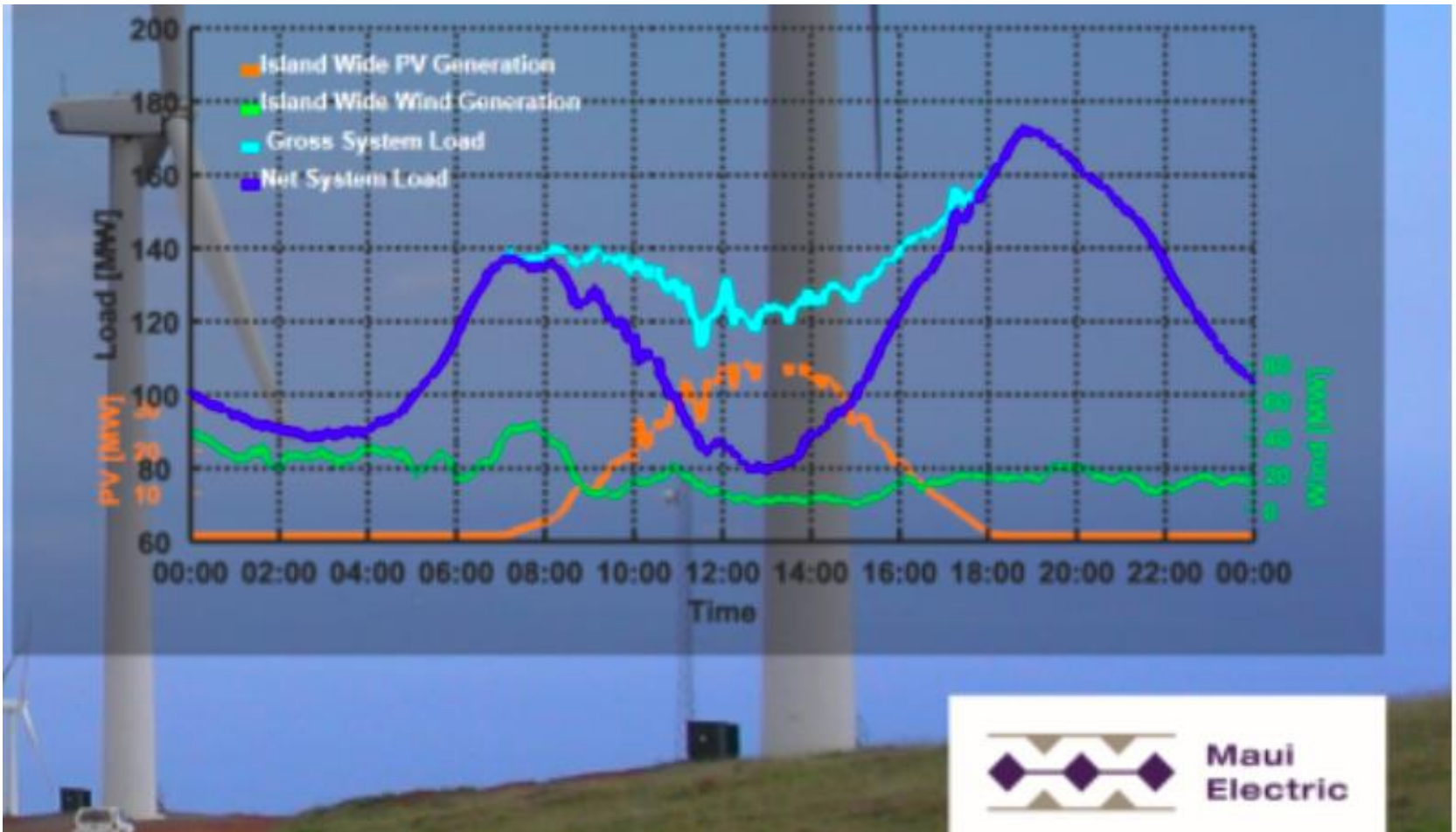


## Grid Saturation Levels : Large percentages of PV on Distribution Lines Lead to Need for Storage and ADR

Number of circuits where generation from distributed solar exceeded 100 percent and 250 percent of daytime minimum load (through April 1, 2015)

	>100% DML	>250% DML	Total Circuits
HECO	166	42	465
HELCO	51	8	136
MECO	33	1	137

# “Duck’s Back” in Hawaii - Low Wind Day, with High Solar Day on Maui, February 2017



Maui  
Electric

# Hawaii Wind – Building Partnerships to Complete Projects - 69MW Wind Farm Came On-Line in 2014

- **Six years** after the original RFP
- First Wind formed a partnership, Kaiwaloa Wind
  - **Makana Nui Associates – Hawaii based LLC**
  - **Kamehameha Schools – landowner of site**
- New turbines can control voltage on their own
  - **Up to 50MW produced no flicker on 1200MW grid**
- HECO was eligible for Federal PTC
  - **Savings – per HPUC requirement – passed on to ratepayers**
- Final agreed PPA price was \$204.50/MWh (originally \$230/MWh) with a 1.75% annual cost escalation
  - **In addition to reducing PPA price, final HPUC decision delayed price escalation by one year**

# Kaiwaloa Wind Farm on Oahu



- **Balancing Progress with Flexibility – “Surprises” Over Previous Ten Years**

**Original HCEI was for a 2030 future – all sectors:**

**40% Renewables**

**30% improvement in energy efficiency**

**What didn't happen:**

**Plan for 400 to 800 MW of wind on Molokai and Lanai  
connected by undersea cable to Oahu**

**No improvement in transportation metrics**

**What was unexpected and did happen:**

**Plummet of solar cell and installation costs allowed state to  
easily meet goals**

# • **Balancing Progress with Flexibility – “No Regrets” Over Next Ten Years**

- **Develop indigenous resources to reach RPS 2030 targets**
- **Flexibility in regulation and utility business practices is key to adjusting to technological innovations and changes in market prices**
- **Try to avoid “wacko” legislation that can impede eventual success**
- **Transformational and potentially disruptive investment decisions must consider societal, energy, and grid costs**
- **While scenarios are useful, some projected technologies just don’t happen!**

# **Changes Continue for US Grid – “stuff will move more quickly that we now anticipate.” Focus Should Be on Implementation vs. Goals**

- State Regulators – subject to legislative mandates
  - Evaluate societal/actual costs of various business models
  - Which type of approach best meets legislatively generated targets and consumer advocacy goals
- Utility business models must change due to changes in technology and government policy
  - Insertion of new technologies must be considered from a systems perspective – including transportation, gas, water
  - Innovative, transformational, and disruptive (but, hopefully, positive) transitions will occur
  - Understanding and developing strategies and architectures for operating a much more information-rich distribution grid.
  - Bolting new things on to legacy systems, while keeping lights on
- State government must work to ensure:
  - Utilities are profitable
  - Electricity prices for end users are reasonable
  - Regulations are flexible enough to adapt to technological advances.

# Hawaii Regulators and Utilities Must Work Together to Get Their “Ducks in a Row” – Or, Prepare for a Possible New Energy Paradigm – “Defection”





# So, Let's Not Spend Too Much Time Arguing and Posturing





LIFE IS GOOD!  
**Hawaii** HOME  
PRICES ARE ON THE  
REBOUND, AND SOON  
WE'LL ALL HAVE  
OCEANFRONT  
PROPERTY!

GLOBAL  
WARMING  
WORSE  
THAN WE  
THOUGHT

# I Am Open to a Beer or Two as Appropriate for these Discussions

