

Energy Storage Demonstration Project at NELHA

Edisun[™]
MICROGRIDS

ENERGY
EXCELERATOR



NELHA

About Edisun Microgrids

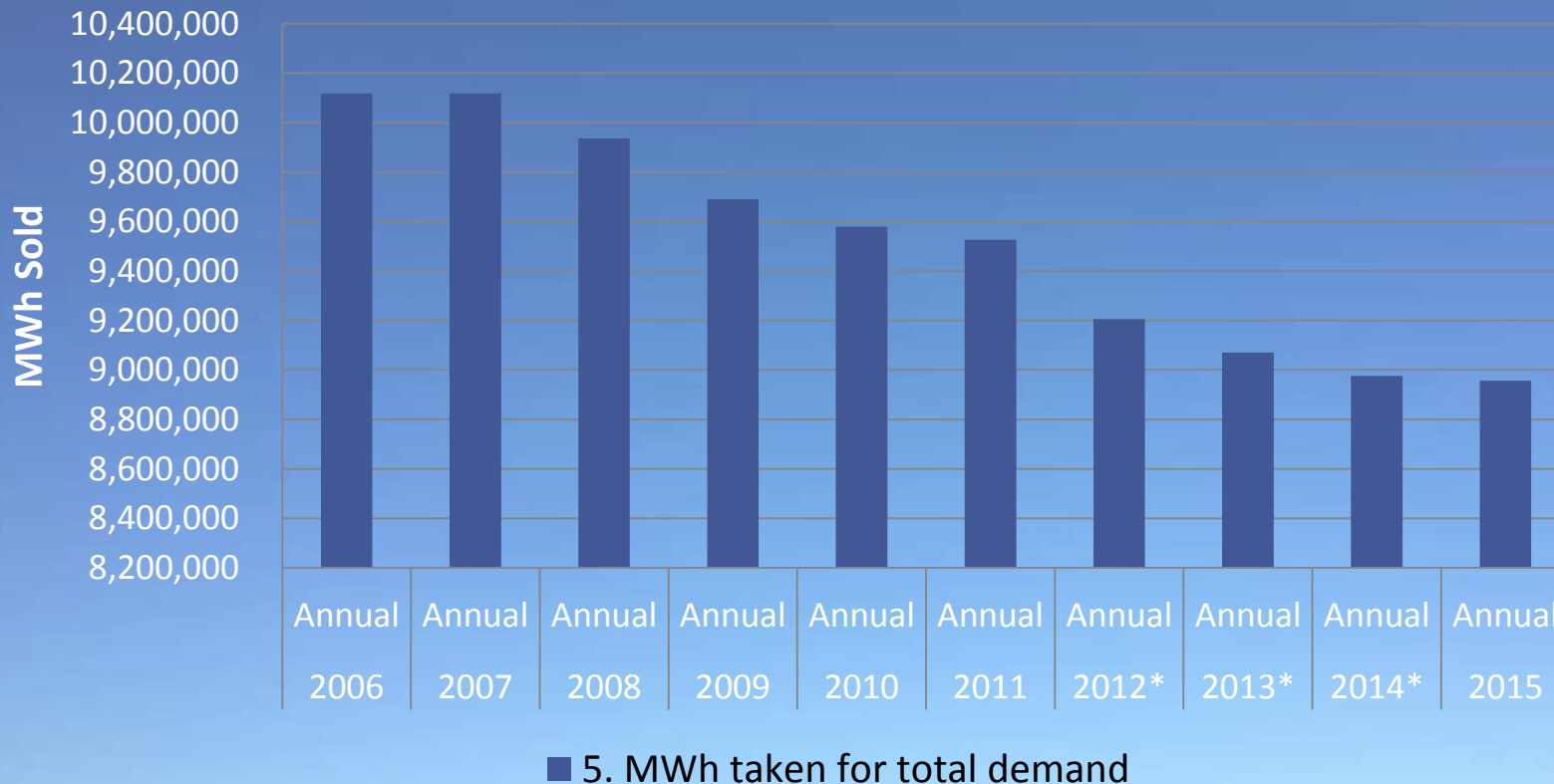
- **Baseload Solar**
Dispatchable renewable energy -day AND night operation
- **PV Booster**
Dramatically improves rooftop solar economics through dual-axis tracking
- **EnergyShift**
Extremely low-cost, bulk energy storage technology suitable for grid

Demand Side Variability Increasing

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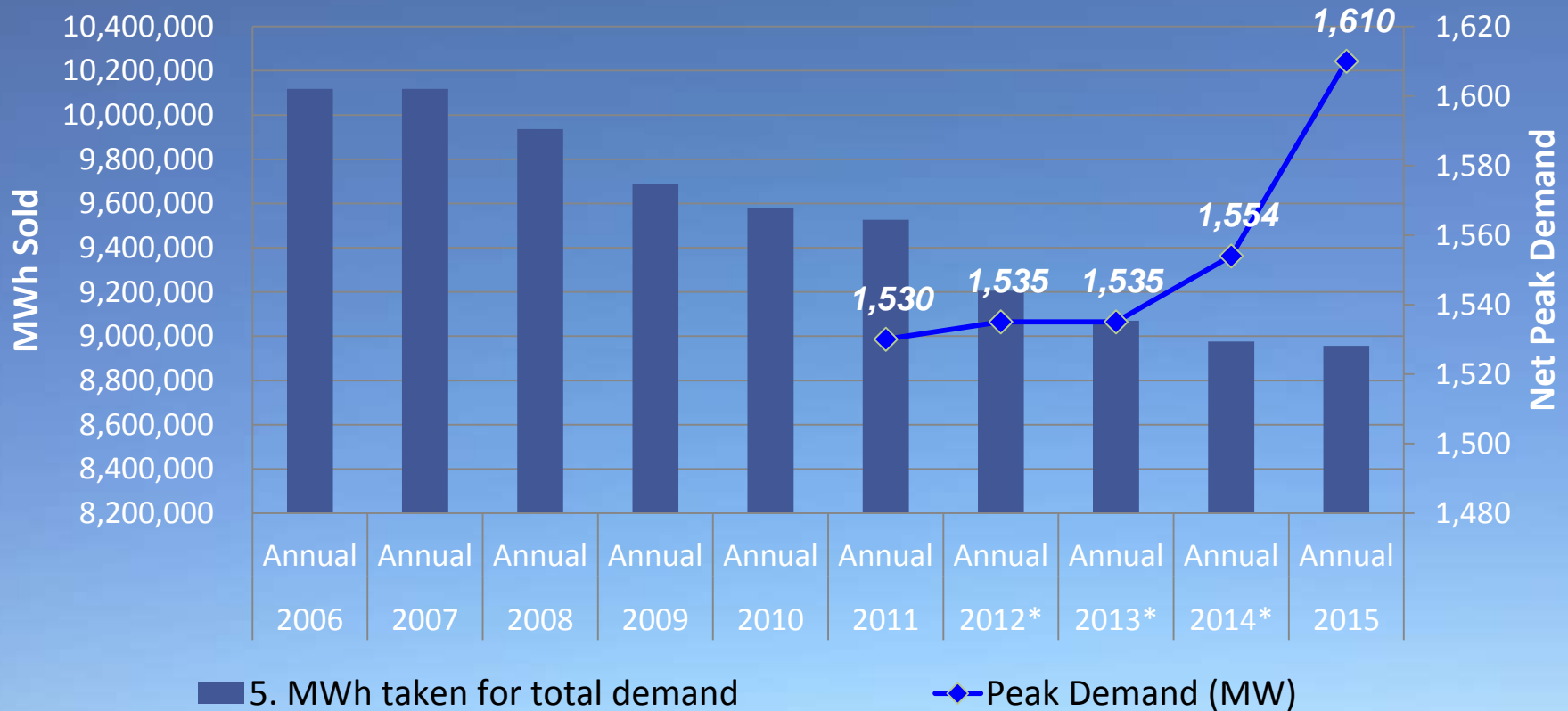
Peak Demand Increasing while Average Demand Declines

System Energy Demand and Net Peak Demand
Hawaii Electric Consolidated
2006-2015 Annual



Peak Demand Increasing while Average Demand Declines

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Demand Side Variability - Increasing

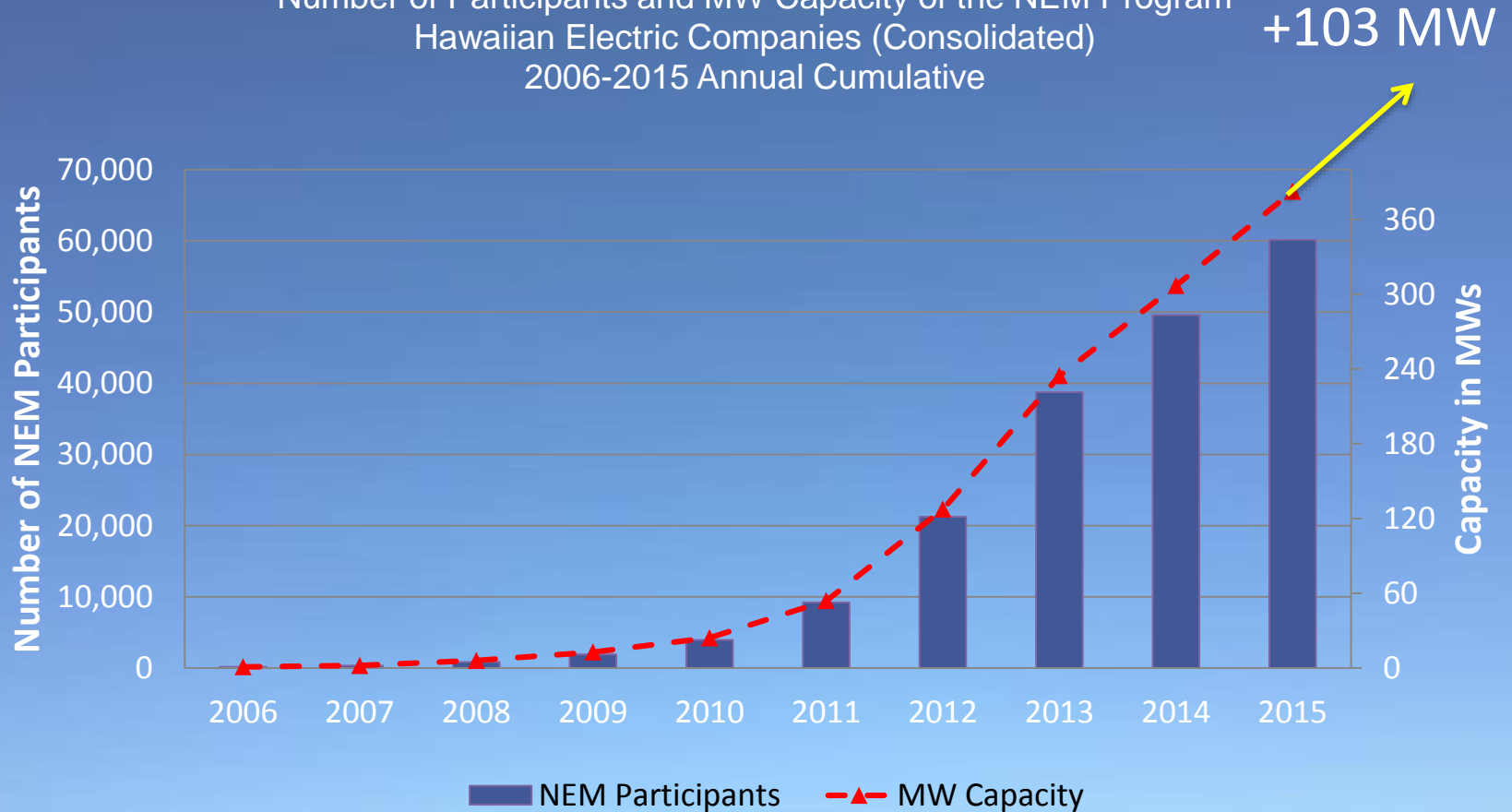
System Energy Demand and Rooftop PV Penetration
Hawaii Electric Consolidated
2006-2015 Annual



Demand Side Variability

Plus an additional 103MW approved but not installed

Number of Participants and MW Capacity of the NEM Program
Hawaiian Electric Companies (Consolidated)
2006-2015 Annual Cumulative



Supply Side Variability – Increasing

Supply Side Variability – Increasing

RPS Requirements

10% of its net electricity sales by December 31, 2010;

15% ... by 2015;

30% ... by 2020;

40% ... by 2030;

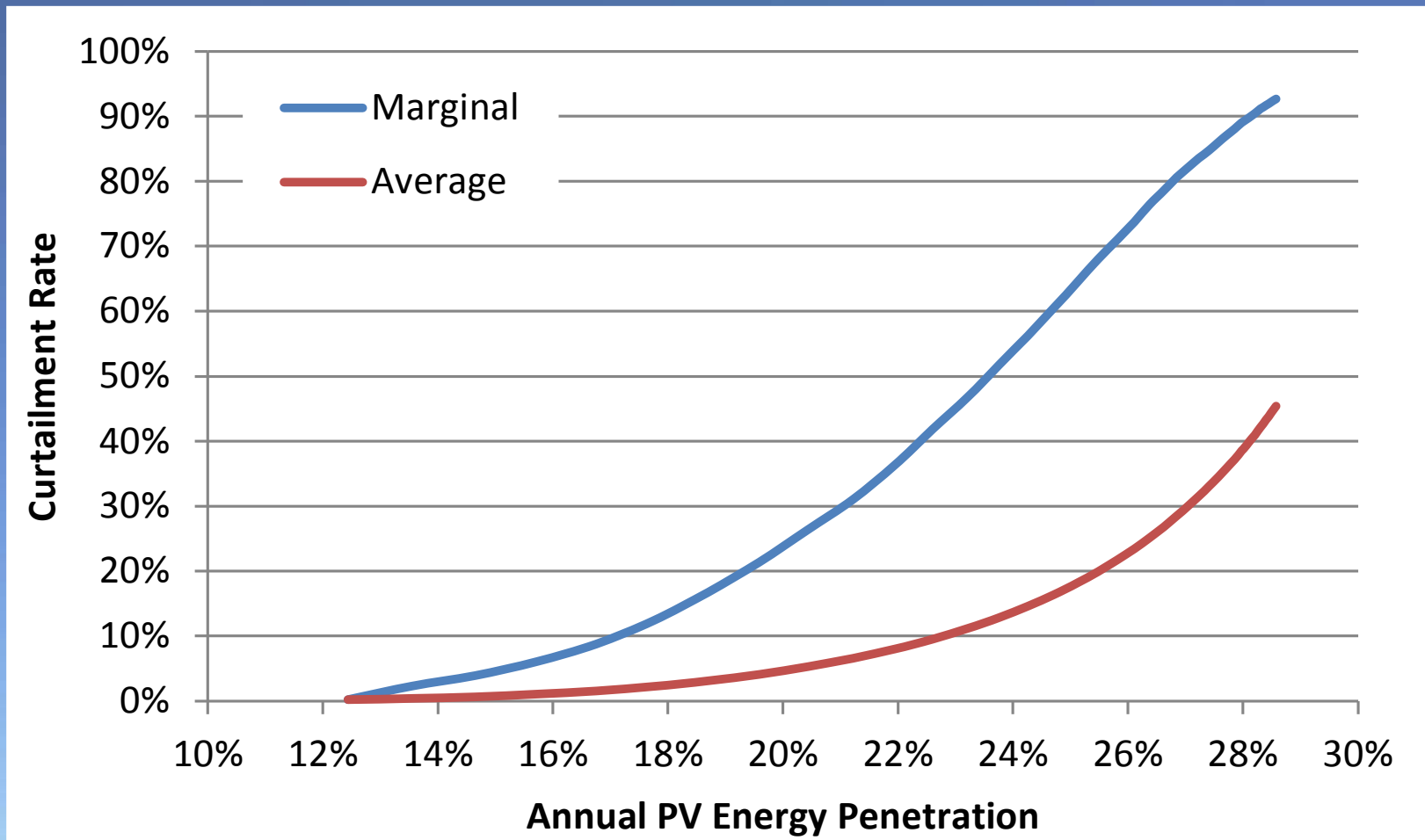
70% ... by 2040;

100% of its net electricity sales by December 31, 2045

Actual 2015 = 23.2%

Supply Side Variability - Increasing

NREL – “Energy Storage Requirements for Achieving 50% Solar PV Energy Penetration in California”; Figure 4, p11.

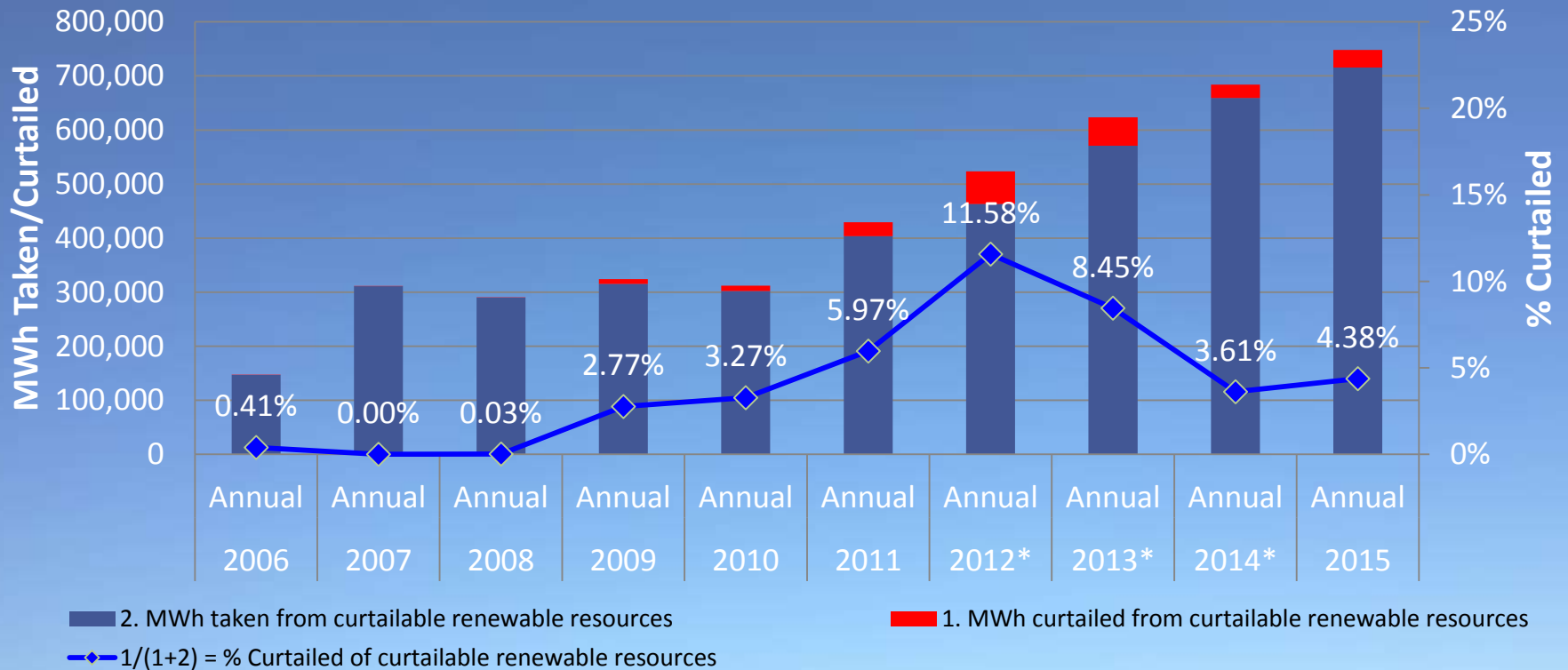


The result?

- Increased curtailment
- Need for flexible generation
- Need for storage

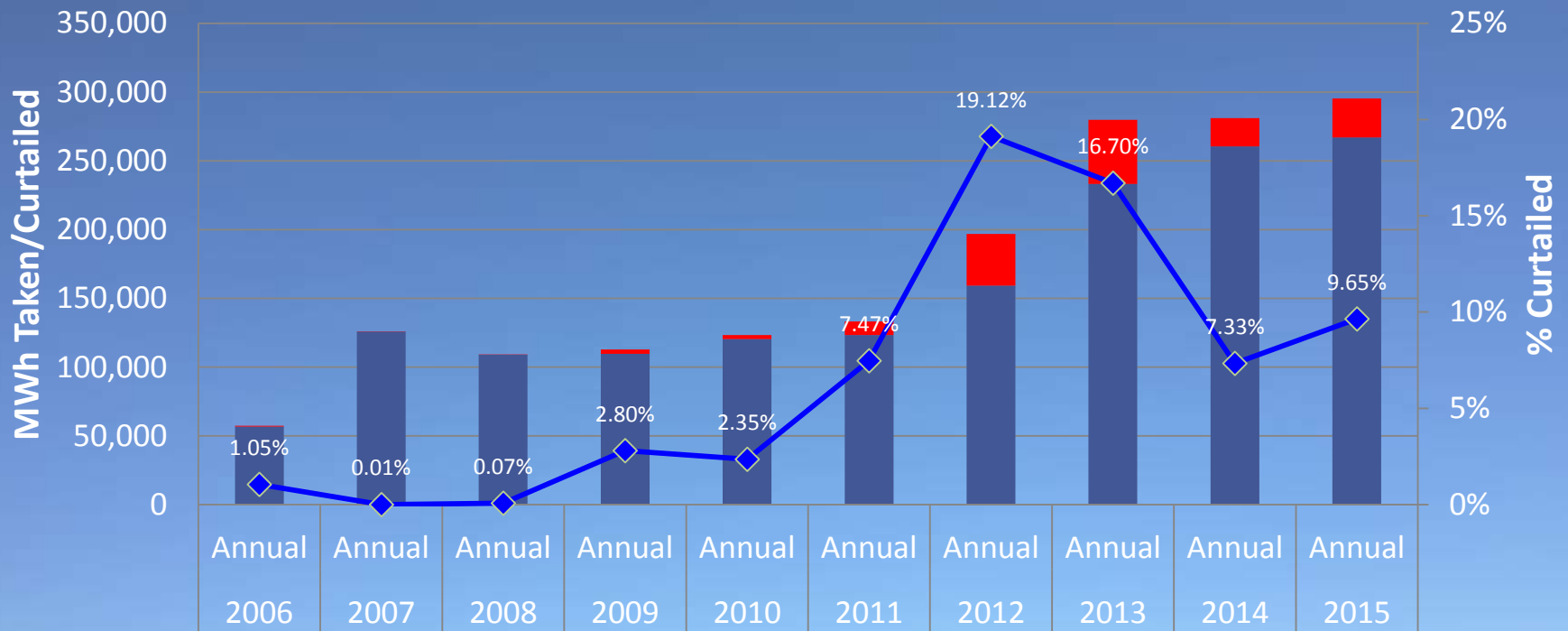
Curtailment Profiles – 32.8 GWh lost in 2015

Estimated Curtailed Energy as a Percent of Available IPP Curtailable Energy
HECO, HELCO, MECO Combined
2006-2015 Annual



Curtailment Profiles – Maui

Estimated Curtailed Energy as a Percent of Available IPP Curtailable Energy
 Maui Electric - Maui Division
 2006-2015 Annual



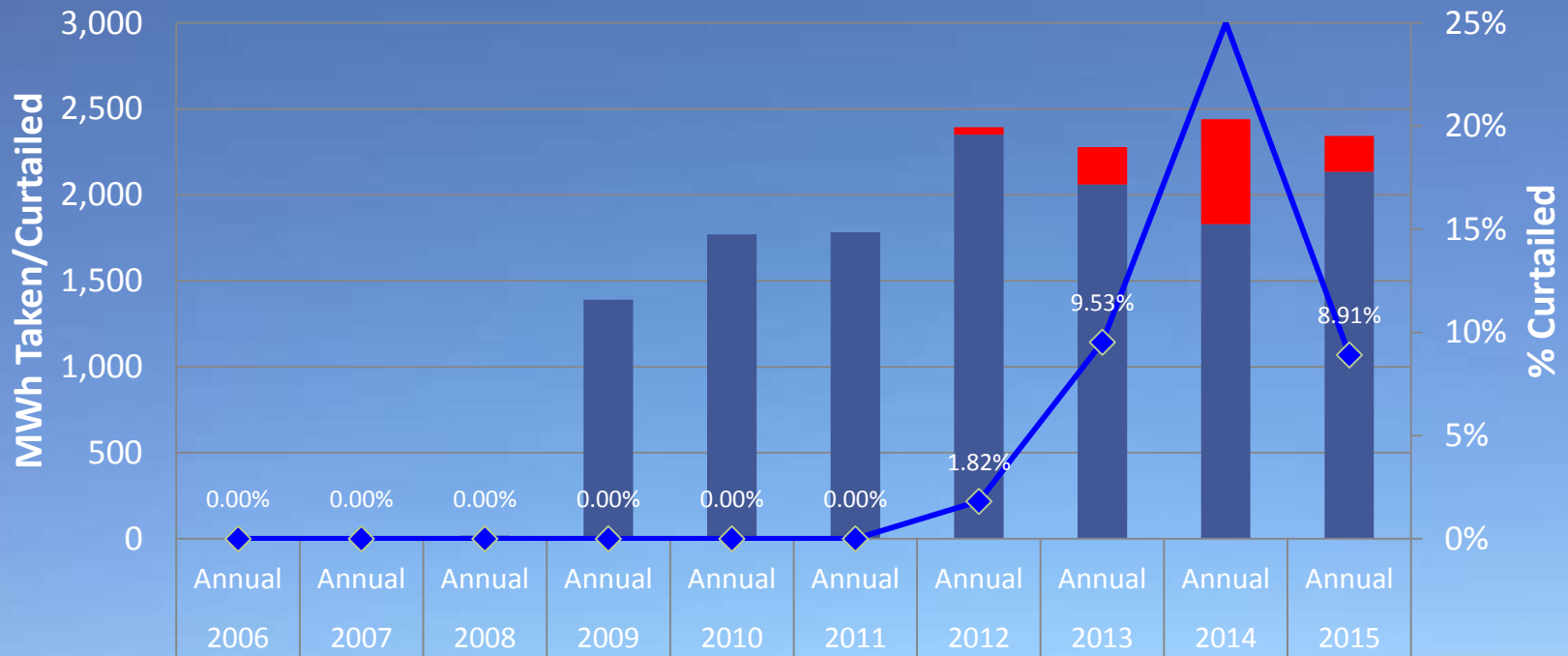
■ 2. MWh taken from curtailable renewable resources

■ 1. MWh curtailed from curtailable renewable resources

◆ 1/(1+2) = % Curtailed of curtailable renewable resources

Curtailment Profiles - Lanai

Estimated Curtailed Energy as a Percent of Available IPP Curtailable Energy
Maui Electric - Lanai Division
2006-2015 Annual



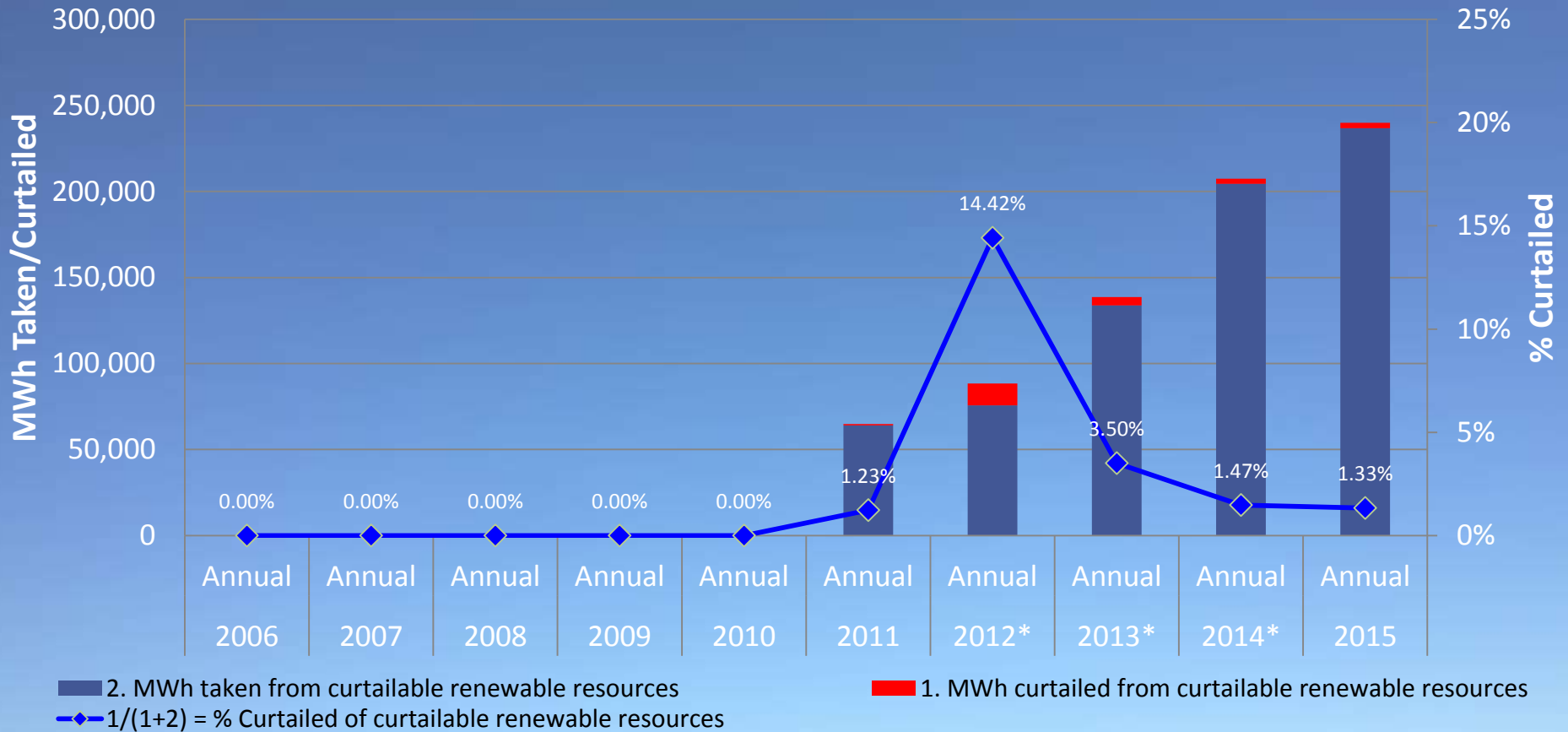
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■ 2. MWh taken from curtailable renewable resources

◆ 1/(1+2) = % Curtailed of curtailable renewable resources

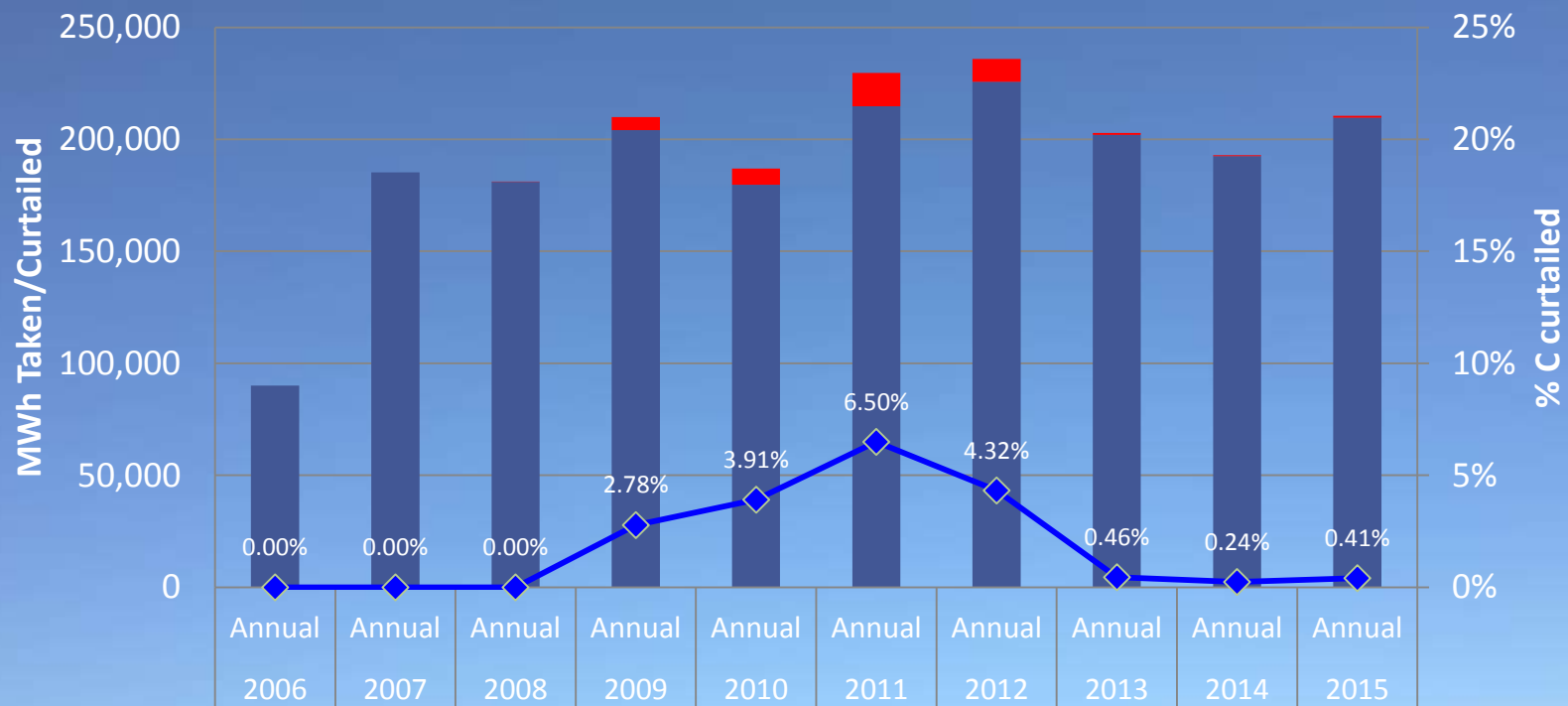
Curtailment Profiles - Oahu

Estimated Curtailed Energy as a Percent of Available IPP Curtailable Energy
 Hawaiian Electric
 2006-2015 Annual



Curtailment Profiles – Big Island

Estimated Curtailed Energy as a Percent of Available IPP Curtailable Energy
Hawaii Electric Light
2006-2015 Annual

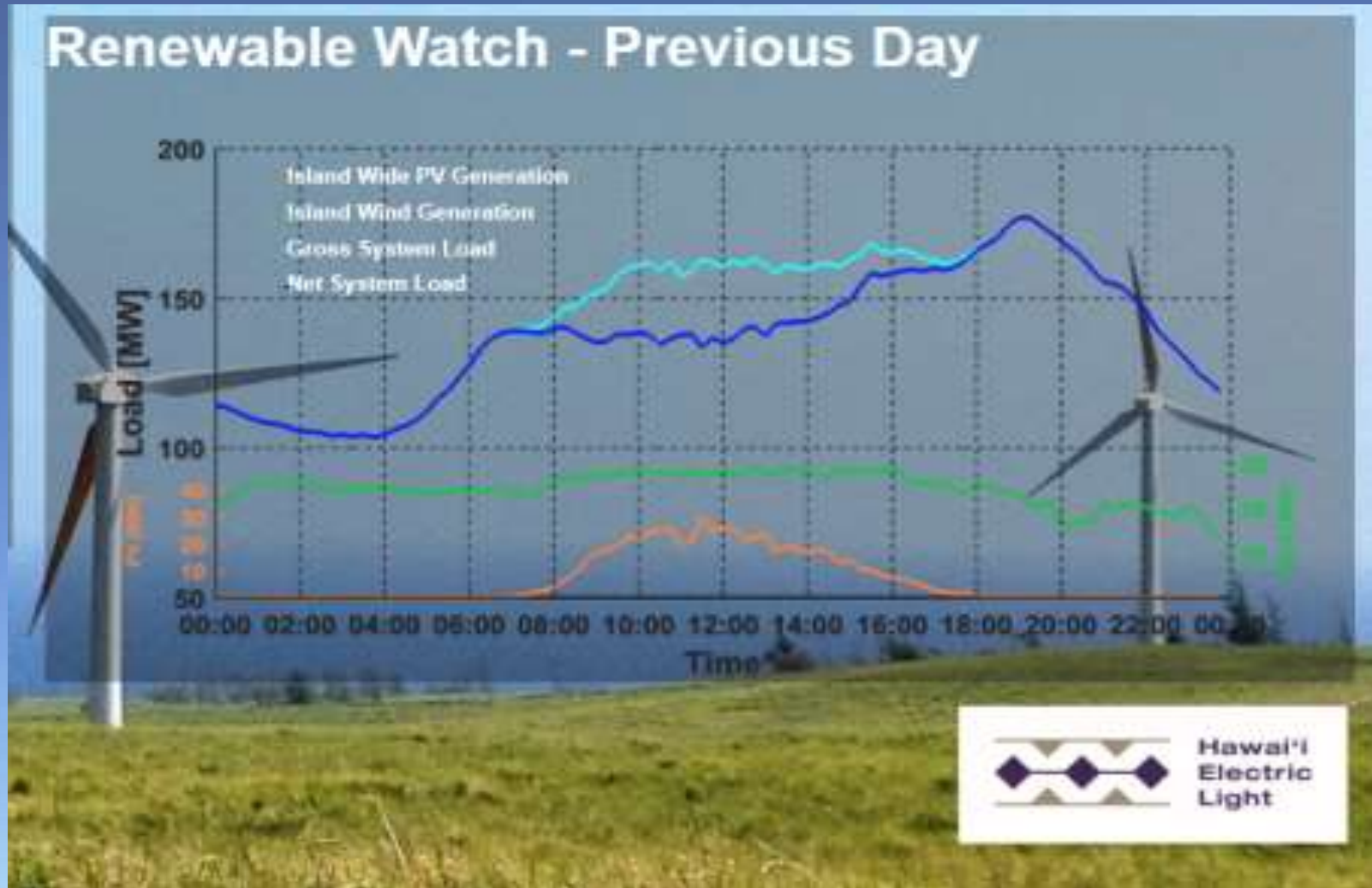


■ 1. MWh curtailed from curtailable renewable resources
◆ $1/(1+2) = \% \text{ Curtailed of curtailable renewable resources}$

■ 2. MWh taken from curtailable renewable resources

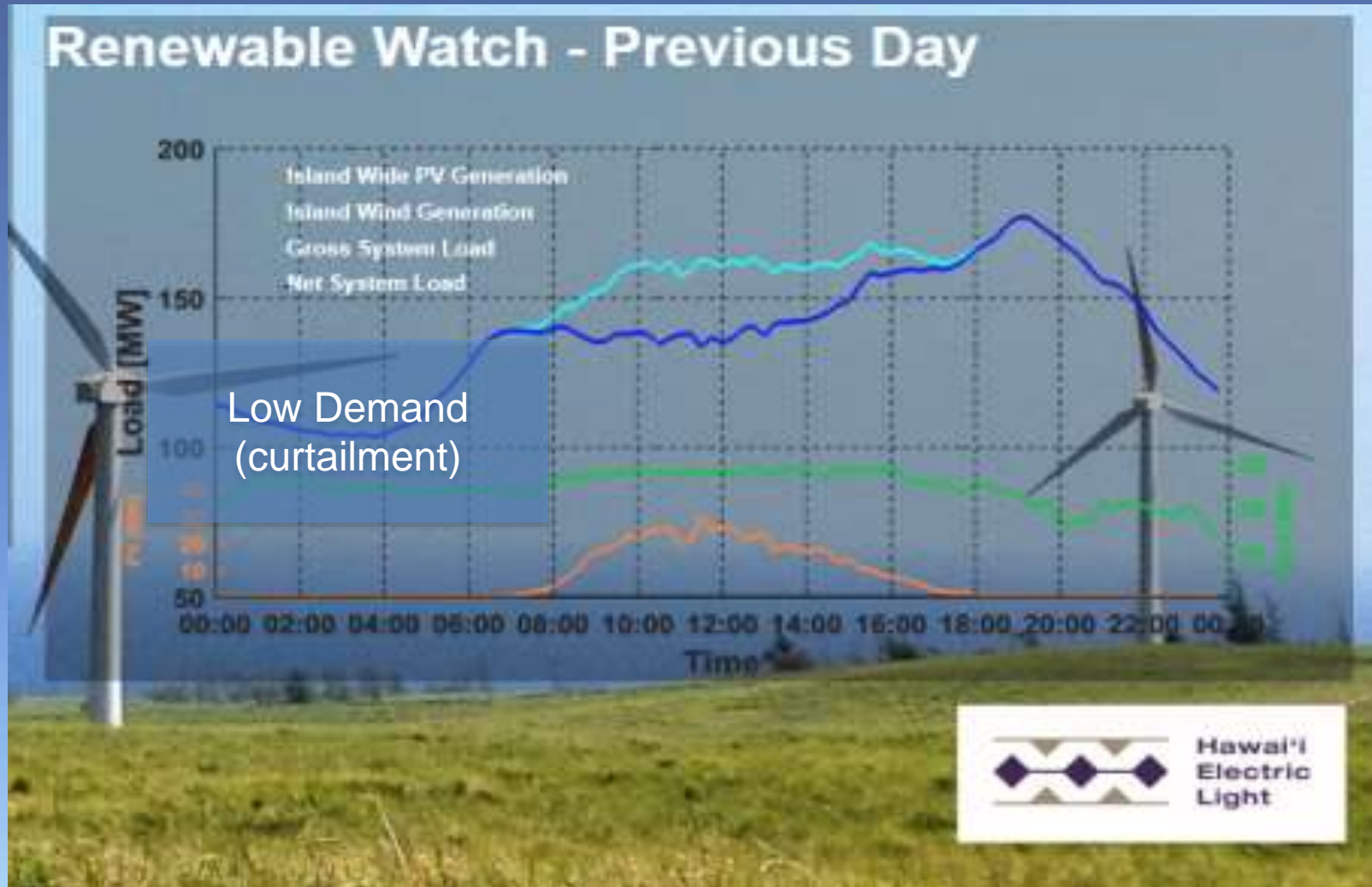
HELCO – Renewable Watch

(<https://www.hawaiielectriclight.com/clean-energy-hawaii/integration-tools-and-resources/renewable-watch>)



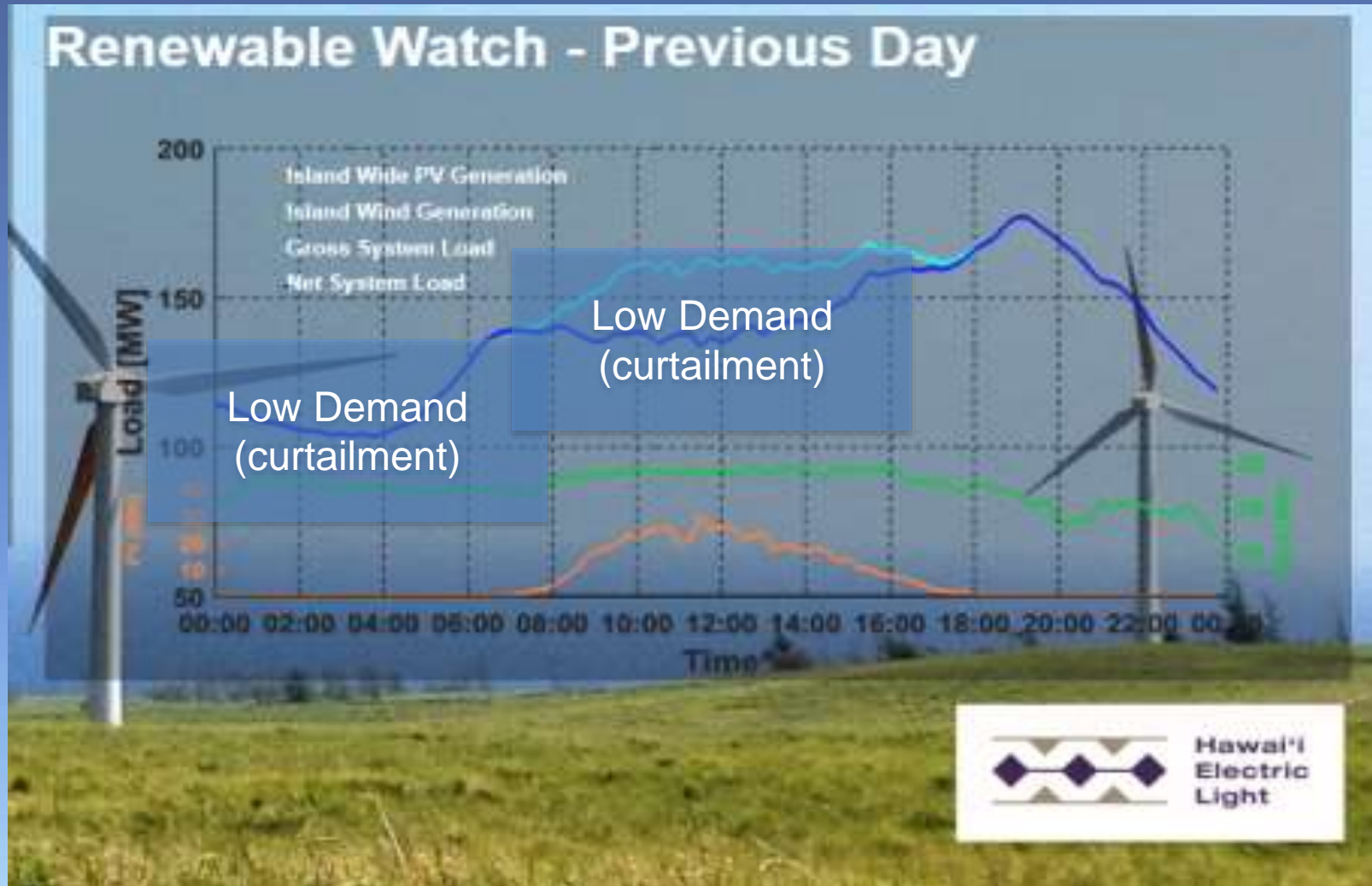
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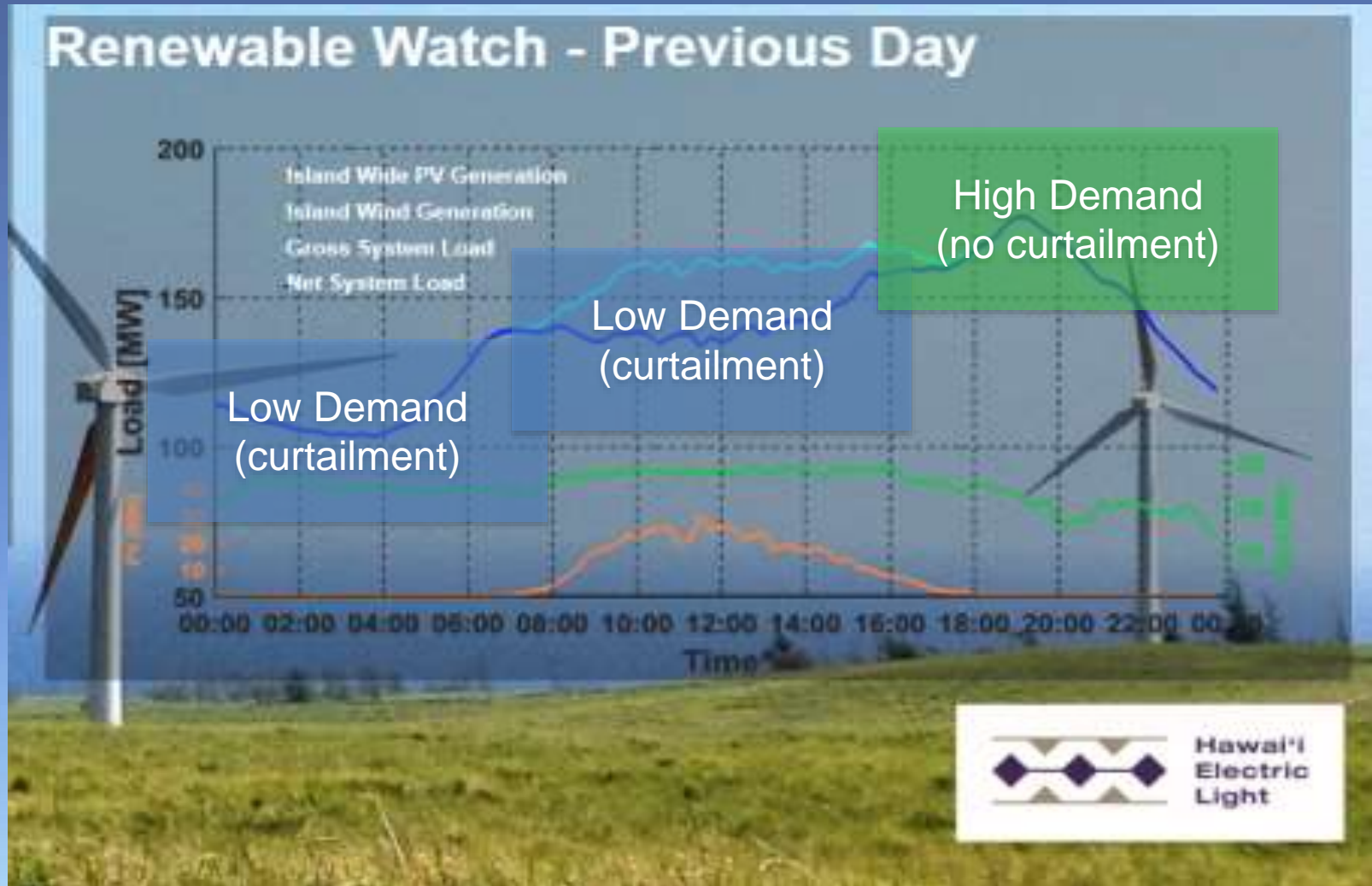
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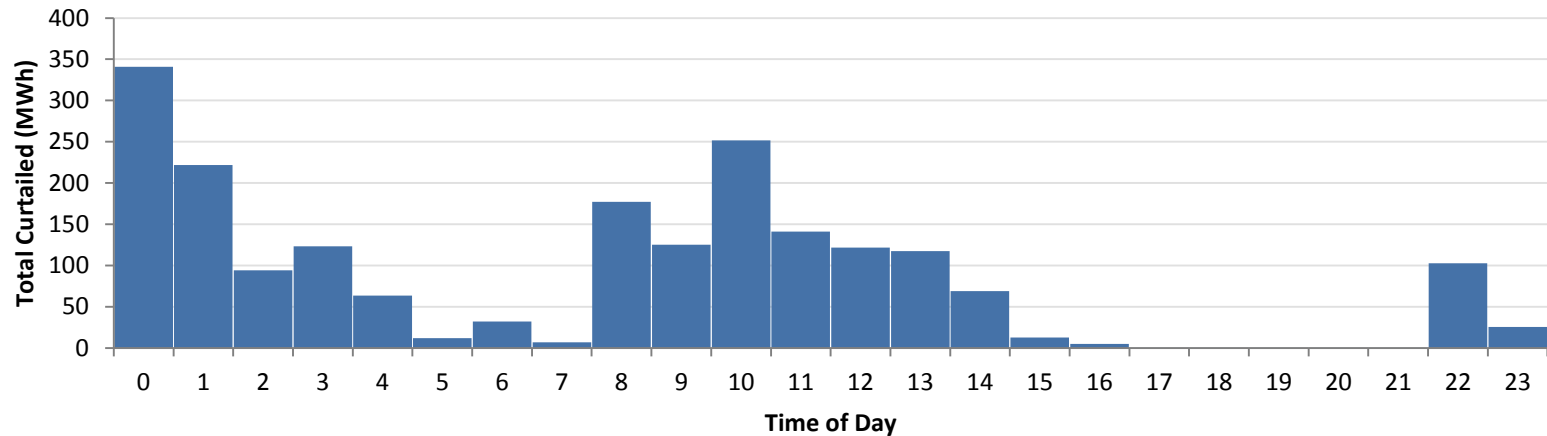
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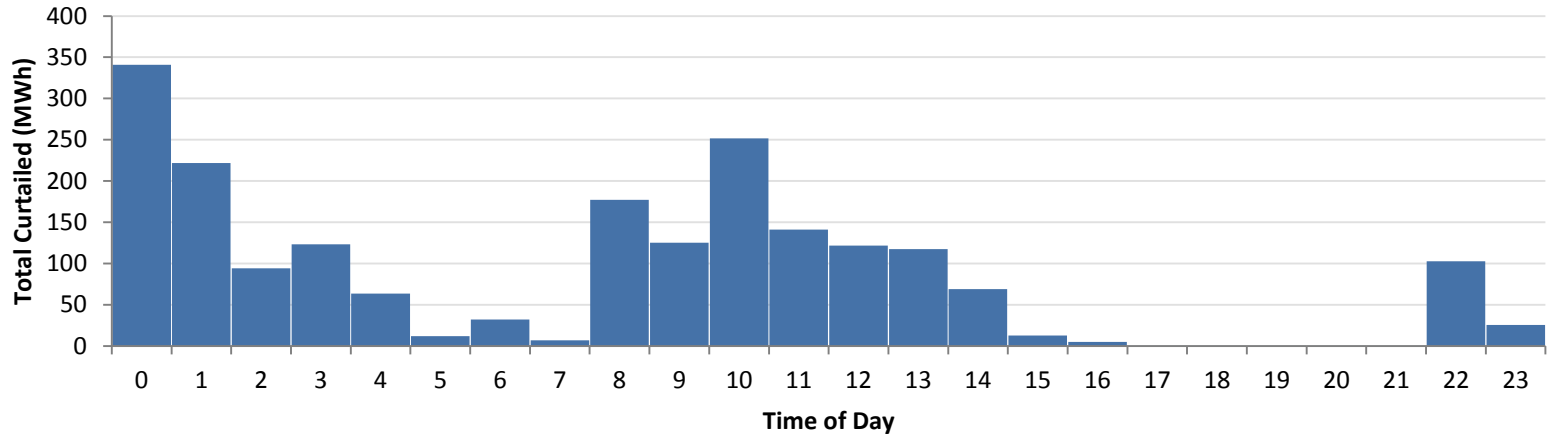
Curtailment Profiles

MWh per Hour Histogram (June/July 2016 - Maui)

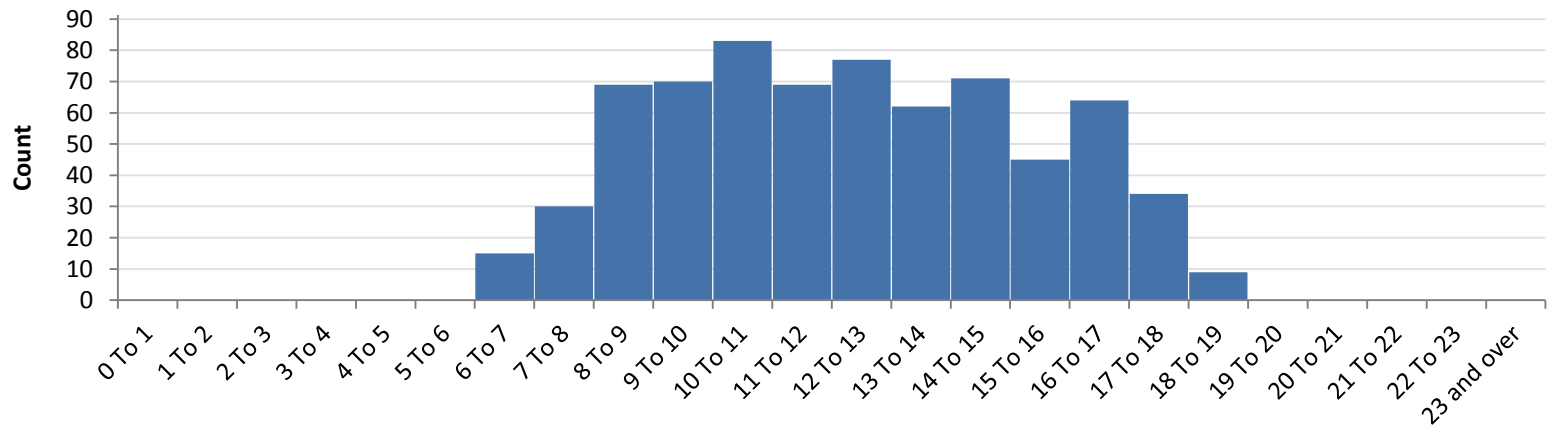


Curtailment Profiles

MWh per Hour Histogram (June/July 2016 - Maui)



Curtailment Events - (June/July 2016 - Lanai)



We need a solution that is:



24-hour Operation



Available On-Demand



Cost-Effective

Edisun Has the Solution

Chemical batteries are too expensive...

So we invented a “thermal” battery, which uses rocks to store energy.

We heat the rocks to 500 degrees, and we can store energy 50x cheaper than electrochemical batteries.

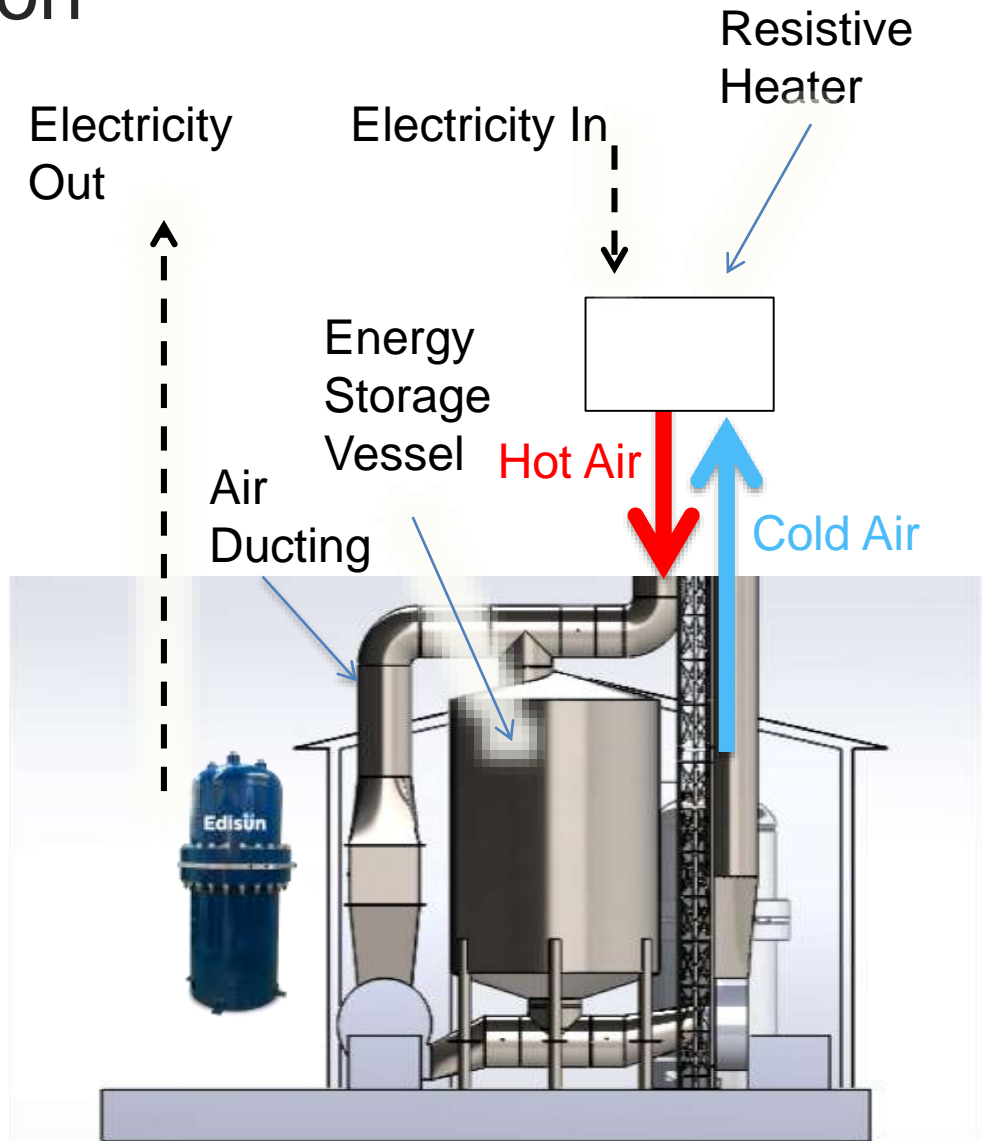


Edisun Has the Solution

- Solar Power Conversion and Storage System



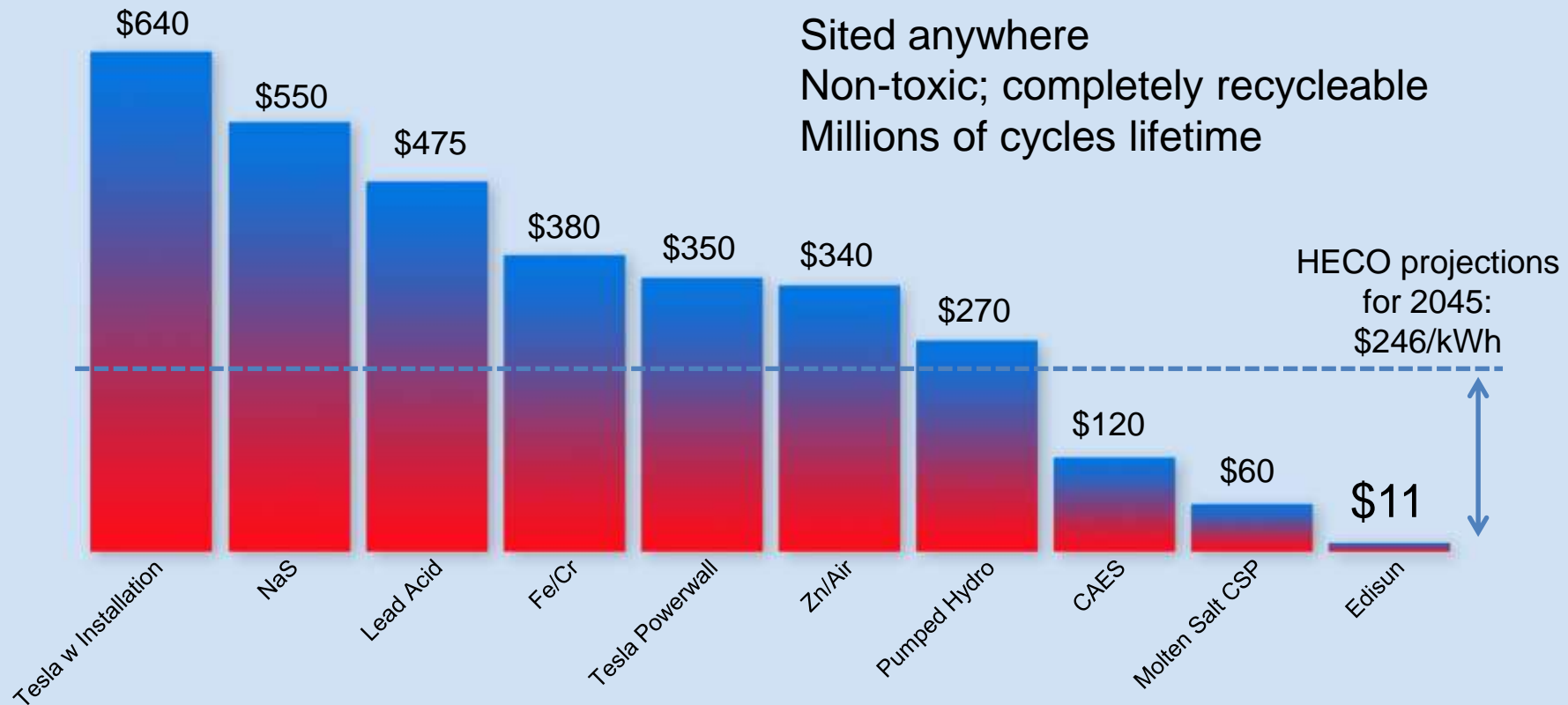
Breakthrough Efficiency Heat Engine



Edisun Storage Breakthrough

50x Lower Storage Costs Make Microgrid Affordable

- Lowest Cost of Storage by far for any Technology
(\$/kWh Capex)



Status Update

- We've built and tested a demonstration unit in California
- We're building and operating a larger demonstration here at NELHA
- We're looking for:
 - Curtailment partners/grid partners
 - Investors interested in participating in our mission
 - International partners who can help us with expansion

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