

Geothermal Energy and Its Value

Imperial Valley Renewable Energy Summit

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Heber Geothermal Complex, CA, USA



Green energy you can rely on

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Introduction

Market leader with proven track record in the geothermal sector

Our mission is to become a leading global renewable energy provider

52

Years of
experience



663 \$M

FY 2016
Revenues



Own & Operate

713 MW



324 \$M

FY 2016
Adj. EBITDA



1,180

Employees



Expansion to Energy Storage



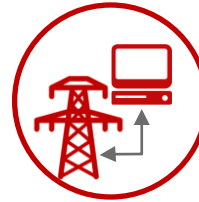
Global
Business
Development



EPC &
Operation



Funding



Energy Storage
Management
Software



Battery



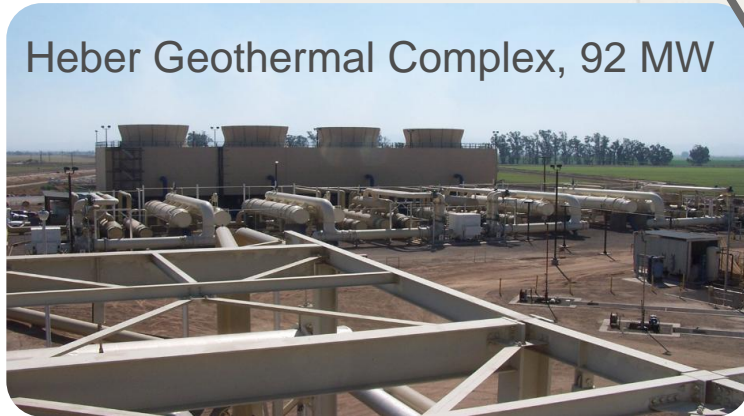
Technology
Provider

Ormat in the Imperial Valley

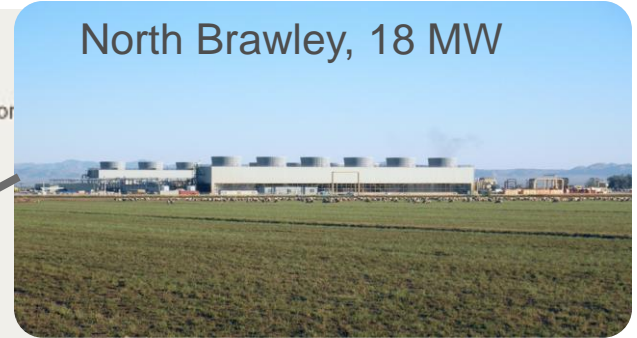
Heber Solar, 10 MW_{AC}



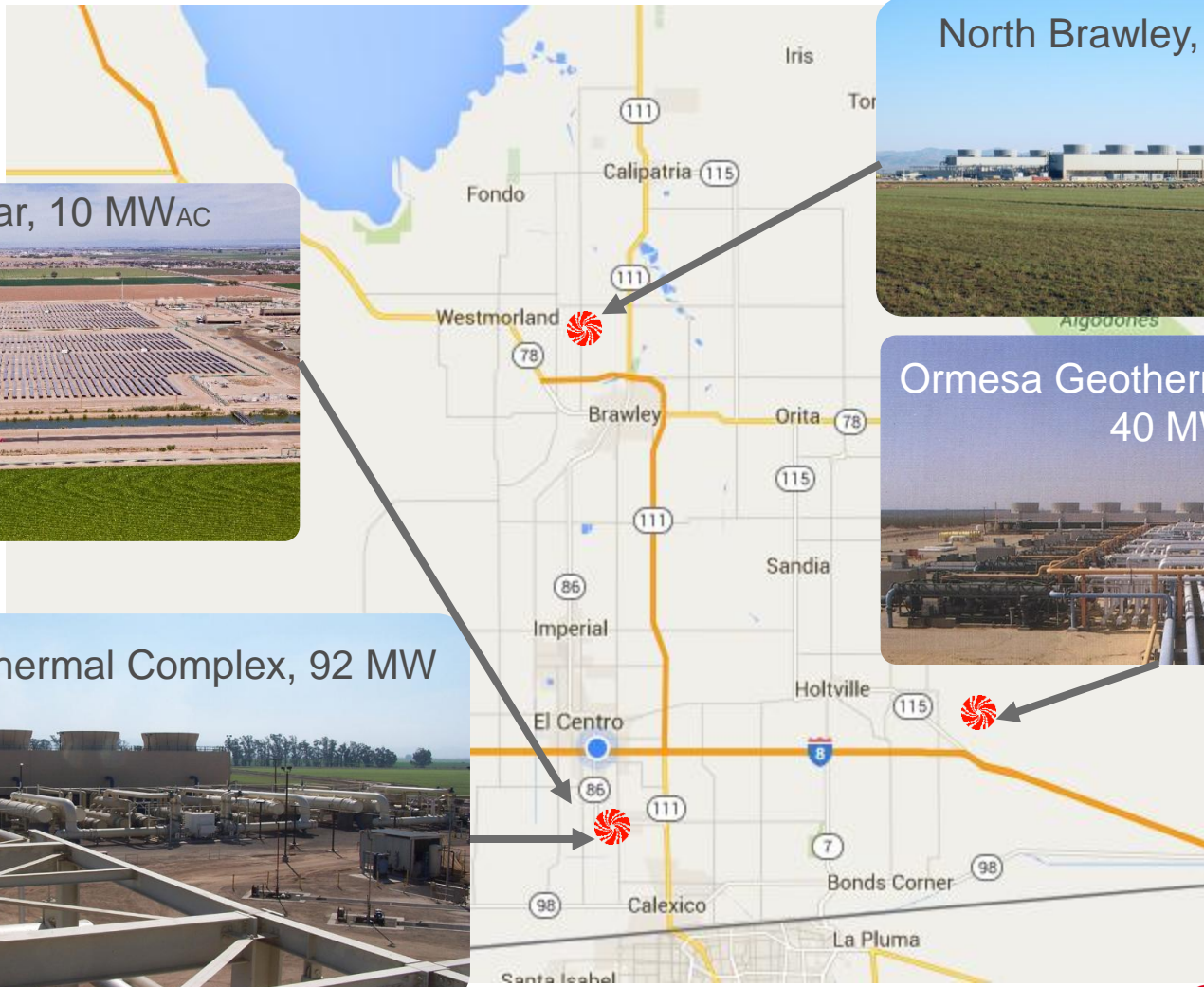
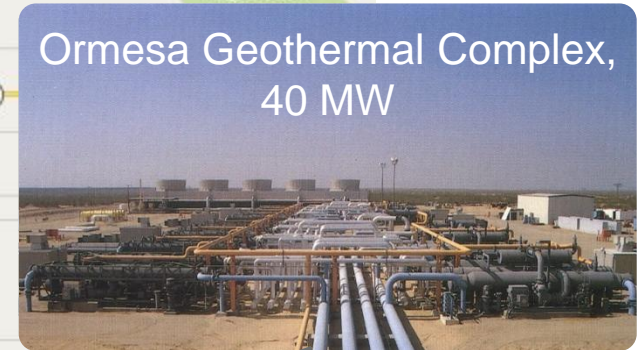
Heber Geothermal Complex, 92 MW



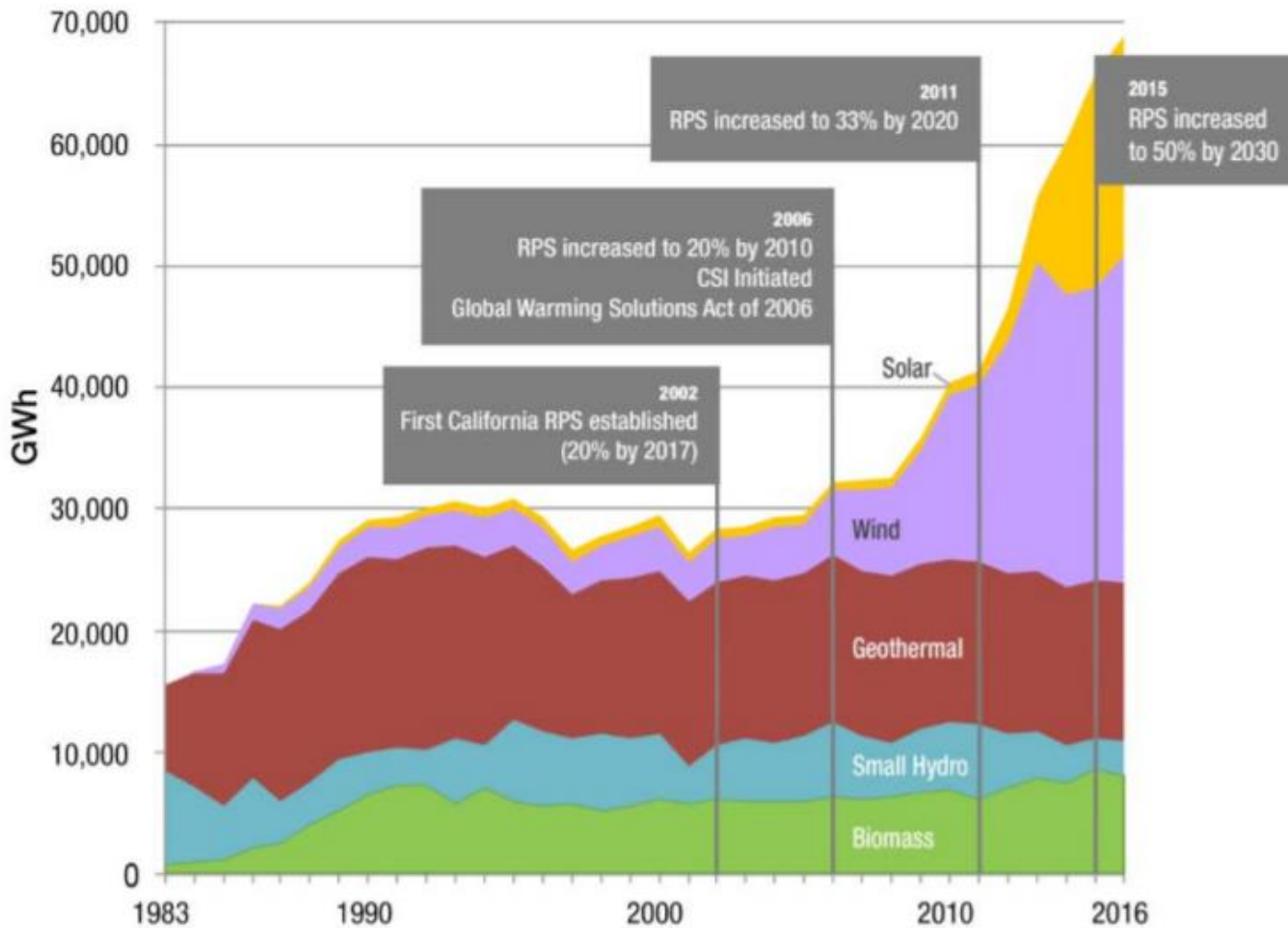
North Brawley, 18 MW



Ormesa Geothermal Complex, 40 MW



California's Renewable Resources Mix

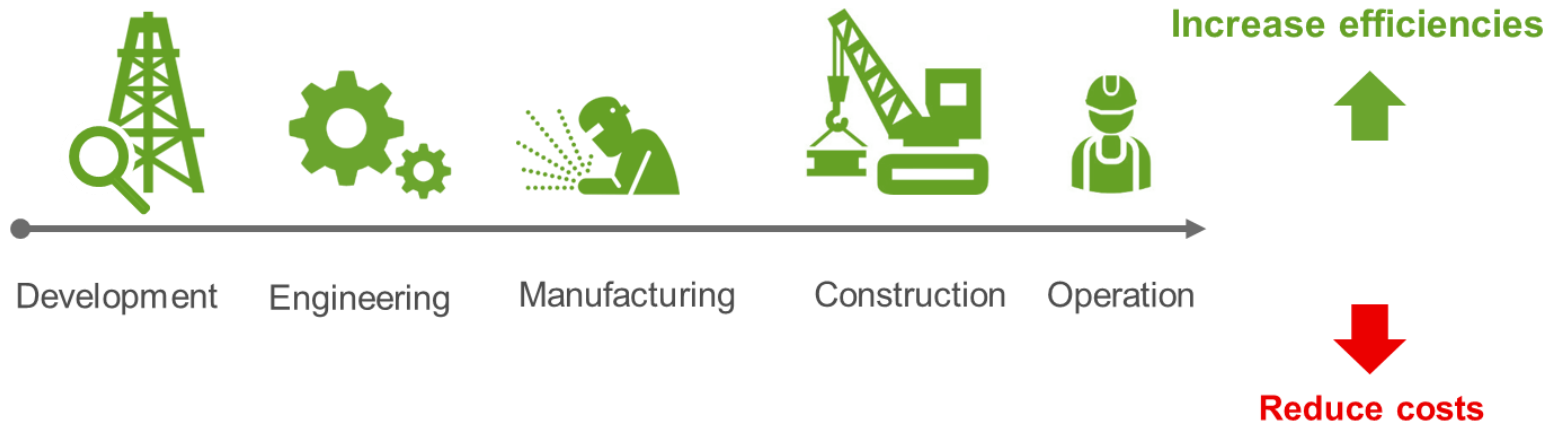


Source: CEC Tracking Progress Report, update December 22, 2016

Cost Reductions Across the Value Chain

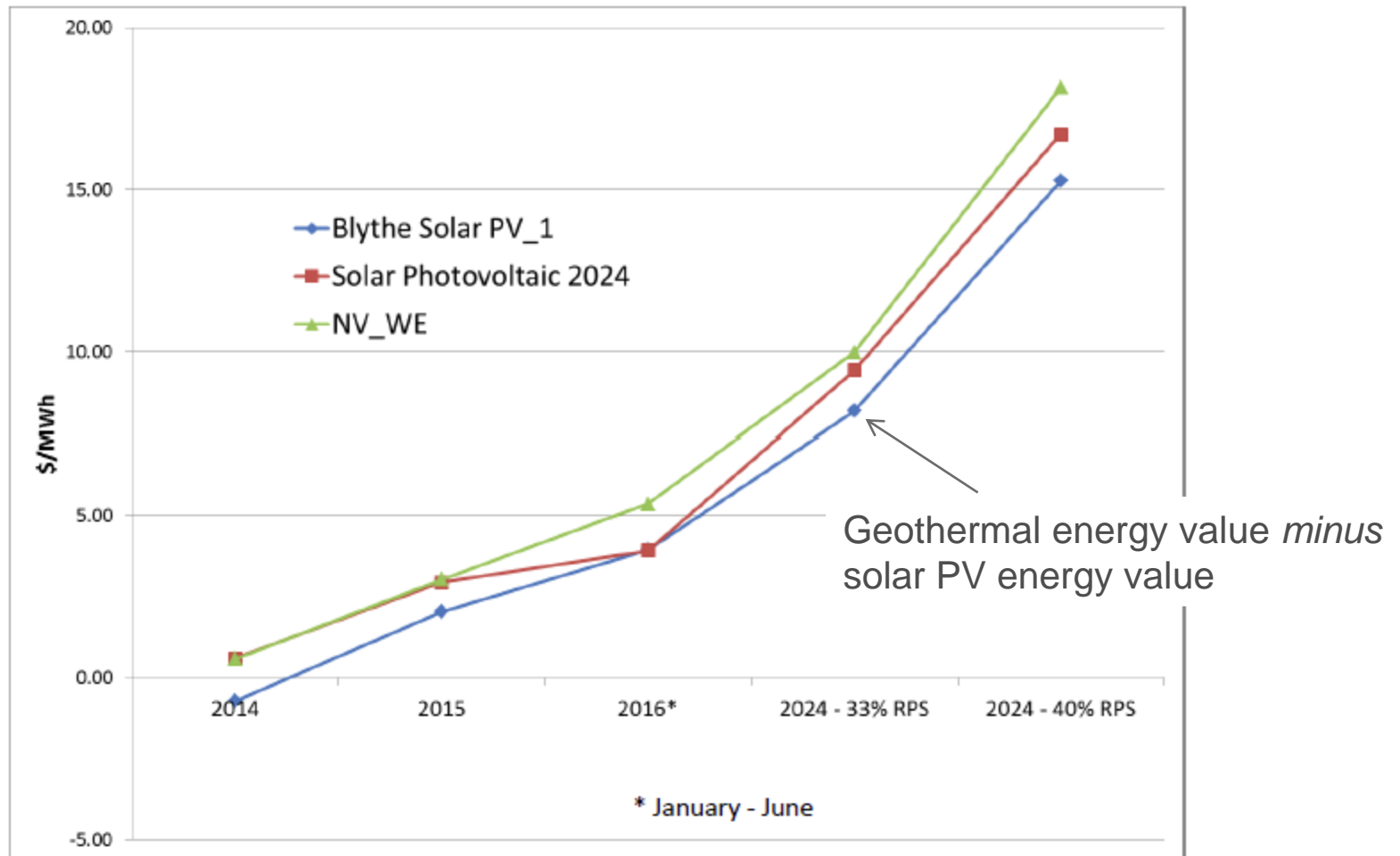
- Exploration:
 - Advanced geophysics
 - Core drilling
 - Fewer dry wells
- Development
 - Bigger production pumps = fewer wells per project
- Power plant CAPEX
 - Bigger, more efficient turbines and heat exchangers
- O&M costs
 - More automation
 - Regional O&M centers
 - Centralized procurement

Cost of Geothermal is Going Down



- Cost of new Ormat geothermal projects is \$4,000-\$4,500/kW
 - Down from \$4,500-\$5,000/kW several years ago
- Levelized PPA prices dropped from >\$100/MWh to <\$80/MWh

Value of Geothermal is Going Up: Energy



Source: Ormat, based on SCE market data, CAISO simulations and CPUC LTPP model



Heber Geothermal Complex, CA, USA



Green energy you can rely on

Valuation Summary: Geo vs. Solar in CA 2024

Attribute	Added Value	Notes / Ref.
Energy	\$15 - \$20/MWh	(1)
Capacity	\$10 - \$19/MWh	(2)
Integration	\$5 – \$20/MWh	(3)
Curtailment	\$4 - \$9/MWh	(4)
Transmission utilization	>\$2/MWh	(5)
Flexibility	?	
GHG emissions	?	
Total	\$36 ~ \$70+/MWh	

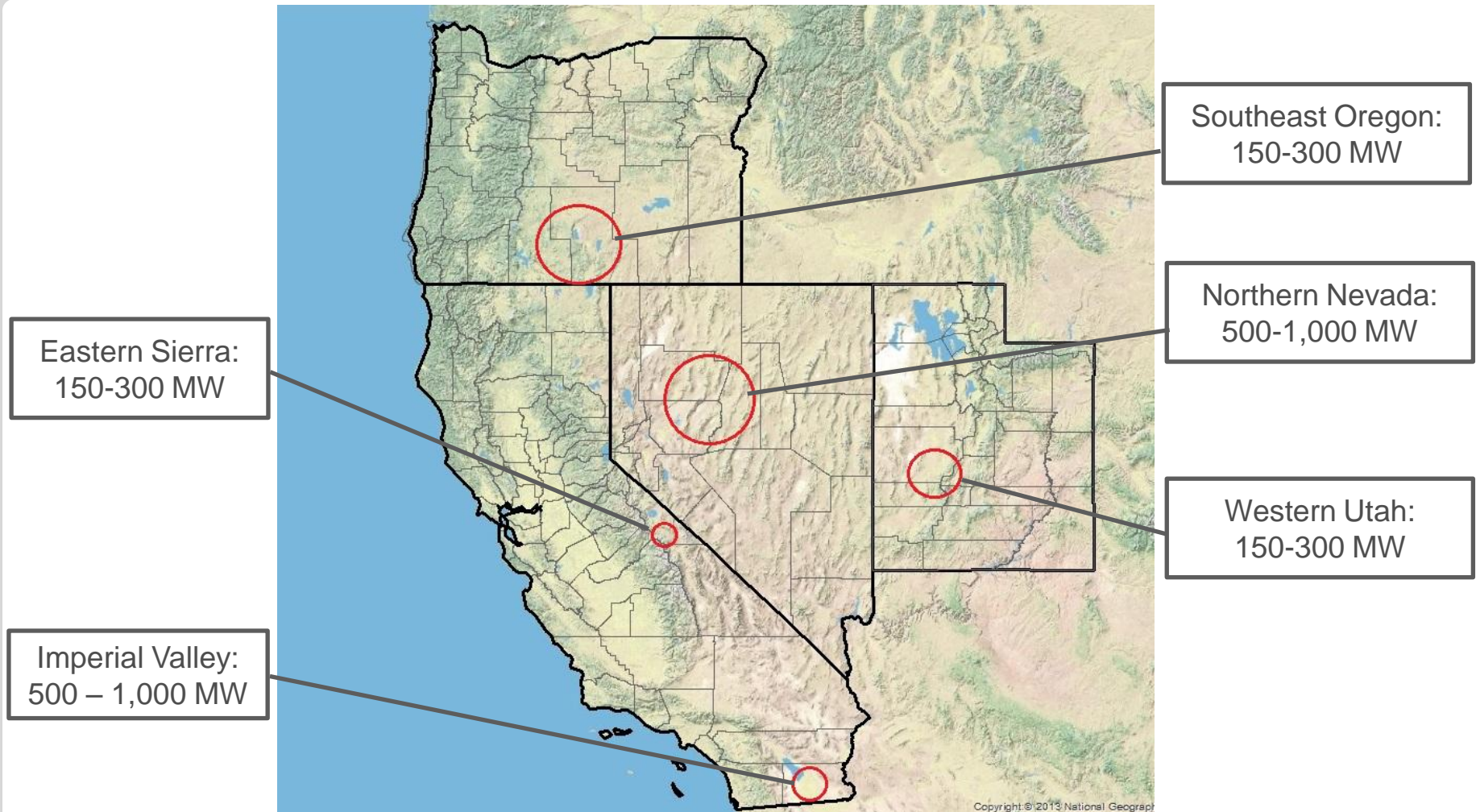
- (1) Based on CAISO simulations and CPUC LTPP model
- (2) Based on CAISO annual revenue requirement of a new 100 MW CT in its 2015 State of the Market report.
- (3) Based on CPUC studies and LADWP IRP.
- (4) Assumes 10% - 20% curtailment of solar at \$40/MWh
- (5) Assumes yearly transmission cost of \$6/MW (taken from LADWP 2014 Power Service Cost of Service Study for the Barren Ridge project) and factors in 80-90% capacity factor for geothermal vs. 25-30% capacity factor for solar PV

Dispatchable Geothermal Case Study: 38 MW Puna Geothermal Venture

- Big Island, Hawai'i
- Dispatchable energy
- Automatic Generator Control (AGC)
- Remotely and automatically controlled by HELCO System Operator
- Dispatch: 22 ~ 38 MW
- Ramp rate up or down: 2 MW / minute
- Spinning reserve at all times: 3 MW



Main Potential for Incremental Development



Source: GeothermEx – *Geothermal Inventory* 2004; GEA – 2014 Annual US & Global Geothermal Power Production Report, Ormat estimates

Ormat's Imperial Valley Roadmap

- Continuous investment in improving operating fleet
 - Heber
 - Ormesa
 - North Brawley
- Greenfield development
 - Truckhaven
 - More



Thank You



For further information: www.ormat.com / info@ormat.com

How it Works

