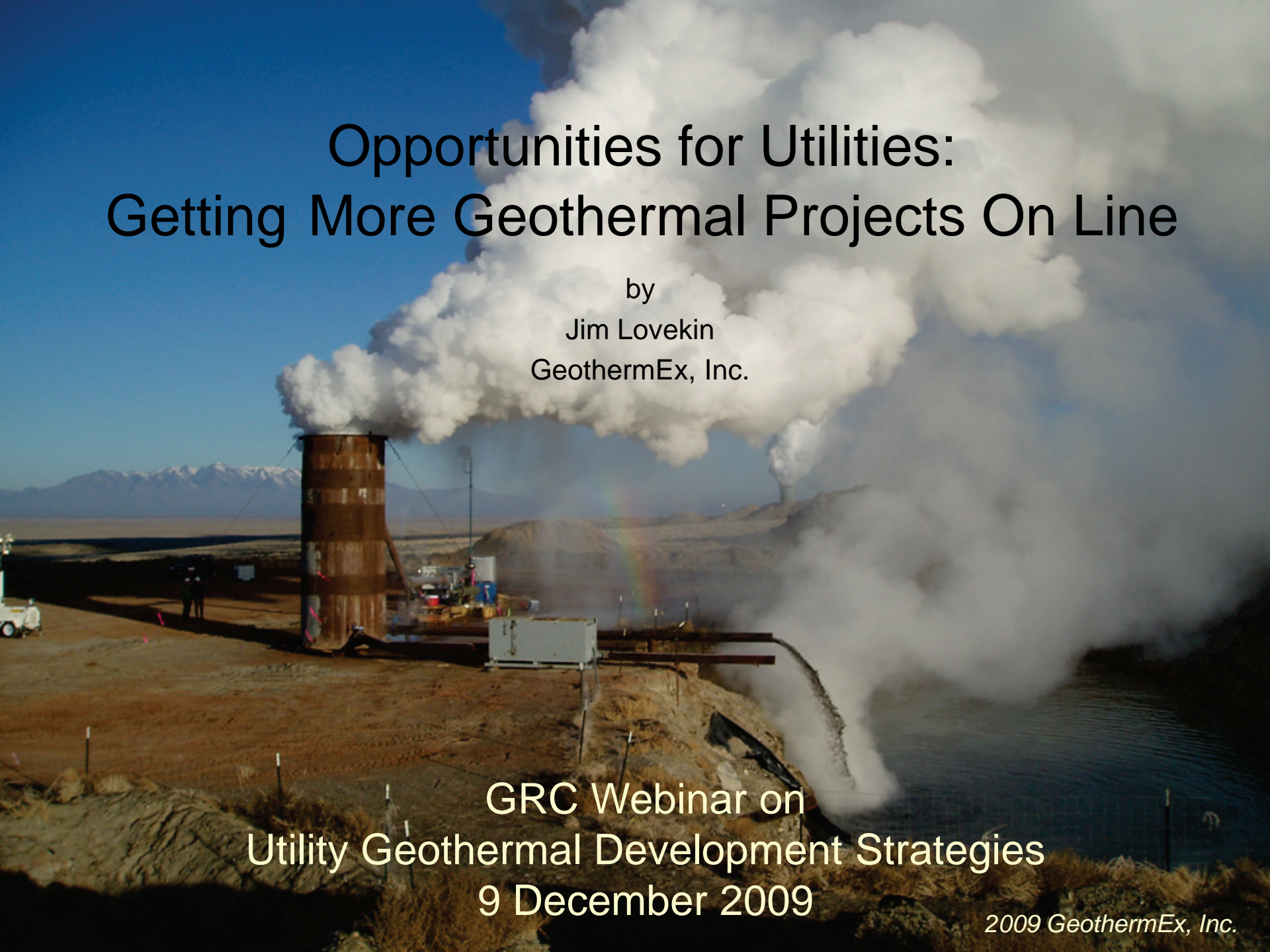


Opportunities for Utilities: Getting More Geothermal Projects On Line

by
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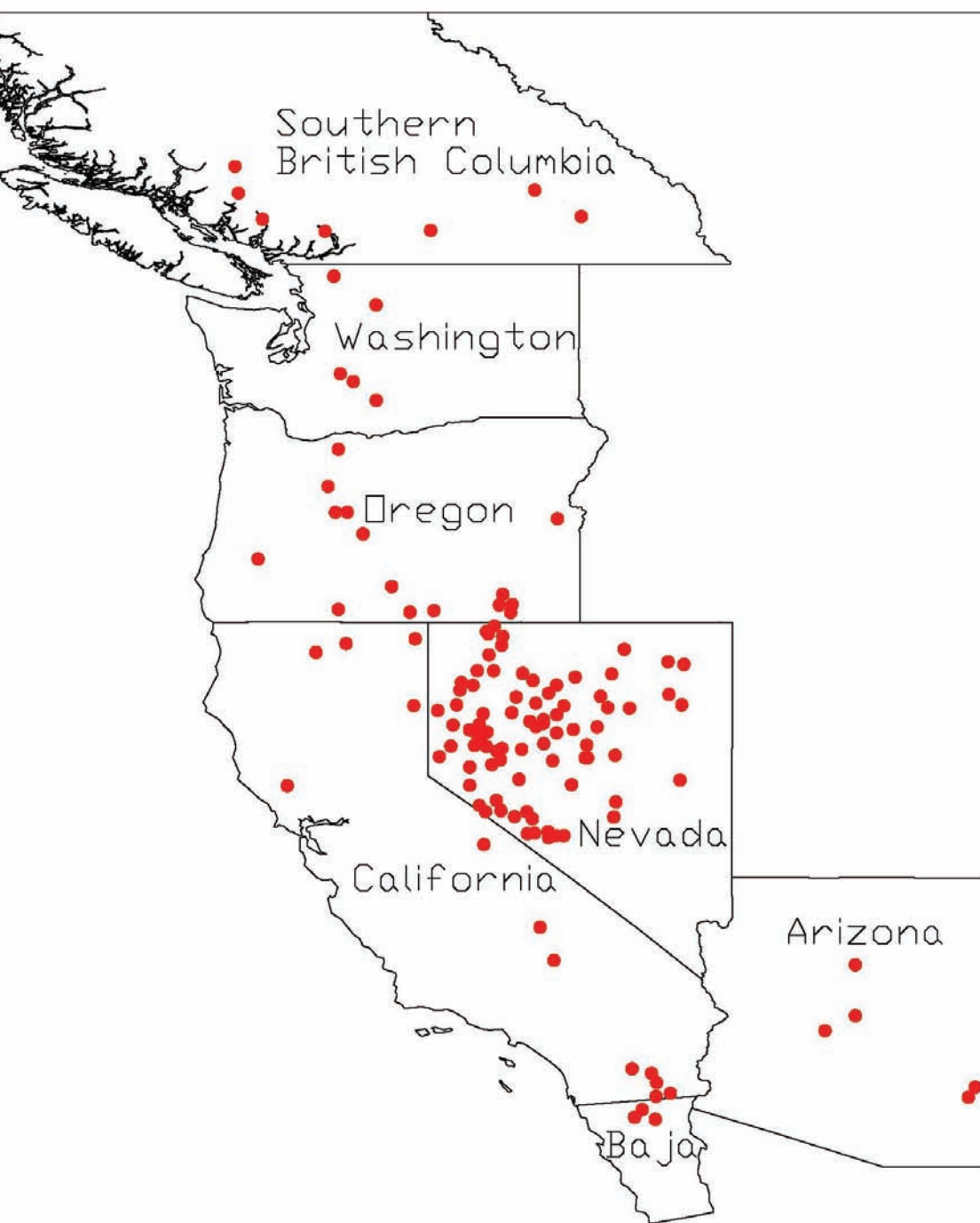
GRC Webinar on
Utility Geothermal Development Strategies
9 December 2009

2009 GeothermEx, Inc.



Outline

- Estimates of potential
 - Locations
 - Megawatts (MW)
- Strategies for utilities
- Stages of geothermal development
- Cost estimates
 - Capital costs
 - Operation and maintenance (O&M) costs



Locations of Geothermal Sites – per Renewable Energy Transmission Initiative (RETI) 2009

RETI Geothermal Analysis

- Focus on identified, conventional hydrothermal resources
- 116 sites identified in 5 US states + British Columbia & Baja California
- Did not quantitatively consider:
 - Undiscovered conventional resources
 - Enhanced Geothermal Systems (EGS)
- Acknowledged that undiscovered and EGS resources could yield much higher potential (tens of thousands of MW)
 - Left as subject for reconsideration in subsequent assessments

RETI Estimates of Geothermal MW

State / Province	Installed Capacity as of Feb 08 (Gross MW)	Estimated Incremental Capacity Within 10 Years (Gross MW)	Total Capacity (Installed + Incremental) Within 10 Years (Gross MW)
California	1,884	2,440	4,324
Nevada	297	1,785	2,082
Oregon	0	600	600
Washington	0	50	50
Arizona	0	50	50
Baja California, Mexico	730	80	810
Southern British Columbia	0	280	280
Total	2,911	5,285	8,196

Western Governors' Association

- Subsequent to RETI analysis
 - Still in progress
- Considered additional geothermal areas
 - Idaho, Utah, entire province of BC
- Western Renewable Energy Zones (WREZ)
- 182 geothermal sites
- Incremental capacity about 6,700 MW gross

Strategies for Utilities

- Purchase geothermal power from Independent Power Producer (IPP)
 - Power Purchase Agreement (PPA)
- Joint venture with IPP
- Operate geothermal projects directly
 - Greenfield development
 - Legacy projects
 - Expansion projects
 - Acquisition

Stages of Development

- Resource acquisition and planning
 - Consolidated site control
- Exploration and resource assessment
 - Geology, geochemistry, geophysics
 - Temperature-gradient drilling
 - Discovery well milestone
 - Confirmation drilling
- Financing (or spending sanction)
- Development drilling
- Construction of plant and transmission

Coring Rig





Greenfield Projects

- Usually make Go / No-Go decision based on first several full-sized wells
- Generally commit to drilling at least 2-3 wells for project of about 25 MW
 - Cost depends on depth and other factors
 - On the order of \$10 million to \$15 million
- If larger project anticipated, initial commitment would probably be the same
 - Staged development

Legacy Projects

- Exploration and/or confirmation drilling may already be done or far-advanced
 - Lower resource risk
- Typically held up by:
 - Environmental issues
 - Lack of acreage control
 - Lack of transmission
- Examples:
 - Medicine Lake, Truckhaven, Fish Lake Valley
- Potentially attractive opportunities if resources can be brought to bear to solve these problems

Expansion Projects

- Resource risk considerably lower
 - Documented reservoir performance
- Examples:
 - Salton Sea, The Geysers, Roosevelt
- Risk of interference between new and old projects needs to be assessed
 - Especially if more than one operator

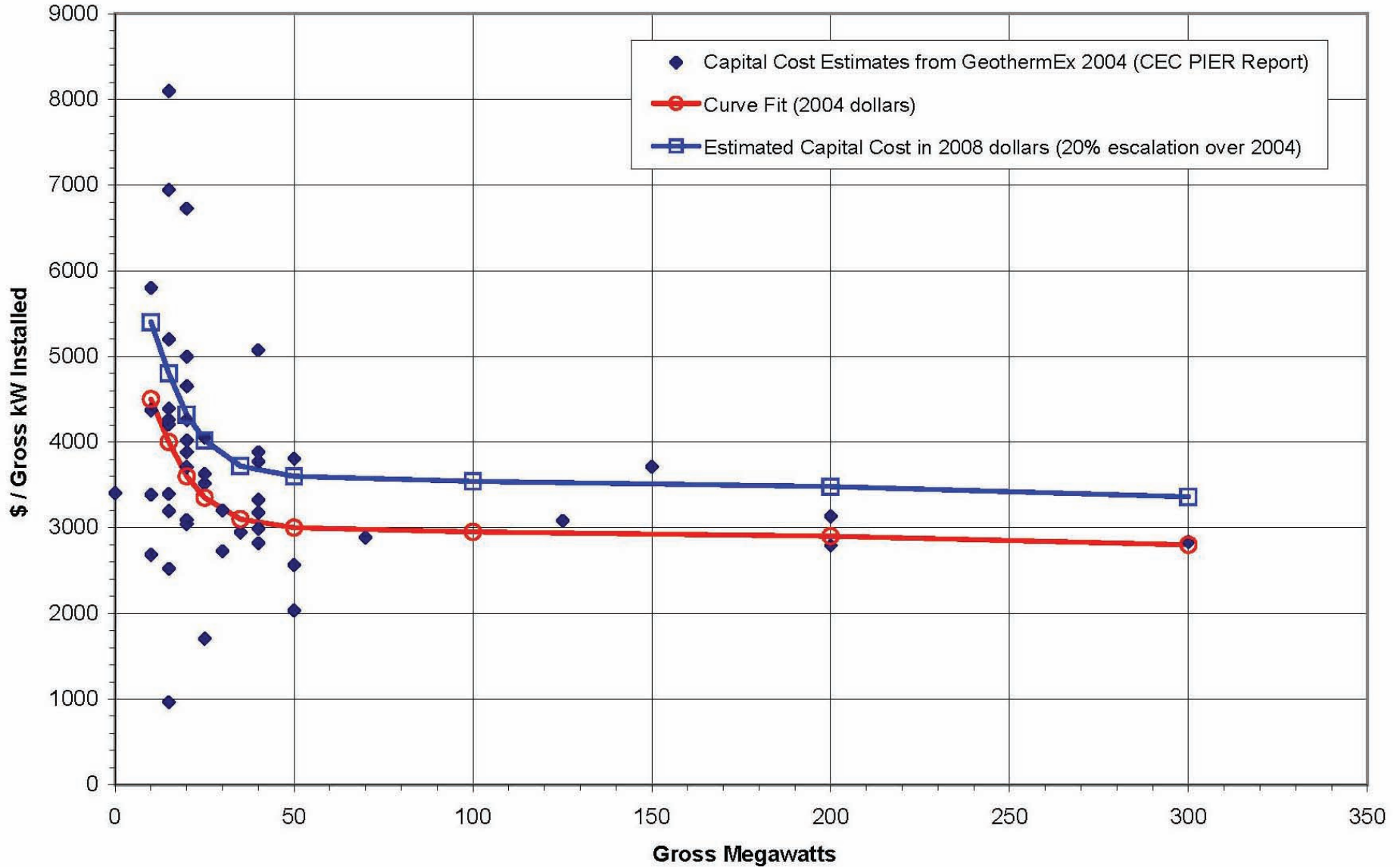
Acquisition Projects

- Negotiation of new PPA upon expiration of old one
- Purchase all or a share of generating assets to position oneself for obtaining rights to geothermal power
- This is long-term strategy
 - PPAs on already-operating facilities typically extend beyond 5 years
- Alternatively, buy out offsetting leases
 - Integrate development strategy with existing operator

Cost Estimates from RETI

- Based on current industry experience
- Comparison to CEC PIER study (2004)
 - 20% escalation to 2008
- Correlation of capital cost to plant size
 - Smaller plants more expensive per kW
 - Essentially level costs per kW over 50 MW
- Correlation used to estimate capital costs for projects not considered in CEC PIER study
- Range: \$3,000 - \$5,500 per kW installed

Estimate of Capital Cost



Cost Estimates (cont.)

- O&M cost range: \$22 - \$30 per gross MW
- Smaller plants toward higher end of range
- Hyper-saline brine O&M: \$35 per gross MW
- These O&M costs include:
 - Site costs
 - General & administrative overhead
 - Workovers
 - Royalties
 - Insurance
- Do NOT include costs of financing and interest payments
 - Such costs WERE included in RETI comparisons between resource types

Levelized Cost Comparisons

- Levelized cost of energy (LCOE)
 - Calculated in RETI study using standardized cash-flow analysis across resource types
 - Geothermal capacity factors assumed:
 - 90% for flash plants
 - 80% for binary plants
 - LCOE values: \$65 to \$130 per net MWh

Summary

- Geothermal resource opportunities at over 150 sites in western US, Canada and Mexico
- Conventional geothermal potential in excess of 6,000 MW – over and above existing plants
- Utility strategies range from traditional PPA to direct operatorship
- Representative recent cost estimate (RETI):
 - Capital costs: \$3,000 - \$5,500 / kW gross
 - O&M costs: \$22 - \$30 per gross MWh
 - LCOE: \$65 to \$130 per net MWh