

Geothermal Development

Oregon Geothermal Working Group
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Construction

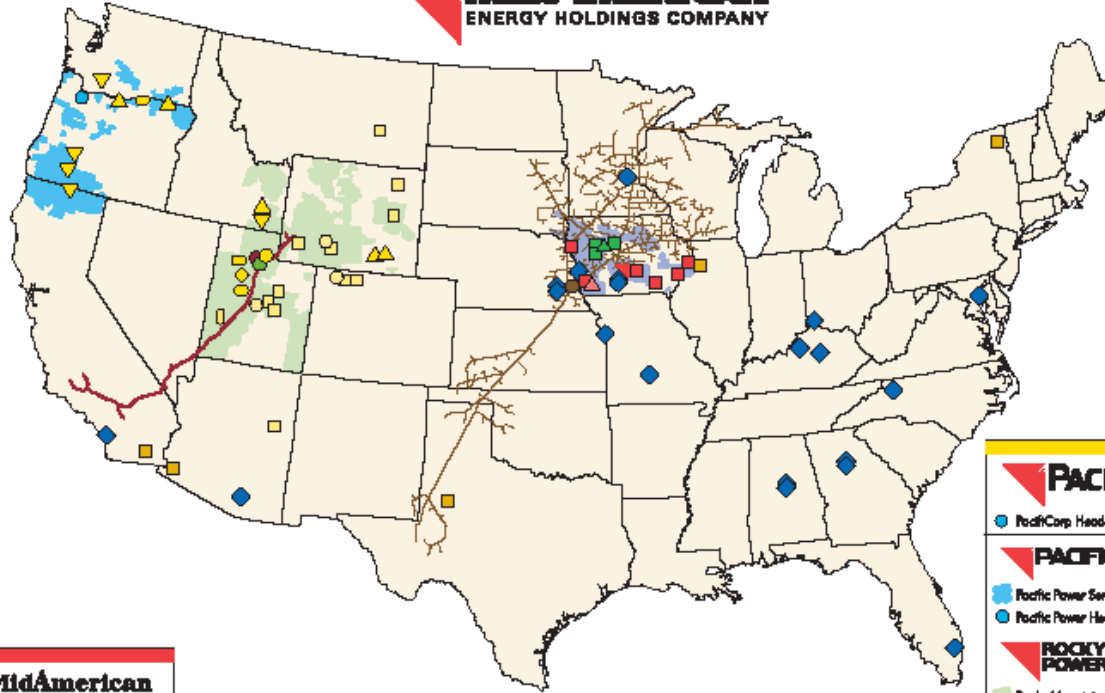
PacifiCorp

- Supply and distribute electric energy in six western states: California, Idaho, Oregon, Utah, Washington, and Wyoming
 - ▶ **PacifiCorp Energy:** Generation, Mining, and Commercial & Trading
 - ▶ **Rocky Mountain Power:** Provide transmission & distribution services in Idaho, Utah, and Wyoming
 - ▶ **Pacific Power:** Provide transmission & distribution services in California, Idaho, and Oregon
- 1.67 million customers
- Over 9,500 MW of generating resources (net capability)
 - ▶ Thermal ~8,000 (coal and gas)
 - ▶ Hydro ~1,200
 - ▶ Renewables ~300+ (wind and geothermal)
 - ▶ Contracts (Includes wind, coal, and gas)
- Over 6,500 employees

PacifiCorp – Service Territory



MidAmerican Energy Holdings Company



MidAmerican ENERGY

- MidAmerican Energy Company Service Territory
- MidAmerican Energy Holdings Company and MidAmerican Energy Company Headquarters
- Generation Operations
- Generation Development
- Wind Project Operations
- Wind Project Development

CALENERGY

- Generation Operations

Electric Services of America, Inc.
a subsidiary of PacifiCorp

- Real Estate Operating Companies

Northern Natural Gas

- Northern Natural Gas Pipelines
- Northern Natural Gas Headquarters

Korn River
AN ELECTRIC UTILITY

- Korn River Gas Transmission Pipelines
- Korn River Headquarters

PACIFICORP

- PacifiCorp Headquarters

PACIFIC POWER

- Pacific Power Service Territory
- Pacific Power Headquarters

ROCKY MOUNTAIN POWER

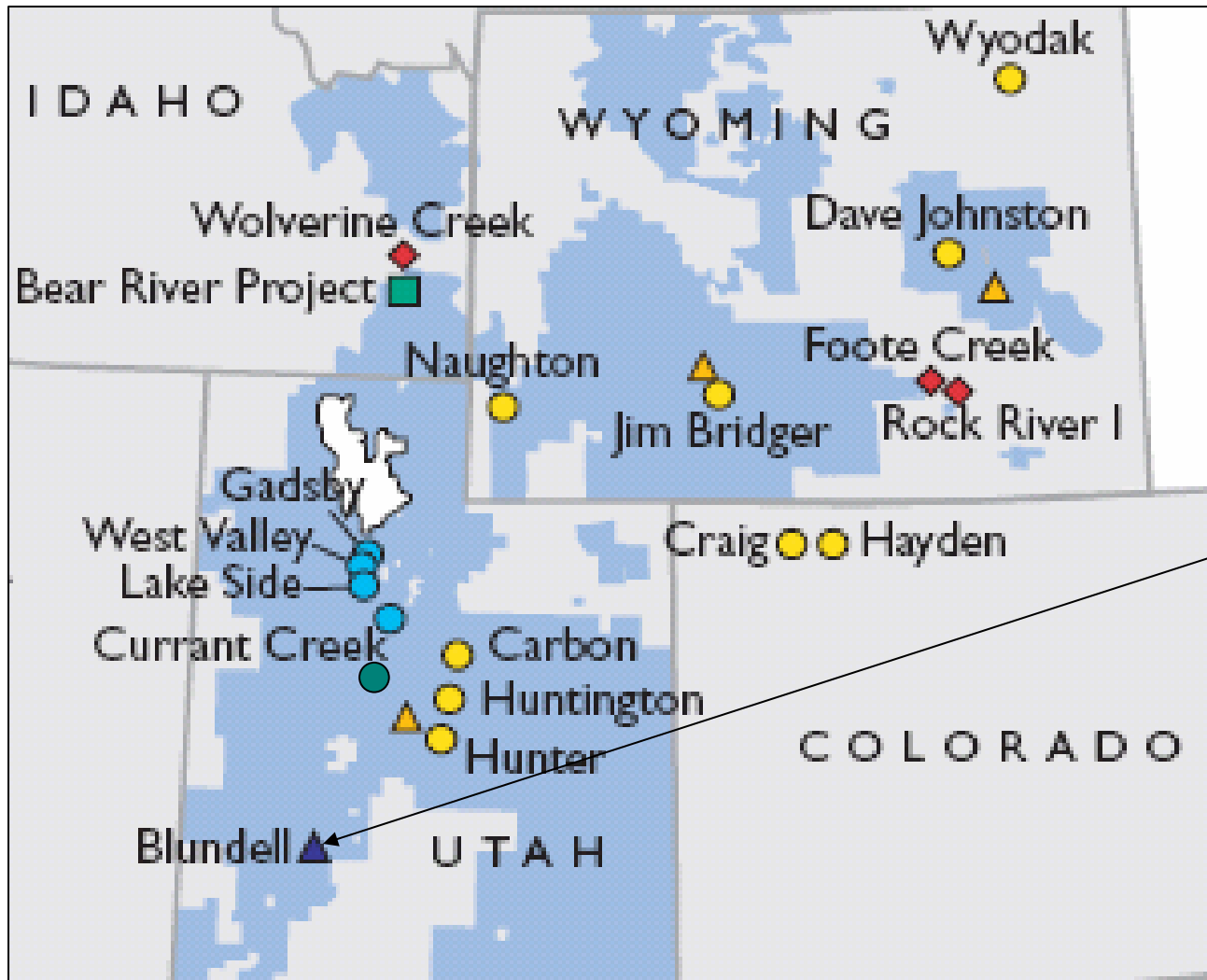
- Rocky Mountain Power Service Territory
- Rocky Mountain Power Headquarters

PACIFICORP ENERGY

- PacifiCorp Energy Headquarters
- Coal-Fueled Thermal Plants
- Gas-Fueled Thermal Plants
- Wind Projects
- Geothermal Plants
- Coal Mines
- Hydro Systems
- Generators Development



Major Resources & Development Areas



**Blundell
Geothermal
Plant**

PacifiCorp's Renewables Commitments

- The 2007 Integrated Resource Plan (IRP) sets revised targets:
 - ▶ **1,400 MW** – The original target date of 2015 has moved to 2010. The commitment remains at 1,400 MW;
 - ▶ **2,000 MW** – The 2007 IRP targets 2,000 MW of renewable resources in PacifiCorp's portfolio by 2013, targeting an additional 600 MW.

PacifiCorp's Renewables Commitments

- What counts towards the 2,000 MW?
- We have defined several resources that “count” as renewables
 - ▶ Hydro (new and upgrades)
 - ▶ Qualifying facility and renewables PPAs
 - ▶ Solar, wave & “waste”
 - ▶ Geothermal (new and upgrades)
- Much of this will come from wind, but not all.
- Very interested in geothermal resources

PacifiCorp Geothermal: Blundell Unit 1

- Location: Milford (Beaver County) Utah
- Geothermal resource: Roosevelt Hot Springs
- The geothermal resource and generating facility is owned and operated by PacifiCorp Energy
- Commercial date: July 1984
- Net capability: 23 MW
- Design: Single flash, brine and excess condensate is reinjected
- Steam conditions (108 PSIA/340°F); General Electric steam turbine generator
- Very high availability (89 % EA, 10-year period, 1997-2006)
- Excellent “base load” renewable resource due to its firm capacity and reliability

Blundell Plant



Blundell Geothermal Plant



Blundell Unit 2

Project – 11 MW bottoming cycle addition

Technology – Ormat Organic Rankine Cycle (ORC); uses isopentane as a working fluid in a closed loop

Budget – \$28 million (includes interconnection and AFUDC)

Target Commercial operation – November 2007

Constructor – CEntry

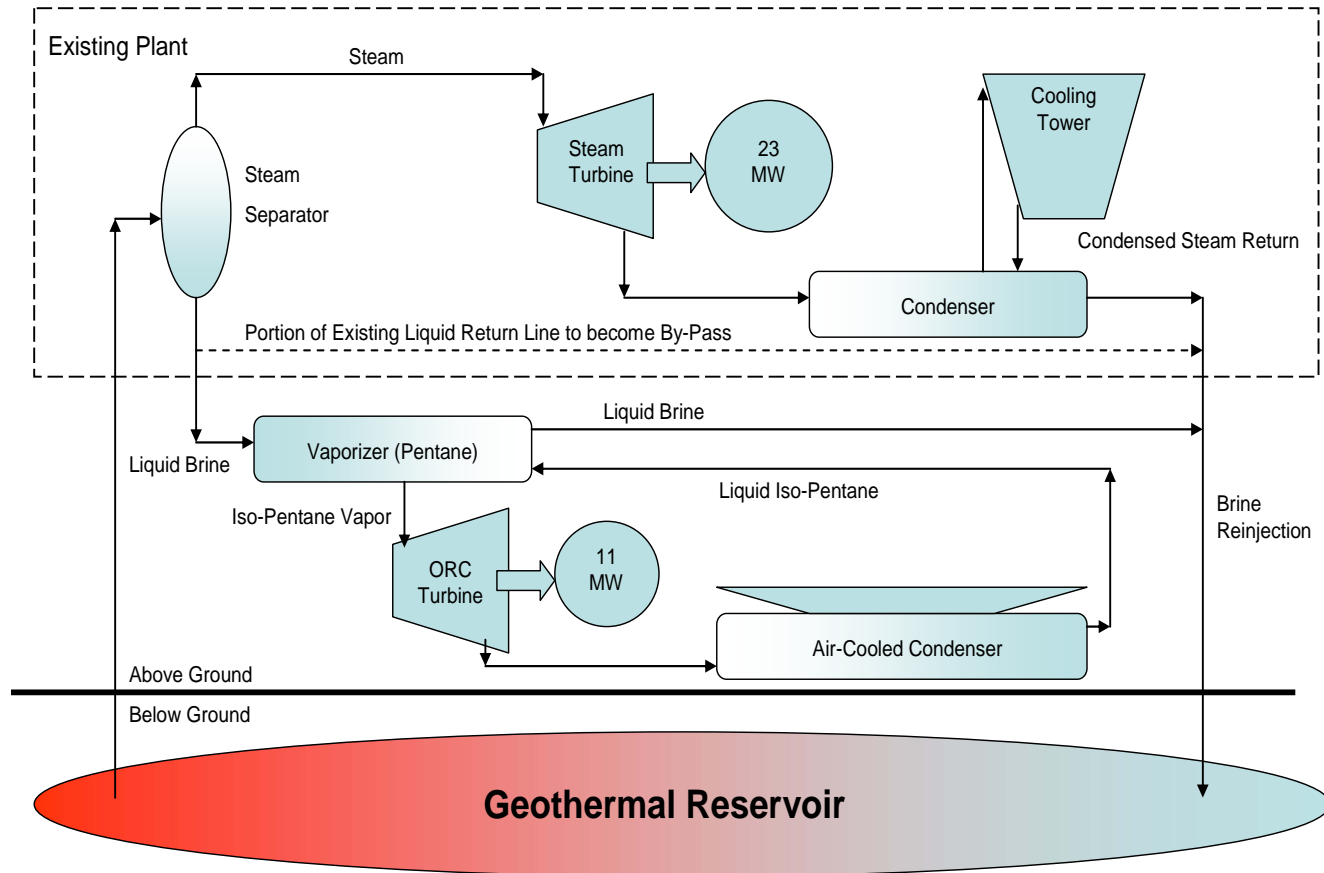
Ownership – 100 percent interest

Key areas to watch:

- ▶ Silica precipitation - acid injection technology and application
- ▶ Cold brine injection temperatures on startup
- ▶ Equipment

Cycle Schematic – After Bottoming Cycle Addition

Blundell Bottoming Cycle Addition



Blundell 2 – Air Cooled Condenser



Blundell – Future Expansion

Project – 30-35 MW (i.e. double existing/current planned generation)

Technologies – Dual flash or Hybrid (single flash with ORC bottoming cycle)

Transmission – Requires new transmission path

Ownership – 100 percent interest

Development – New test production & injection wells to be drilled; permitting started

Key concerns

- ▶ Schedule
- ▶ Drill rig availability
- ▶ Construction costs
- ▶ Long term sustainability of geothermal resource

Blundell Plant under attack (Milford Flat Fire)



Geothermal Resource Development

Project development hurdles:

- High capital costs (wells, collection field, plant, transmission, development)
- Uncertainty regarding sustainability of geothermal resource
- Drill rig availability and well costs (\$4 - 4.5 million each)
- Typically resources are on federal lands; extensive permitting process
- Lease acquisition cost (BLM and/or state)
- Site locations typically not close to loads – need for transmission lines (with associated permitting)
- Transmission studies
- Water rights
- Air permit
- Well completion risk
- “Proving” a geothermal resource is expensive!

Evaluating Generating Resources

- Cost of Energy analysis (Capex & O&M). A risk analysis is done around major parameters:
 - ▶ Performance (gross & net generation, availability, reliability)
 - ▶ Capital cost
 - ▶ Periodic well maintenance costs / ongoing capital
 - ▶ O&M and royalty payments
 - ▶ Renewable Portfolio Standards – cost comparison to other renewables
- Availability and application of incentives:
 - ▶ PTC/ITCs
 - ▶ Sales and/or property tax waivers
 - ▶ Renewables benefits (“carbon, green tags”)
- 3rd Party expert evaluations of the geothermal resource

Geothermal Development - Options

- Power Purchase Agreement (QF < 80 MW)
- Prove out geothermal resource and sell geothermal resource
- Joint development (subject to due diligence and appropriate risk sharing)
 - ▶ Very limited appetite for geothermal resource speculation
- Build, Own, Operate, Transfer (BOOT) – covers development, resource and operational risk
- Start transmission studies early!

Thank you

Questions? Comments?

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