Geothermal Energy
in the Klamath Basin

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Geothermal Resources of the USA

- High temperature: Electric Power
- Low temperature: Direct Use
- Ambient temperature: Heat Pumps

Cascading geothermal fluids – combined heat & power
Klamath County

District Heating
- 3 sites
  - Industrial
    - 2 sites
  - Greenhouse
    - 2 sites
  - Aquaculture
    - 1 sites
  - Space Heating
    - Over 600 sites
  - Snow Melting
    - 4 main areas
  - Resort/Spas
    - 4 swimming pools
Klamath Falls

- 600 geothermal wells
- 100 to 1,800 ft deep
- 100 to 220°F
- Majority use downhole heat exchangers
- City district heating system – 24 buildings
- Pavement snow melting systems
- Oregon Institute of Technology
“Big Springs” – Modoc field
Past and Present

- Original location was a military facility
- Original campus (1947 – 1960) spent $100,000/yr for heating
- Appropriation of $150,000 for exploration for a new campus for OIT – late 1950s
  - Used for master plan
  - Exploration to determine availability of geothermal water for space heating
Normal fault system on the east side of campus
Well Drilling

• **OIT #1 – 1959**
  – Depth 1,200 ft produced 510 gpm of 78°F water – used as domestic water now

• **OIT #2 – 1960** further west and south of OIT#1
  – Depth 1,220 ft producing 170 gpm of 176°F water

• **OIT#5 and 6 – 1963** – area close to OIT#2
  – Depths 1,716 and 1,800 ft producing 442 and 250 gpm of 191°F water
One of three wells which services the OIT system. The depths of the wells range from 396 m (1,300 ft) to 549 m (1,800 ft). The combined capacity of the well pumps is 3,700 L/min (980 gpm).
OIT snow melting using geothermal
New geothermal snowmelt system on campus
New OIT Geothermal Projects

- Small-scale power plant: 280 kW  
  - Completed

- Deep Well Drilling project  
  - Completed

- Medium-scale power plant: 1.5 MW  
  - Development stage

- Incubator greenhouses

- Incubator aquaculture ponds
Small-Scale Power Plant

- Use existing wells at approx. 600 gpm
- Take 15°F off the top
  - actually is 27°F – to campus around 165°F
- Remainder adequate to heat campus
- Binary (organic Rankine cycle) power plant – 280 kW gross (208 kW net)
- Water cooling though a cooling tower - 70°F
- Provide 10% of electrical energy use
- Demonstration site and student laboratory
280 kW plant using OIT existing wells
Small-Scale Power Plant 2

- Unit installed in existing Heat Exchange Building
- Testing and commission started in February 2010
- Interconnection agreement signed
- Power Purchase Agreement (PPA) signed
- Selling Power in March 2010
- Total cost of project - $1.1 million
- Funding
  - Blue Sky Fund Award - $100,000
  - Energy Trust - $487,000
  - BETC - $279,273
  - State Bonds
Small-Scale Power Plant 3

- Water Rights
  - Limited Use
  - Transfer
- UIC permit
  - Added power to the mix
- Controls
- Combining meters
Deep Well Project

• Completed a reflection seismic survey
  – Better location of the fault
  – Located the drilling site
  – 63 2.2-lb dynamite charges at 18 feet deep
  – Located on campus and surrounding property
• Optimum drilling target 3,000 to 4,000 ft
• Drill site in southeast corner of parking lot
• Completed Environmental Assessment - FONSI
OIT seismic survey
New well for high temperature plant - deviated
Dedication – Jan. 24, 2009
Deep Well Project 2

- Drilled a deep well to 5,308 ft (deviated)
- Based on geochemistry analysis - >300°F should be encountered
- First Pump Test Results
  - 196°F temperature
  - 1500 gpm
  - 23 feet of drawdown
- Another pump test needed
  - to monitor surrounding wells and for water rights
  - 2500 gpm with 75 feet of drawdown
- Need to purchase a pump for the well
Temperature profiles of deep well

Profiles before liner and cleaning

Final profile after liner and cleaning

Start of liner

S.W.L
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Geothermal High Temperature Power Project

Injection Wells

Drill Rig at the Production Well

Existing Geothermal Wells

Geothermal Power Plant
Normal fault system on the east side of campus
Medium-Scale Power Plant

- Drilled a deep well to 1,615 m (5,300 ft) (deviated)
- Binary power plant – 1.5 MWe gross – 1.0 MWe net
- Will provide nearly 60% of campus electrical needs
- Reject water could be used to supply additional heat to campus and to surrounding buildings
- Used as a demonstration site and student laboratory
Medium-Scale Power Plant 2

- Cultural Survey
- Drill an injection well
  - Contract awarded
- Complete pipeline from power plant to injection well
  - Design completed
  - Working on RFP
- Hopefully operational by late 2012
Medium-Scale Power Plant 3

- Completed pipeline up to heat exchange building
- Pump test completed in June 2010
  - Water Rights
  - Injection well
  - Specify pump
- First RFP for the Power Plant Design closed
- Second RFP will close this month
- Applications
  - Interconnection Agreement
  - PPA
  - FERC
  - BETC (completed)
  - Energy Trust (applied)
  - EIA Form 860 report
Medium-Scale Power Plant 4

- State agency
  - Proposal process
  - Legal sufficiency – DOJ

- Funding
  - CDP
    - FY08  $ 984,000
    - FY09  $1,522,400
    - FY10  $1,000,000
    - FY11  $ 400,000 ???
  - State Bonds
    - F-Bonds  $1,000,000 with $2,000,000
    - G-Bonds  $1,000,000 with $2,000,000 (??)
Cost And Time

• Low temperature power plant: $1,100,000
• High temperature power plant: $11,900,000
• Incubator greenhouse: $300,000
• Incubator aquaculture facility: $300,000
Conclusion

- OIT is the first campus to receive all of its heating energy from a geothermal resource under campus.
- OIT has the first geothermal power plant on a university campus and the only one operating in Oregon.
- We are approaching a 100% “green” campus – PV, wind and biomass will be added in our Sustainable Energy Park.
- With our Renewable Energy Engineering BS program – we are a training facility in all forms of geothermal energy use – as well as a demonstration/tour site.
Addition Information
From
Geo-Heat Center

- http://geoheat.oit.edu
- Bulletin Articles
- Technical Articles
- Technical Assistance
- Geothermal in Oregon report
- Updates on campus geothermal projects
- geoheat@oit.edu
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THANK YOU