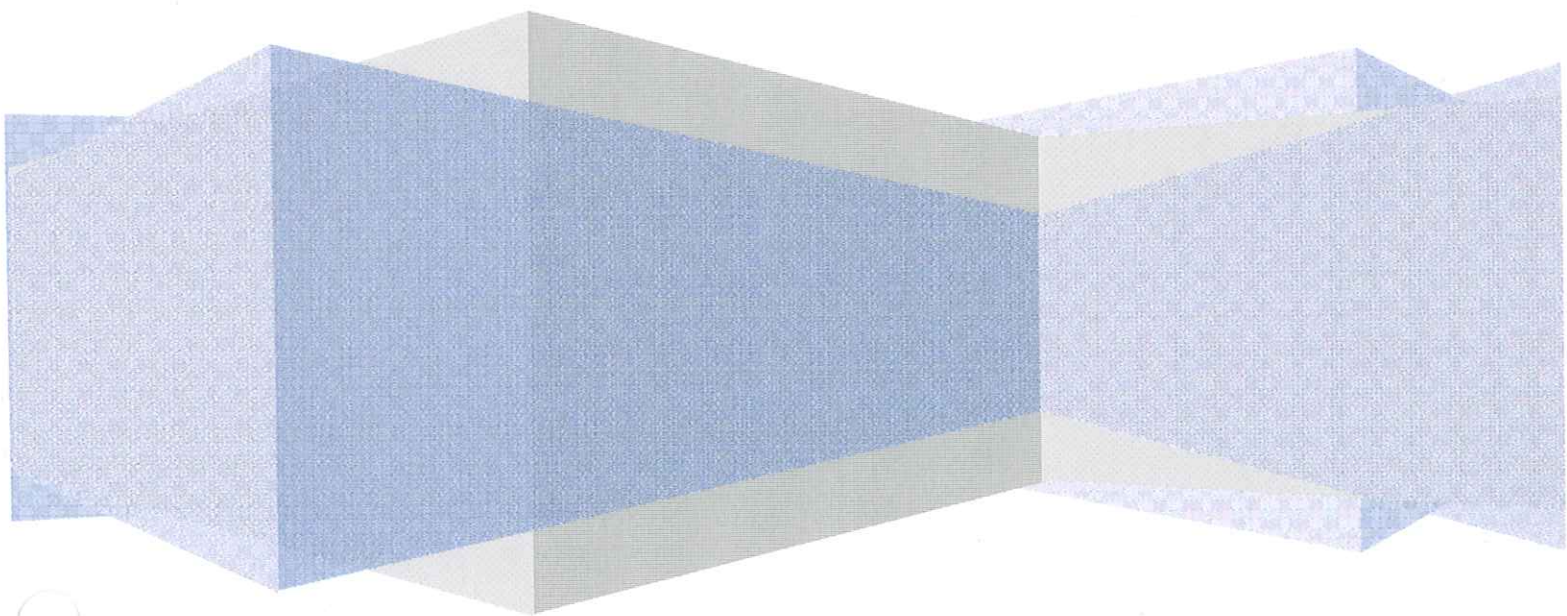


Klamath and Lake County Geothermal Agricultural Industrial Park

Final Report



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FINAL REPORT

DOE Award Number: DE-FG36-05GO85021

Recipient Organization: South Central Oregon Economic Development District

Project Title: Klamath and Lake County Geothermal Agricultural Industrial Park

Technical Contact: Darryl Anderson 541.947.4407
darryla@andersonengineering.com
Betty Riley 541.884.5593
betty@scoedd.org

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EXECUTIVE SUMMARY

HOW THE RESEARCH ADDS TO THE UNDERSTANDING OF THE AREA INVESTIGATED

In both Klamath and Lake County there is an abundance of geothermal resources. The Klamath and Lake Counties Geothermal Industrial park development efforts have built on previous work completed throughout the region in relation to geothermal development. This project gives industries the ability to utilize a renewable resource while enhancing development opportunities in rural distressed areas. Through the greenhouse and aquaculture industry alone, millions of megawatts of power are saved each year through the use of geothermal energy. This not only increases the energy efficiency with in these particular industries, but allows for production at a lower cost, in turn, increasing profitability and creating economic sustainability in rural communities.

THE TECHNICAL EFFECTIVENESS AND ECONOMIC FEASIBILITY OF THE METHODS OR TECHNIQUES INVESTIGATED OR DEMONSTRATED

This type of industrial park development has also created an opportunity for the local university (Oregon Institute of Technology), along with the Geo-Heat Center (GHC) and Oregon Renewable Energy Center (OREC) to study this particular renewable resource to further advance their understanding of geothermal. For example a report that looked at the different types of heating systems for a greenhouse operation to optimize the best use of a geothermal resource in a closed-loop algae growing system was completed by the Geo-Heat Center in June 2009 (*Geothermal Greenhouse Feasibility Study Project: Klamath Falls Algae Bio-Fuel Plant*). In this report a spreadsheet was developed which can be manipulated for different greenhouse sizes, materials, geothermal resource availability and heating systems to optimize the system and costs.

HOW THE PROJECT IS OTHERWISE A BENEFIT TO THE PUBLIC

In the past in Paisley, a community of 260, economic development was measured in job retention. This project has provided the stimulus for a renewable energy economy in the small community that could create steady growth. The proposed 10 million dollar investment in Paisley for geothermal development over the next few years could result in 125 jobs according to the Department of Energy (DOE estimates 1,250 jobs could come from every \$100 million invested in renewable energy). The greatest benefit of this economic growth would be overcoming the risk of the potential loss of a community in Oregon such as Paisley that represents the historical achievements of this State.

Mathew Preusch, rural editor for the Oregonian stated "For places such as Lake County, a timber and ranching area still struggling with the downturn in public lands logging, power generation is seen as its economic future. Lake County leaders say the projects have the

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potential to make this oft-forsaken outpost of Oregon a leader in the state's push for renewable power generation. And, perhaps they hope, it can make the county's 7,500 residents energy exporters.

ACCOMPLISHMENTS

The over arching goal of our efforts was to attract new businesses to Klamath and Lake counties for the purpose of capitalizing on our abundant geothermal resources. Due to the distance between the major population centers characterized by known geothermal resources, the project has focused on the establishment of two sites – one in each of the counties. At each site the goal was to establish a producing geothermal well on property that will then be available for purchase or lease by businesses considering a relocation or expansion into the area. Of the four hurdles commonly encountered by businesses in using geothermal - awareness, drilling risk, regulatory uncertainty, and hardware/engineering - successful completion of this work will eliminate the first three.

Success Stories



Liskey Farms Ag Industrial Park, Klamath County Oregon

In 2007, Green Fuels of Oregon, Inc. signed a lease with Liskey Farms to develop a Biodiesel production facility in existing greenhouses. The company uses canola seed and used restaurant oil as their feedstock. The geothermal water available on the site is used to help in the reaction process of making the Biodiesel. SCOEDD staff assisted Green Fuels with siting requirements and financial assistance. In 2009, Green Fuels partnered with Rogue Biofuels to increase distribution of their product.

Local farmer Rick Walsh has located Fresh Green Organic Garden Community Supported Agriculture facility at Liskey Farms. This business sells organically grown vegetables.

Also in 2007, SCOEDD staff has worked with Team Klamath to assist a company that provides Augmentative Biological Controls (ABC) for spider mite pests. The company, Biotactics, farm

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eight different species of predatory mites for all different climates. The predatory mites they render are a natural insect that are eco-friendly.

Expanding to Klamath Falls and utilizing geothermal water to heat the greenhouses helped lower their utilities and eliminate the high expense of propane. A financing package was completed which, in addition to debt financing through SCOEDD, Klamath Community Development Corporation and the State of Oregon, included another \$135,895 in grant funding from Climate Trust for the Carbon offsets. Biotactics had planned to build an additional 168,500 square feet of greenhouses in Romoland, California. Natural gas and propane would continue to heat these greenhouses. The funding package enabled Biotactics to move its operations to Liskey Farms in Klamath County, Oregon. The company currently employees eleven fulltime workers utilizing 70,000 square feet of existing greenhouses at Liskey Farms. Future plans to build an additional 130,000 square feet.

“Gone Fishing” Farms uses the waste water from the Liskey Farms greenhouses to grow tropic fish for aquariums and tilapia for the food market. Geothermal water quickly mixes with the cold pond water to provide 80°F (27°C), which is ideal for the fish. The owner raises more than 100 varieties of fish and sells to markets in the San Francisco Bay Area – trucking about a 1,000 fish each week. SCOEDD funded a loan to Gone Fishing for working capital and equipment to begin processing Tilapia at their property. This working capital allows Gone Fishing to process up to 300,000 pounds of Tilapia per year which equates to \$450,000 in annual sales.

In addition, SCOEDD staff worked with American Future Fuels (AFF) to help determine whether geothermal energy (in the form of heat) would make feasible algae production in photo-bioreactors within geothermal heated greenhouses. The Geo-Heat Center was contracted to look at the overall layout of the system from the Anaerobic Digester, the Photo Bio Reactors and the greenhouse to determine the best uses for the geothermal water. AFF determined it is not feasible to produce algae oil as feedstock for transportation fuels such as biodiesel; however the company will be pursuing algae production for the production of electricity. The company also identified several limiting factors to locating at Liskey Farms including having a source of fresh ground water.

Other companies looking to locate at the Liskey’s Farm is a company that wants to produce electricity using small scale, low heat geothermal. The process uses the water to heat a refrigerant such as Freon, causing it to expand into a gas. This will force turbines to rotate and generate electricity.

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PROJECT ACTIVITIES

PHASE 1 LAND PARCEL IDENTIFICATION

The identification of suitable land requires the collection of information addressing local geothermal resources, land ownership and zoning to identify the sites with the best prospects for this type of development. Such issues as existing geothermal wells, water availability, utilities, zoning (parcel size requirements, land use, etc.) and other regulatory issues (fluid disposal, etc.) will be addressed. Concurrently, discussions will be held with key stakeholders in the area (Existing resource owners, local government, private long owners) about the project.

The expected outcome of this task is to find a parcel of land suitable for the development of a geothermal agricultural industrial park.

Kevin Rafferty, PE was contracted to complete phase 1 of this project. He produced two site selection reports in late 2005, early 2006. These reports document efforts to identify and prioritize potential geothermal sites in Klamath and Lake Counties, Oregon. The primary site selection process involved the identification of locations where geothermal wells are co-located with vacant land. Subsequently, other factors such as site access, land value, utility availability, well access, presence of multiple wells, owner interest, zoning, piping costs potential, and fees for the use of heat were considered. An evaluation of all of these factors weighted as to impact in successful development at a given site was made and is summarized in table format.

Geothermal areas exist in several locations around Klamath County but three areas constitute the major targets for this effort: The City of Klamath Falls, Olene Gap to the east of town and Klamath Hills to the south of town. Existing development and other factors tend to cause most areas in the city (with the exception of the south Spring Street area) to be unattractive for this project. The Jones property at Olene Gap ranks highly but suffers from poor access. The highest potential is in the Klamath Hills area including Liskey Farms where several properties have existing high temperature wells and several have multiple wells. Zoning in this area allows for the development of greenhouse or aquaculture businesses, land values are generally lower than at other sites and site access is directly from Lower Lake Road in all cases.

Known geothermal areas also exist in several areas of Lake County. Beginning in the north, existing hot wells are located in the extreme north east corner of the county near Glass Butte, in the Paisley area, between Adel and Plush, at several locations in and near the town of Lakeview and south of Lakeview near the state line. Approximately 60 wells and springs above the temperature of 120 F exist in the county, the vast majority of which are in the immediate Lakeview area.

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Prioritizing individual geothermal sites in Lake County was a somewhat more difficult task than for Klamath County. In Lake County, due to the similarity in resource temperatures (many of which are in the 200 F +/- range, zoning (most in A-1 or EFU designation), access (most accessible from local highways), utility availability (little other than electricity at most sites) and land value (similar at most sites), the relative attractiveness of individual sites is driven more by other factors. Among these are potential water rights issues, local interest in development at particular sites, water disposal considerations and perceived owner interest (if known).

Elimination or relegation to low priority of certain sites is possible for:

- Summer Lake Hot Springs due to existing development as a campground/hot spring business
- Crump Geyser due to isolated location, little privately owned land, currently active consideration and leasing for electric power generation
- Rustan (Rockford Ranch) – due to lack of owner interest
- Jackson Mining Company well due to isolated location and location on BLM land
- Downtown Lakeview (swimming pool well) due to lack of sufficient vacant land in immediate vicinity of the well for commercial development of the type considered in this work.

The remaining areas and the sub-sites they contain offer a variety of advantages and disadvantages and these are addressed in the report.

Based on the scores, the corrections wells and the Barry Ranch resource appeared to be the most favorable to pursue given the goals of this project. In order to use the corrections source, development would have to occur on an adjacent parcel. As mentioned in the text, this would most easily be accomplished on a parcel, of adequate size, in close proximity to the corrections mechanical building (to minimize piping cost) and preferably to the south of the building (to permit access to city water and sewer if possible). Given these considerations, the Utley (lot 600 T39S R20E 4B) and Cogar (lot 500 T39S R20E 4B) properties, located on either side of the Dusenberry haul road to the south of the mechanical building, were also recommended for owner contact.

The available heating capacity at the Corrections and Barry Ranch sites is approximately the same and would be sufficient for an initial phase of commercial development. Although the Corrections source scored higher in this evaluation, the Barry Ranch probably offers a better prospect for expansion (provided the resource will support it) beyond the currently available capacity as there is less likelihood for interference with other well and property owners. The Barry Ranch site tends to dovetail with the interests of the town and Lake County Resources and their interest in development on the south side of town.

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The Lake County Industrial Park is northwest of the Barry Well site. Situated along South "M" Street the site currently has a Redi-Mix Concrete Plant, a sound booth manufacturing building, two small distributor buildings, and a telemarketing facility. An additional building owned by Lake County is used for a business incubator or start up facility. This on-site geothermal water would be a selling point for new business to locate on site or for existing business to take part in the cheaper energy. Heating could be accomplished by pumping 183^o F. water from the supply well and transporting the water to the schools and hospital to supply approximately 5 million BTU's of heat energy per hour. After heating these facilities the return water, at 130^o, will be available for the Lake County Industrial Park before being re-injected back into the groundwater aquifer.

PHASE 2 LAND ACQUISITIONS AND NEGOTIATION.

In this phase various approaches to accessing the necessary land were evaluated and prioritized. The expected outcome to this task was to secure an agreement, in regards to and identified parcel of land.

In Klamath County, conversations with Tracey Liskey of Liskey Farms determined the owners were interested in further development of their geothermal resource and the designation as an agricultural industrial park.

A model lease agreement between Liskey Farms and potential lessees was developed by Justin Throne, Attorney at Law and was approved from Tracey Liskey of Klamath County. The lease allows for the use of property and geothermal water for heating of buildings, irrigation of crops, warming of water and other uses consistent with the terms of the lease.

In Lake County, the area considered for the project is the Barry wells located on land owned by Jere Barry. The site is directly next to Highway 395, about one mile south of Lakeview. This site has several advantages:

1. The wells already exist and produce hot water. Therefore, the wells will do require exploratory expenses.
2. The hot springs directly west of the site and a geothermal spring to the northeast of the site indicate the geothermal resource close to the surface.
3. No geothermal development has been done in this area resulting in no prior water rights or conflicting geothermal rights.
4. The landowner is interested in working with the Town, and agreed to a Geothermal Well Development Agreement with the Town, a copy of which is **Exhibit 1** in the Appendix.

PHASE 3 RESOURCE DEVELOPMENTS.

Once the land is secured, a well will be drilled on the property to prove the resource. Test pumping will be performed to verify the capacity of the well. If possible, water rights and other

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appropriate regulatory requirements will be initiated to reduce the burden on the commercial developer. The expected outcome to this task is to have a proven geothermal resource on the identified parcel of land.

Klamath County

Several meetings were held with Tracey Liskey, Oregon Institute of Technology (OIT) and other parties to identify next steps for expanded resource development of the Liskey Farms properties. They were interested in adding an additional well and working with the county on designation as an Agricultural Industrial Park with a geothermal overlay.

After discussions with the Liskey's determined plans for a higher volume of re-injection (upwards of 2,500 gpm to be re-injected), it was determined that a 10" well design would be inadequate. The production wells at Liskey's have very high flows, and after reviewing the higher pumping rates the engineer determined they would cool the production wells due a thermal breakthrough most likely occurring. For these higher rates a more comprehensive study of the water in the area for hydrostatic heads and aquifer characteristics was needed. After a conference call with all parties it was decided to do more testing.

Using funding available through the Natural Resource Conservation Service (NRCS) we were able to complete well testing at Liskey Farms. Two re-injection well sites were proposed by others for Liskey Farms. Based on the testing completed by Anderson Engineering (working with ECO:LOGIC Consulting Engineers) the first site, located approximately 800 feet southwest of Well 3 did not appear to be suitable for this purpose. A well at this location may encounter low-permeability geologic materials that manifested themselves as a discharge boundary during the testing of Well 3. The second site, located approximately 2,000 feet southeast of Well 3 appears to be suitable for re-injecting 2,500 gpm of heat-spent thermal effluent. Based on the available data and information, it appears to be located sufficiently cross-gradient respect to Well 3 such that it minimizes the potential for breakthrough of the effluent at the Well 3 at this pumping rate. However, the well site should be moved closer to the road (east) to lessen the potential for the well to be impacted by the discharge boundary an increase the probability of encountering high permeability geologic materials. Moving the site to the east also may increase the depth to water, which may increase the likelihood that re-injection can take place under gravity-flow conditions.

A complete copy of the Liskey Farms Well 3 Testing Report is available upon request.

Tracey Liskey also identified the need for additional piping from an already operational well. The approximate 120 feet of piping was needed to supply new green houses being built on his property. SCOEDD worked with NRCS on the required NEPA process for both the well testing and the in ground piping. NRCS approved the use of their funding for both the well testing and additional piping expanding the geothermal for use by Biotactics and the piping and testing were completed in December 2007.

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Lake County - Lakeview

During initial 24 hour pump testing performed by on the Barry Well by the Town of Lakeview, water temperatures of 180° to 190° F were present. However the production well at the Barry site still needed extensive pump testing to determine if any deviations in temperature would be found during long term use of the well. A 10 to 14 day test was needed to determine if any deviations in the temperature would occur over long term use. In addition, the long term pumping would allow monitoring of one adjoining well and a nearby spring to see if long term use would have an impact on other surrounding sources. And the increased pumping would allow determination of some additional hydraulic characteristics of the aquifer and help identify a site location for the re-injection well. For the project to move forward a re-injection site has to be identified and a well drilled for re-injection of the water after the heat has been extracted.

An environmental review of the rehabilitating existing geothermal wells on the Barry property was completed and NEPA determination letter dated December 31, 2007 was issued authorizing use of DOE funds for cleaning and pump testing of the geothermal wells on the Barry property.

Since the plan is to provide heat to the Lakeview Hospital and Schools in addition to the Industrial Park, additional studies were necessary to determine peak load analysis of these facilities. The initial review used the average amount of BTUs that the schools and the hospital use per year. However, it was necessary to determine the peak needs of each facility during the coldest times of the winter to determine if the source is adequate to provide peak load heat to the facilities. In addition, a review of the hospital and school's heating facilities was necessary to estimate any conversion costs they may have in converting from their traditional oil fired boilers to geothermal heat.

The County's incubator building at the industrial park also needed to be analyzed for heat needs. The industrial park is available for businesses to locate and geothermal may be a very good attraction. Analysis in this area will determine how much heat is available to offer existing businesses and possible new recruits.

Financing and Budget

The Town also needed to develop a cost estimate for the project and a plan for long term financing proposals including grants, loans, and other possible funding for construction of the project. The financial study would also include heating rates to be charged to the users to repay system costs and yearly operation.

A feasibility report funded by this DOE award and the State of Oregon completed in January 2009 determined the project would be feasible and should be pursued. The estimated cost of the project is \$3.5 million; however the savings for Lake Health District and Lake County School

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District would total \$2.4 million over the life of the system. The Town would also benefit from the geothermal system operation income, and the increased jobs from users putting their money into different expenditures other than energy.

After review by DOE NEPA staff it was determined that a full third party environmental assessment (EA) would need to be completed. SCOEDD contracted with RMT, Inc out of San Mateo CA to complete this assessment. The draft EA has been released for review and the final document completed by February 2010.

Next steps for this project include:

- Identification of funding package
- Completion of engineering report and costs for installation of the piping to the industrial park and community facilities
- Drilling of new well

Lake County – Paisley

The Rafferty report also identified a good potential for commercial application of geothermal wells in the Paisley area associated with the wells located on the Colahan property. These are the highest temperature and most favorably situated wells with respect to development. According to ODWR records, a well (SW/NE quarter of section 23) originally drilled to a depth of 315 feet in 1964 produced 104 degree F water. This well was deepened to 432 ft in 1987 and produced 50 gpm of 175 degree F water. A second well also completed in 1987 produces 300 gpm of 175 degree F water, though no details of the well location other than section 23 are included on the completion report.

Through a feasibility study completed by the Colahan's with USDA Value Added Ag grant funding, the property wells were determined to produce enough hot water for the development of a 1 MW electrical generation facility. Surprise Valley Electric Coop has taken the lead in the development of this project. The geothermal electric project can also become an engine for other satellite businesses. For example, the USDA study found that a Tilapia Business would integrate and be profitable if it could use the downstream waste heat from the geothermal electric power plant. Additionally the town of Paisley could be heated with the waste heat. Finally the neighboring ZX Ranch expressed interest in using waste heat to operate an anaerobic digester. The anaerobic digester would convert the cow manure into methane and organic fertilizer. This project has received \$2 million in economic stimulus funding From the US Department of Energy to move forward.

PHASE 4 OUTREACH

The final step in the process is the promotional campaign. In this phase key industries will be targeted through various means to publicize the availability of the site. To a large extent, this phase will build on efforts that are ongoing in both counties (attending industry association meetings, targeting specific companies ie tomato, building on results of Lakeview study).

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As part of the outreach strategy, attended various conferences including Harvesting Clean Energy Conference in Boise Idaho the end of January, 2007. **Exhibit 2** is a copy of the brochure developed by the Town of Lakeview for marketing purposes.

Tracey Liskey has actively promoted his property through his involvement in the Oregon Farm Bureau and the Oregon Sustainability Board. Additionally Klamath County Economic Development Association promotes Liskey' Ag Industrial park on their website – "Sustainable Klamath".

In Lake County, the website *sustainable-lake-county-oregon.com* also promotes geothermal sites in the community of Lakeview. Once the geothermal heating district is installed, SCOEDD will include the availability of Geothermal in promoting Lake County's Industrial site through the Oregon Prospector.com.

Both Lake and Klamath Counties expanded their Enterprise Zones to include the geothermal properties identified. Oregon's enterprise zones offer a unique resource to local communities, unmatched by any other business incentive. Besides tax abatement, an enterprise zone lends visibility and focus to local economic development efforts.

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PRODUCTS DEVELOPED

PUBLICATIONS

- ❖ Darryl J. Anderson, PE, Geothermal Heating Feasibility Study, January 2009 – explores the possibility of utilizing known geothermal resource site (Barry Well) for heating district to include hospital, schools and Lake County Industrial Park
- ❖ Kevin Rafferty, PE, *Klamath County Geothermal Agricultural/Industrial Park Preliminary Site Selection Report*, December 2005 - this report documents efforts to identify and prioritize potential geothermal sites in Klamath County
- ❖ Kevin Rafferty, PE, *Lake County Geothermal Agricultural/Industrial Park Preliminary Site Selection Report*, January 2006 - this report documents efforts to identify and prioritize potential geothermal sites in Lake County

NETWORKS/COLLABORATIONS

In 2006 the Town of Lakeview, City of Paisley, Lake County, South Central Oregon Economic Development District, Lake County Chamber of Commerce, the Oregon Renewable Energy Center and Lake County Resources Initiative came together to form the Lake County Renewable Energy Working Group. Realizing all the renewable energy potential, the group set as their goal to be fossil fuel free from an energy standpoint in five years.

The Town of Lakeview is pursuing hydro, geothermal heating district and geothermal electrical production; the City of Paisley is pursuing geothermal development; Nevada Geothermal has leased the Grump Geyser in Plush and is doing exploration work; Lake County is pursuing solar and wind in conjunction with private developers in Christmas Valley.

In 2007 the Lake County Chamber of Commerce held meetings through out the county on renewable energy potential and out of these meetings a great interest developed from ranchers and farmers in ground source heat pumps, solar watering pumps and small on the farm wind generation. As a result of all this interest it became clear we needed to establish a Renewable Energy Director (RED) position to lead this effort working with local units of government, industry and landowners in developing these renewable energy potentials and to achieve the vision of being **Oregon's Most Renewable Energy County**.

OTHER PRODUCTS

Several articles have been published related to the renewable Energy efforts in Lake and Klamath Counties. **Exhibit 3** includes copies of some of these articles and current links are provided below:

Tiny Town takes Geothermal Lead

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<http://dicoregon.com/news/2009/11/04/tiny-town-takes-geothermal-lead/>

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Geothermal resources allow Klamath Falls farm to diversify, produce clean fuel

<http://www.oregon.gov/ODA/liskeygeothermal.shtml>

GEA's Klamath Falls Workshop Showcases Diverse Uses of Geothermal Resources

http://www.pennenergy.com/index/power/renewable-generation/display/1899097455/articles/renewable-energy-world/geothermal_energy/2009/09/geas-klamath-falls-workshop-showcases-diverse-uses-of-geothermal-resources.html

The following websites showcase some of the efforts related to this project:

<http://sustainable-lake-county-oregon.com/project.aspx>

Exhibit 1

GEOTHERMAL LEASE AGREEMENT

PARTIES:

Jere P. Barry and Wanda S. Barry,
husband and wife
17082 Highway 395 South
Lakeview, Oregon 97630

Landowner,

Town of Lakeview,
an Oregon municipal corporation
525 North First Street
Lakeview, Oregon 97630

Lessee,

- A. Landowner owns the following described real property as located within Lake County, Oregon, said real property being hereinafter referred to as "the Property":

That portion of Tax Lot 4601 lying east of U.S. Highway 395 as located within the NW $\frac{1}{4}$ SE $\frac{1}{4}$ of Section 27 in Township 39 South, Range 20 East of the Willamette Meridian.

- B. Landowner desires to lease to Lessee certain rights in and to the Property and Lessee desires to lease such rights from Landowner upon the terms and conditions of this Agreement.

Accordingly, and for the consideration as stated herein, Landowner and Lessee agree as follows:

1. **Definitions.** For the purposes of this Agreement the following terms shall have the meanings as indicated:

(a) **OECD Grant.** That grant that Lessee is applying to receive in the amount of \$40,000.00 from the State of Oregon Economic and Community Development Department (OECD) to allow Lessee to conduct a geothermal feasibility study upon the Property.

(b) Effective Date. The date that the OECDD grant is formally approved by the State of Oregon.

(c) Geothermal Resources. The natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, the natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases and steam, in whatever form, found below the surface of the earth, exclusive of oil, hydrocarbon gas or other hydrocarbon substances, but including the following:

- (i) all products of geothermal processes embracing indigenous steam, hot water and hot brines;
- (ii) steam and other gases, hot water and hot brines resulting from water, gas or other fluids artificially introduced into geothermal formations;
- (iii) heat or other associated energy found in geothermal formations; and
- (iv) any byproduct derived therefrom.

(d) Governmental Regulations. All laws, orders, ordinances, regulations and statutes of federal, state and local governmental agencies, authorities, and courts.

(e) Landowner. The Landowner as designated herein as well as any of their successors and assigns.

(f) Lessee. The Town of Lakeview, Oregon, and any of its successors and assigns.

(g) Property. The real property described on the first page hereof.

(h) Lease Payments. The lease payments payable by Lessee to Landowner in accordance with Section 4 of this agreement.

(i) Royalty Payment. The production royalty that may be payable by Lessee to Landowner in accordance with Section 5 of this agreement.

(j) Surface of the Property or Surface. The title to the surface and the surface estate of the Property, excluding the Geothermal Resources, mineral estate and all minerals.

2. Grant of Exploration Privilege and Lease. Landowner grants to Lessee the rights and privileges described in this Section.

2.1 Grant of Exploration Privilege. Landowner grants to Lessee the right and privilege to enter on the Property for the purpose of conducting its feasibility study and for the purpose of exploration for Geothermal Resources, including reasonable rights of ingress and egress for personnel, machinery, equipment, supplies and products and the right to use so much of the Surface of the Property and water located on the Property as may be reasonably needed for such purposes. However, Lessee's right to use the Surface and water located on the Property shall not interfere in a material way with Landowner's agricultural pursuits and in the event of such material interference or conflicting uses, Landowner's right to utilize the Property shall be dominant. Landowner's grant to Lessee is exclusive with respect to Geothermal Resources.

2.2 Uses. Lessee is granted the exclusive right, subject to Landowner's agricultural pursuits on the Surface of the Property, to use the Property including, but not limited to, the right to place and use excavations, ditches and drains, wells, pumps, pipes, pipelines, reservoirs, tanks, water works, pumping stations, generating plants, transmission lines and to construct, erect, maintain, use and, at its election, to remove all of the foregoing and all other improvements, property and fixtures for the exploration, development, production, processing, removal, sale, shipment or use of Geothermal

Resources. All of the activities described in this Section shall be conducted for the primary purpose of exploring for and the development of Geothermal Resources.

2.3 Water Rights. Lessee, in its name, shall have the right and obligation to apply for and obtain any necessary water rights required by the Oregon Department of Water Resources for the exploration of or use of the Geothermal Resource. Any water right obtained is assignable pursuant to Section 15 below and Landowner shall cooperate with Lessee in the water right application process.

3. Term. The initial term of this Agreement shall commence on the Effective Date and shall expire on December 31, 2010, unless this Agreement is sooner terminated, cancelled or extended. Landowner grants to Lessee and Lessee shall have the option and right to extend the term of this Agreement subject to Landowner and Lessee agreeing to a Royalty Payment.

4. Payments. For the initial term of this Agreement, Lessee shall make the following Lease Payments to Landowner:

- a. the sum of \$4,000.00 on the Effective Date of this lease;
- b. the additional sum of \$6,000.00 on or before January 1, 2009; and
- c. the additional sum of \$7,000.00 on or before January 1, 2010.

5. Lease Extension and Royalty Payment. In the event this Agreement is extended by Lessee beyond December 31, 2010, then the Lease Payment to be paid by Lessee to Landowner will be a Royalty Payment for Lessee's use of the Geothermal Resources for heating or energy purposes based upon a percentage of gross revenues obtained from the sale or use of the Geothermal Resources. In the event of such lease extension, Landowner and Lessee agree to mutually and in good faith negotiate the amount of said Royalty Payment.

6. **Compliance with Law.** Lessee shall, at Lessee's sole cost, comply with all Governmental Regulations relating to the condition, use or occupancy of the Property by Lessee, including but not limited to all exploration and development work performed by Lessee during the term of this Agreement or any extension hereof. Lessee shall, at its sole cost, promptly comply with all applicable Governmental Regulations regarding reclamation of the Property and Lessee shall defend, indemnify and hold harmless Landowner from any all actions, assessments, claims, costs, fines and liability arising from or relating to Lessee's failure to comply with any applicable Governmental Regulations.

7. **Geothermal Development Practices and Information.**

7.1 **Geothermal Practices.** Lessee shall work the Property according to the highest standards and practices of the geothermal industry in the State of Oregon utilizing the best technology available.

7.2 **Information and Data.** During the term of this Agreement, Landowner shall have the right to examine and make copies of all data regarding the Property and the development of Geothermal Resources in Lessee's possession during reasonable business hours and upon prior notice.

8. **Taxes.**

8.1 **Real Property Taxes.** Landowner shall pay when due all ad valorem real property taxes assessed against the Property.

8.2 **Personal Property Taxes.** Each party shall promptly pay when due all personal property taxes assessed against each party's personal property, improvements or structures placed upon or used on the Property.

9. Insurance and Indemnity.

9.1 Lessee's Liability Insurance. Lessee shall maintain liability insurance in an amount sufficient to satisfy any claims that may be made against Lessee in accordance with the Oregon Tort Claims Act.

9.2 Waiver of Subrogation. Lessee and Landowner each waive any and all rights of recovery against the other, and against the agents, officers, employees and representatives of the other, for loss of or damage to the Property or injury to person to the extent such damage or injury is covered by proceeds received under any insurance policy carried by Landowner or Lessee and in force at the time of such loss or damage.

9.3 Waiver and Indemnification. Landowner shall not be liable to Lessee and Lessee waives all claims against Landowner for the injury to or death of any person or damage to or destruction of any personal property or equipment or theft of property occurring on or about the Property or arising from or relating to Lessee's business activities conducted on the Property. Lessee shall defend, indemnify and hold harmless Landowner from any and all claims, judgments, damages, demands, expenses, costs or liability arising in connection with injury to person or property from any activity, work or things done by Lessee or Lessee's agents and employees, invitees or contractors on or about the Property.

10. Relationship of Parties. This Agreement shall not be deemed to constitute any party, in its capacity as such, as the partner, agent or legal representative of the other or to create any joint venture, partnership or other fiduciary relationship between the parties.

11. Inspection. Landowner or Landowner's duly authorized representative shall be permitted to enter on the Property at reasonable times for the purpose of inspection, but they shall

enter on the Property at their own risk and in such a manner as not to unreasonably delay or interfere with the operations of Lessee.

12. Termination by Landowner. In the event of any default or failure by Lessee to comply with any of the covenants, terms or conditions of this Agreement, Landowner shall be entitled to give Lessee written notice of such default which notice shall specify the details of the default. If such default is not remedied within 30 days after receipt of the notice, provided the default can reasonably be remedied within that time, or, if not, if Lessee has not within that time commenced action to cure the same, then Landowner may terminate this Agreement by delivering notice to Lessee of Landowner's termination of this Agreement. In the event Landowner elects to terminate this Agreement as set forth above, then such termination shall preclude Landowner from pursuing any and all other available legal remedies.

13. Termination by Lessee. Lessee may at any time terminate this Agreement by giving 30 days advance written notice to Landowner. In such case, any and all Lease Payments previously paid by Lessee to Landowner for any unexpired term of this Agreement shall remain the sole property of Landowner without obligation to reimburse Lessee for the same.

In the event of Lessee's termination of this Agreement, Lessee shall surrender the Property promptly to Landowner, transfer any attendant water rights to Landowner and shall remove from the Property at Lessee's sole cost all buildings, structures and equipment. After termination of the Agreement, Lessee shall have the right to enter on the Property to perform its obligations for compliance with reclamation or restoration of the Property. Lessee shall commence reclamation and restoration of the Property immediately upon termination of this Agreement in accordance with all applicable Governmental Regulations.

14. **Confidentiality.** The data and information, including the terms of this Agreement, coming into possession of Landowner or Lessee, shall be deemed confidential and shall not be disclosed to outside third parties except as maybe required to disclose information under the laws and regulations of any federal, state or local governmental authority.

15. **Assignment.** Both Landowner and Lessee may assign all or any portion of this Agreement, or any of the rights hereunder, to any third party. However, in the event of such assignment, then the terms of this Agreement in all respect shall be binding upon such third party assignee.

16. **Time of Essence.** Time is of the essence in the performance of all obligations of the parties under this Agreement.

17. **Entire Agreement.** The parties understand that this Agreement constitutes the sole Agreement between them and there are no other terms or conditions, expressed or implied, other than as set forth herein. This Agreement may only be amended or modified by an instrument in writing, signed by the parties and attached hereto.

18. **Governing Law and Venue.** This Agreement shall be construed and enforced in accordance with the laws of the State of Oregon. Any action or proceeding concerning the construction, or interpretation of the terms of this Agreement or any claim or dispute between the parties shall be commenced and heard in the Lake County Circuit Court.

19. **Severability.** If any part, term or provision of this Agreement is held by a court of competent jurisdiction to be illegal or in conflict with any law, then the validity of the remaining portions or provisions of this Agreement shall not be affected in any way.

Dated the 6th of December, 2007.

LANDOWNER:

LESSEE:

Town of Lakeview

Jeff P. Barry
Jeff P. Barry

By: Rick Watson
Rick Watson, Mayor

Wanda S. Barry
Wanda S. Barry

Attest: Christy Pavola
Christy Pavola, Town Recorder

Exhibit 2

Additional Resources

Lake County Chamber of
Commerce

541-947-6040

www.lakecountychamber.org

*General information about the area
including schools, community
organizations, health care, etc.*

Lake County Development
Corporation

541-947-5300

Ronne Lindsay, Office Manager
*Information on business development
opportunities, funding, incentives*

Anderson Engineering &
Surveying, Inc.

541-947-4407

www.andersonengineering.com

Darryl Anderson, President
*Information on existing utilities, town
and county building standards,
geothermal resource potential and
well locations*



TOWN OF LAKEVIEW, OREGON

525 North 1st Street

Lakeview, OR 97630

541-947-2020

www.townoflakeview.com

Ray Simms, Town Manager
lakeviewtownmanager@yahoo.com

TOWN OF LAKEVIEW, OREGON

GEOHERMAL BUSINESS OPPORTUNITIES



Exhibit 3

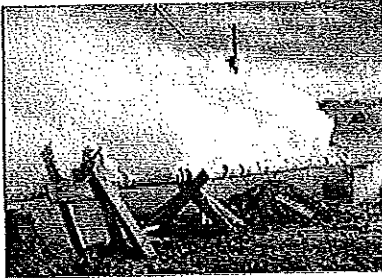
Daily Journal of Commerce

<http://djcoregon.com>

Tiny town takes geothermal lead

by Justin Carinci

Published: November 4th, 2009



The southern Oregon city of Paisley, best known for its annual mosquito festival, could soon add another distinction: the site of the state's first commercial geothermal electricity plant. The federal Department of Energy awarded the project a \$2 million grant.

Lake County is flush with underground hot water. Sometimes, it bubbles to the surface, as it does at the Summer Lake Hot Springs resort. Other times, farmers tap into it when drilling irrigation wells. That happened on the property of Mark and Erin Douglas,

where the power plant would be built.

"We drilled it in 1980-81," Erin Douglas said, "My grandpa did, and he talked to people then" about using the water for a power plant.

"It wasn't hot enough or enough flow to make sense then," she said.

In fact, the hot water was a nuisance, Douglas said. Because it would burn the alfalfa crop, the family had to pump the water through ponds and ditches to cool it enough to use. To make matters worse, the heat caused the pumps to wear out quickly.

But the family held onto the idea of producing electricity. Mark Douglas, also the mayor of Paisley, called around to see if there was any interest. He found an engineer who pitched the idea to Surprise Valley Electrification Corp., the local electrical cooperative.

Surprise Valley knew about the well for years, said Lynn Culp, the co-op's member service manager. "We knew it's been there all along," he said. "But we weren't looking for these kinds of opportunities until just recently."

Increasing electricity costs changed that. Surprise Valley doesn't produce any electricity itself, instead buying electricity from the Bonneville Power Administration and distributing it to 6,175 metered customers in California, Oregon and Nevada.

Costlier Bonneville electricity made the Douglas well idea look more promising, Culp said. Surprise Valley applied for a federal stimulus grant through the Energy Department. It was one of 11 such projects to receive grants, out of 28 applicants, said department spokeswoman Tiffany Edwards.

While 235 degrees Fahrenheit is certainly hot, it's not hot enough to run a traditional steam power plant. The Energy Department classifies the Paisley plant as a "low-temperature project."

Low-temperature geothermal plants are also called binary plants, because they use two separate fluids to produce electricity. Hot water is pumped from the well and passes through a heat exchanger, where it heats a fluid with a lower boiling point than water.

Vapor from that fluid turns a turbine, which turns a power generator. The second fluid condenses and returns to the loop system. Separately, the water is pumped back into the aquifer.

On the Douglas property, the hot water could take a useful detour, Erin Douglas said. It would pass through a second heat exchanger to warm a fish-farming pond.

Oregonians have used geothermal energy for warming and other purposes for years, said Diana Enright, spokeswoman with the state's Department of Energy. But no utility produces electricity from the state's underground heat.

The Paisley project could capture renewable energy more consistently than wind or solar plants, Enright said.

"The great thing about geothermal is its base-load energy," she said. "That means it produces 24-7."

Surprise Valley officials expect to produce about 2 to 3 megawatts per month from the geothermal plant.

"Some people think it could be more than that, but who knows," Culp said. "It's kind of a 'guess-and-by-golly' for a lot of it."

Surprise Valley currently distributes 15 or 16 megawatts per month.

The grant would cover only a small piece of the plant's cost, Culp said, although he declined to reveal the cost estimate. "It's more than \$2 million ... significantly more," he said.

The co-op would develop the plant and then pay royalties to the Douglas family, although details haven't been worked out, Erin Douglas said. It probably won't be enough for retirement, she said, but the royalties and fish farm would supplement income from the family ranch and business.

"My husband has a lumber business and a sawmill," Douglas said. "It's a difficult time. We've been scrambling to get logs."

If all goes well, the plant could be up and running in one year, Culp said. That puts Paisley in a race with two other low-temperature projects in nearby Klamath Falls.

Neither is a utility, however: one would go toward the city of Klamath Falls' energy needs. The other, at the Oregon Institute of Technology, would help power the campus.

That leaves tiny Paisley in a leadership role, Enright said. "Paisley's been working on this a long time," she said. "It would be a great thing for them."

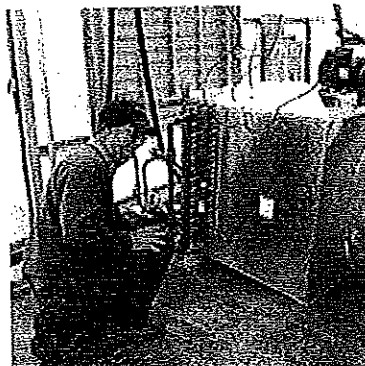
Complete URL: <http://djcoregon.com/news/2009/11/04/tiny-town-takes-geothermal-lead/>

Geothermal resources allow Klamath Falls farm to diversify, produce clean fuel



If Tracey Liskey's grandparents revisited their homestead south of Klamath Falls, they would certainly be surprised at the diversity of agricultural products grown on the property today. Tracey Liskey and his siblings have harnessed the geothermal energy first discovered on the property by his grandparents to create new economic opportunities for their own operation and for the region.

Tracey Liskey believes his grandparents first discovered the property's geothermal resources when they tried to develop a spring or well for drinking water. Today, hot water from the two wells is piped around the property, providing an excellent source of heating for several greenhouses and ponds.



After water comes out of the wells at 185 to 190 degrees, it is cycled into the greenhouses. The tailwater from the greenhouses is used to warm the ponds.

Until recently, the Liskeys grew nursery products in the greenhouses, supplying many of the hanging baskets in the city of Klamath Falls. The greenhouses are now leased for fruit and vegetable production, to a company that grows spider mites, and for growing tropical fish.

"The warm air in the greenhouses warms the fish tanks," Liskey explains. His lessee, Ron (last name), also raises tropical fish in the ponds warmed with greenhouse tailwater for sale in pet stores.

Recently, the Liskeys and business partner Rick Walsh harnessed geothermal energy for another renewable project - a canola crusher and biodiesel production facility. The first batch of canola oil was recently processed through the facility.

"The fire marshal was very pleased to know we were heating the operation with geothermal energy," Liskey says. "It really increased the safety of the operation."

In the future, Liskey Farms plans to create an agricultural business park featuring other products grown with geothermal energy.



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BOOKMARKS

GEA's Klamath Falls Workshop Showcases Diverse Uses of Geothermal Resources

With over 100 participants from all over the world, the Geothermal Energy Association's (GEA) two-day *Geothermal Energy Small Power and Direct Use Workshop* that took place last month at the campus of the Oregon Institute of Technology heralded a growing recognition that geothermal resources are available for a lot more than utility-scale electricity production.

Direct use, as the name implies, involves using the heat in geothermal water directly (without a heat pump or power plant) for such things as heating of buildings, industrial processes, greenhouses, aquaculture (growing of fish), and resorts. Direct use projects generally use resource temperatures between 38°C (100°F) to 149°C (300°F). Current U.S. installed capacity of direct use systems totals 470 MW or enough to heat 40,000 average-sized houses.

Klamath Falls, Oregon, is located on a Known Geothermal Resource Area (KGRA) and has been used by residents primarily for space heating since the turn of the century. At present, there are over 550 geothermal wells serving a wide variety of uses. This utilization includes the heating of homes, schools, businesses, swimming pools and snow melt systems for sidewalks and a section of highway pavement. Most of the eastern portion of the city is heated by geothermal energy.

With opening welcomes from Klamath Falls Mayor Todd Kallstrom, MaryAnn Zemke of OIT, John Lund, the Director of OIT's Geo-Heat Center and Karl Gawell of GEA, the workshop featured speakers highlighting the many uses of geothermal resources. The next day, many workshop participants toured sites featured at the workshop.

OIT was picked as the site for GEA's first event of this kind for good reason. When it was built, the campus location was originally chosen for the region's geothermal energy potential and has been heated by the direct use of geothermal energy since 1964. Three geothermal wells supply all heating needs of the 11-building campus.

A few days before the workshop kicked off, a new 280-kW (gross) Pratt & Whitney "Pure-Cycle" geothermal power system began operations on the OIT campus. As one of the main sponsors of the workshop, Pratt & Whitney Sales Manager Michael Ronzello explained the installation and use of this unit, which will provide approximately 20% of the electricity demand on campus and will save the school about \$100,000 annually. The PureCycle system taps geothermal water supplied from existing wells now used to heat the campus.

The addition of the PureCycle geothermal power system will move the campus closer to becoming a "zero net-energy" user and is the first step in OIT's plan to develop a larger-scale (1.0 MW_e) binary power plant. "We'll be the first campus in the world to be 100% powered from a geothermal resource on its campus," said John Lund. The school also offers a degree in renewable energy engineering and will use the geothermal power plant as a teaching tool and hands-on laboratory for OIT students. "This is an important addition to our campus academic programs that will better prepare our students to perform in the real world," Lund said.



The City of Klamath Falls has an extended Geothermal Heating District, in operation for over 25 years, which was a natural extension of geothermal use on campus. Construction funds were provided by the U.S. Department of Energy, the state of Oregon and the city of Klamath Falls. Currently, the system is approaching the original 1977 design capacity, and serves the city's wastewater treatment plant, 24 buildings totaling about 400,000 square feet, 150,000 square feet of greenhouses and approximately 105,000 square feet of sidewalk, road and bridge snowmelt systems. (Image: OIT's Toni Boyd gives a demonstration at the OIT Geo-heat center.)

Other communities were also highlighted at the workshop. For Carby, CA, about 75 miles south of Klamath Falls, installing a geothermal heating district system provided the town a much needed economic boost. Dale Merrick illustrated how geothermal projects enhance town pride and well-being as much as the bottom line for heating businesses and homes. Other examples were Chena Hot Springs in Alaska, Mammoth Lakes, CA, the first oil-field geothermal recovery project at the Rocky Mountain Oilfield Test Center in Wyoming, and the resurgence of interest in Texas. (The author wishes to thank Bernie Karl, Lyle Johnson, Dave Harvey and Janet Abbott for their educational presentation.)

Participants closed out the workshop with a reception at the Creamery Brew Pub and Grill, the only brewery in the world that uses geothermal energy in their brewing process and to heat their building.

Private-sector Use of Geothermal

The second-day tour highlighted areas in which the private sector has embraced the use of geothermal resources in the Klamath Falls region. A massive tree seedling greenhouse business is operated by IFA Nurseries, the "Gone Fishing" operation of Ron Barnes and Liskey Farms.

For sheer variety, the Liskey Farms operation became the centerpiece of the workshop tour. The geothermal resource on the Liskey property was once considered a nuisance to Jack Liskey, the ranch owner. It has been used for house heating, stockwater and even irrigation on the 300-acre ranch. It has also been used for growing all varieties of cattle feed and

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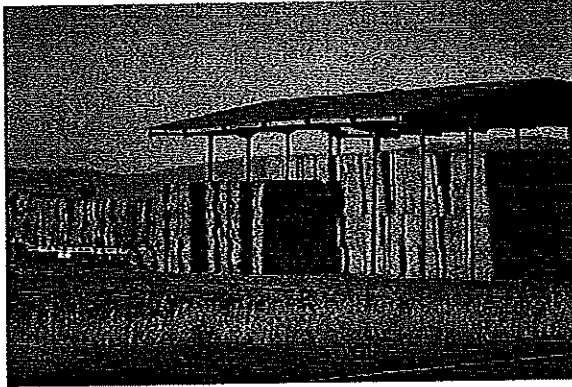
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for frost protection of crops. Currently, it is still used for space heating, equipment cleaning and softening hay for feeding calves.



Klamath Falls, Oregon, Credit: GEA

There are six geothermal wells on the ranch, which heat an array of greenhouse operations by finned tube pipes below each bench with a metal shield placed over them to better distribute the heat. The greenhouse effluent water is used to heat 37 shallow tropical ponds adjacent to the greenhouses. The outflow from the ponds is then cooled in a large storage pond and finally used for stock watering.

A series of greenhouses near the entrance road are used for biodiesel production, for raising organic vegetables and for a very unique "biopeset" control operation. The biodiesel facility, run by Rogue BioFuels is heated by a radiant floor system and geothermal energy is also used in the biodiesel fuel process.

The tour day ended with a walk around "Gone Fishing" Farms which uses the waste water from the Lisky greenhouses to grow tropic fish for aquariums and tilapia for the food market. Geothermal water quickly mixes with the cold pond water to provide 80°F (27°C), which is ideal for the fish. The owner raises more than 100 varieties of fish and sells to markets in the San Francisco Bay Area - trucking about a 1,000 fish each week.

For GEA and the workshop participants drawn from a worldwide audience, the two-day study in innovation left all asking what other communities and areas have geothermal resources that can be tapped, reused and shared to offer a similar economic benefits in communities both large and small.

The workshop gave participants a roadmap of the financial incentives and regulatory options to institute direct use and small power projects.

GEA would like to thank the U.S. Department of Energy, the U.S. Department of Agricultural, the U.S. Bureau of Land Management, the Oregon Department of Energy and the Energy Trust of Oregon for providing an excellent overview of how to fund and permit projects similar to those featured at Klamath Falls.

For more information on the event, or to obtain a copy of GEA's August 2009 Report on "Small Power and Direct Use Incentives," please contact GEA.

John McCaul is the Western States Representative for the Geothermal Energy Association.

Source: Renewable Energy World

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