

**PARTNERS FOR AN
ENERGY EFFICIENT TOMORROW**

**AMERICAN ENERGY
AWARENESS WEEK
IN HAWAII**

TUESDAY, OCTOBER 23rd

**AN OVERVIEW OF GEOTHERMAL
DEVELOPMENT IN HAWAII**



**ENERGY DIVISION
DEPARTMENT OF PLANNING AND
ECONOMIC DEVELOPMENT**

10/24

Other uses for Geo-energy

Dr. John Lund, Oregon Institute of Technology

Direct uses:

- 1) Space heating & cooling 60% (~~4100°F - 4200°~~ ^{150°F - 250°F})
- 2) Ag & Aquaculture 25% (2100°F - 2200°F)
- 3) Industrial processes 15% (7200°F - 7400°F)

- A) Food processing
- B) Soil ~~heat~~ warming
- C) Green housing, etc.
- D) paper plant process

4) Spas & bathing uses (in all countries)

Space heating & cooling

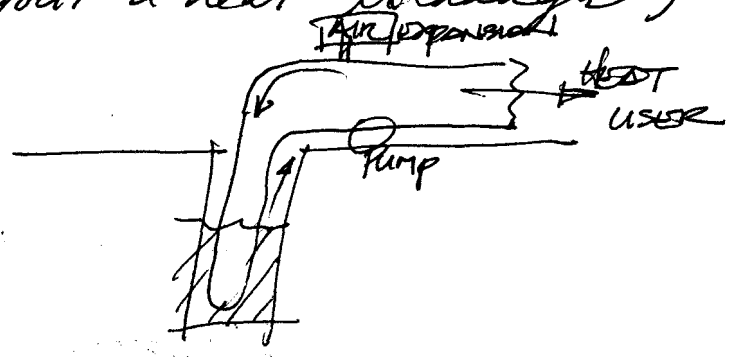
- a) Iceland, Rotorua N.Z., Boise Idaho, Klamath falls
- Agri + Aquaculture (greenhouses)
- a) Hungary, USSR, Iceland, ~~etc~~ Japan

Industrial processes

- a) Larderello Larderello Italy; Myvatn, Iceland; New Zealand, Brady Hot Spring, Klamath Falls

Direct Use Systems (with or without a heat exchanger)

- shell & tube exchangers
- plate exchangers
- Down hole heat exchangers



PROGRAM

- 8:00 AM Registration
- 8:30 AM Opening Remarks
Kent M. Keith, Director
Department of Planning and Economic Development
Geothermal Overview
Potential Geothermal Resource in Hawaii
Charles Helsley, Director
Hawaii Institute of Geophysics, University of Hawaii
Exploration and Development of the HGP-A Geothermal Well and Plant
John Shupe, Director
Pacific Site Office, U.S. Department of Energy
Review of HGP-A Geothermal Plant Performance
George Jenkins, Operations Superintendent
Production Department, Hawaii Electric Light Co., Inc.
Status of Geothermal Subzone Designation
Donald Thomas, Assistant Geochemist
Hawaii Institute of Geophysics, University of Hawaii
- 10:15 AM Break
- 10:30 AM Geothermal Development
HELCO's Future Development Plans
Alva Nakamura, Manager of Engineering
Hawaii Electric Light Company, Inc.
MECO's Future Development Plans
Arden Henderson, President
Maui Electric Company, Ltd.
Developer's Perspective
Ralph Patterson, Manager
Hawaii Project, Thermal Power Company
- 11:15 AM Status Report on Environmental Issues
Introduction
Jacquelin Miller, Associate Specialist
Environmental Center, University of Hawaii
Baseline Studies
Flora and Fauna
Charles Lamoureux, Professor,
Botany Department, University of Hawaii
Air Quality Survey
James E. Houck, Senior Environmental Scientist
NEA, Inc.
New Zealand Studies
Sanford Siegel, Chairman
Botany Department, University of Hawaii
Puna Health Survey
Bruce Anderson, State Environmental Epidemiologist
Environmental Regulations
Jacqueline Parnell, Environmental Planner
Question and Answer Panel
- 12:30 PM Adjourn

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Hawaii Natural Energy Institute, University of Hawaii

Overview Session

50%

10/23/84

90% imported of which 26% from electricity
per flat feet

Dr. Charles Helsley - geothermal potential

- 1) HGP's background - completed 1976
- 2) Philippines: 450 MW (1978) online
- 3) Hawaiian Geology - heat dissipated w/ time
 - a) Statewide assessment (twice)
 - b) Aoni map of resource areas
 - c) ^{can} calculate volume of hot rock from geological data
but unable to precisely estimate MW potential
 - d) ^{can} potentially supply all of the state's needs
for a 100 years
 - e) everything is dependent on the undersea cable.

Wally Bachman

Q: Rev. ~~Bachman~~ (?) (volunteer chemist for Tapoto)

how will transmission lines withstand rise
in elevation due to lava flows?

A: lines will be built to allow for expansion
and movement.

Clara Takalia

Dr. John Shupe

- 1) background of HGP from start to finish
 - a) contributors, money spent, site selection, etc

Q: Mary Madsen Toluy
Disposal of drilling mud? (potential for
chemicals to leach into groundwater.) Not similar
to conditions at Geysers re: components of the steam.

Q: amt of water used?

A: provided by the county, 100,000 gal pond
maintained at site. (depends on type
of drilling air vs. mud and if there
is loss of circulation) mud is bentonite
clay plus silica, sodium ^{sulfate} additives.

George Jenkins (Herc.)

operations of HGP-1 facility.

51 1/2 million kilo-watts
43% H₂O produced since start of HGP-1.
43% steam, 57% brine produced during
operation.

Don Thomas

- 1) Act 214 background
- 2) outlined the 7 criteria used in assessment
- 3) development of rules & regs.
- 4) public request for all avail. info
- 5) selection of ~~two~~ technical committee
- 6)

Heeco future development plans
Alwa Katanura

10/23

1985

1) alternate energy	MW	Forecast	% of total
a) Bio mass			
b) Geothermal			
c) wind			
d) Hydro			
TOTAL	50.8	267,200	48.2

Rate: 29,000 barrels/day
 cost: \$1 million/day

- 2) Heeco's participation
 - a) Heeco well & power plant
 - b) Request for proposal (1985) due in 1985
- 3) PGV
 True/Met Pacific
 Barnwell } have submitted RFP's
 ? # of wells (3) or (2)
- 4) new transmission line
 Keamuku to Kaumana
 10,000 MW Oahu vs. 96 MW Hawaii (peak load) demand this year
- 5) H.D.W. cable
- 6) 25MW was only used as an example
 RFP has not specified amt of Megawatt required.
 May 1985 RFP selection to be made

Meco future development

Anden Andersen

Mami also has about 100 MW peak demand

30 MW energy used to pump water to irrigate

Mami can use energy very readily

* 50-100 MW growth energy estimated on Mami

Mami alternate energy?

projected 110 MW in 1988 when greater capacity will be needed

options:

- 1) Co-generation (Mami plan use of steam) -
10-12 MW can be achieved thru joint use
- 2) Load management of water pumps
that use 30 MW at peak loads
- 3) Burning garbage, and tree farming for fuel
addition of ~10 MW more
- 4) Wind energy - not constant
but may be used to pump water and reduce
by 5 MW used for water pumping.

10/23

Ralph Patterson (formerly of Dillingham)

PG&E manager

145 plants / 3,800 MW worldwide geoth. production

8.3% worldwide growth rate of geoth. develop.

USA - 29 power plants

Philippine 19 p. plants

Italy, Mexico, Japan, Iceland, El Salvador

1) Areas thermal energy use:

- a) processing of products (food)
- b) Home heating

2) program of development:

- a) planning
- b) land leasing
- c) permitting activity
 - 1) drilling
 - 2) leasing
- d) exploration, drilling
- e) flow and chemical tests
- f) reservoir report and analysis
- g) design and siting of power plants
- h) Commercial operation

i) year 1 - 8 for development

total cost \$20 million for 25 MW @ 5 MW per wells

w/ 1 spare and 1 injection well

Environmental Session

Jackie Miller - Environ. Center at UH
Moderator

Panel: Jackie Parnell
Bruce Anderson
Stanford Siegel
James Houck
Charles Lamoureux

- 1) Public Health concerns
 - 2) Changes to the Natural Environment
 - 3) Economics related to the above (2)
- } 3 issues

① Public Health due to noxious emissions

C. Lamoureux - Estuary

1) Base line study of Puna area and effects on native plants & animals

a) Environmental assessments are required

15 different environ. assessments in Puna alone for flora & fauna (esp. birds)

{ Study from Mt South to the coast and Natl park to the Cape Kumukahi in the East

2) Kahauloa - "fern" proposed for endangered list
note

per Lamoureux, native plants should suffer no change from growth develop due to presence of natural emissions in the surrounding area

ask for how he
got monitor stations
during HSP & overland
respirable vs inhalable?

(4)

10/23

James Brock ^{air quality}
3 environmental ^{phase lead} surveys
for a 2 year period.
 $\frac{1}{2}$ of all particulate ^{matter} is organic from spores.

- 1) H_2S
- 2) SO_2
- 3) TSP - Total suspended particulate
- 4) Chem. of respirable & inhalable
- 5) Rainwater catchment
- 6) Radon/Mercury

SO_2
Max > 1000
Typical (5-15)
EPA std 365 micro gram
24 Hrs

H_2S
Max 1 hr 10
Typ (1-10)
Calif. std 152

Scotford Siegel
Potomac Studies in New Zealand

Bruce Anderson
proposed an quality study and health survey.
Hawai Blacker Estates as a control above
Nanawale & Pahoia vs. Leilani Estates
no significant difference in data except
for the common cold

gas short permits & reg's

formerly ?

1 State Office of Environmental Control
Jacqueline Parnell

1) Environmental regulations

a) Land uses

b) DLNR growth reg's

c) DOTT reg's

2) County level

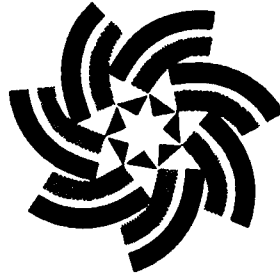
UIC adopted on Jan 1984

1) How would a 2000' ft buffer affect the Kelle park
and NARS?

near areas is then fern ^{endangered} found.

2) Overview of geothermal develop (7 volumes)

3)



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ENERGY EFFICIENT TOMORROW**

**AMERICAN ENERGY
AWARENESS WEEK
IN HAWAII**

WEDNESDAY, OCTOBER 24th

**GEOTHERMAL ENERGY AND ITS APPLICATION
IN HAWAII**



**ENERGY DIVISION
DEPARTMENT OF PLANNING AND
ECONOMIC DEVELOPMENT**

PROGRAM

8:00 AM Registration

8:30 AM Opening Remarks

Linda Kapuniai Rosehill, Deputy Director
Department of Planning and Economic Development

Hawaii Deep Water Cable Development

Technology Development
Gary Okura, Senior Electrical Engineer
Hawaiian Electric Company, Inc.

Legal, Institutional, and Financial Aspects
Gerald A. Sumida, Attorney
Carlsmith, Wichman, Case, Mukai, & Ichiki

Direct Use of Geothermal Resources
John W. Lund, Chairman, Engineering Technical Division
and Research Associate
Geo-Heat Center, Oregon Institute of Technology

10:30 AM Break

10:45 AM Methanol Energy Bridge Between Hawaii and Oahu
Joaquin J. Perez, Project Development Manager
EBASCO Services, Inc., Santa Anna, CA

Puna Geothermal Research Facility
Patrick Takahashi, Acting Director
Hawaii Natural Energy Institute

Geothermal Industrial Park Case Study
James W. Moreau, Energy Conservation Program Manager
Department of Planning and Economic Development

12:00 NOON Adjourn

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Hawaii Natural Energy Institute, University of Hawaii

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Leada Rosehill (opening statement)

3,000 MW potential energy brings rise to
Transmission and direct heat use.

Jerry Okura

H.D.W. Cable Development (1981 started)

260 miles from Oahu to Hawaii

7,000' depth of channel between Hawaii & Maui

- Cable design has been approved by D.O.E.

next step will be the construction of the cable

30,000 length for testing in the channel
Alenuihaha Channel

300 KV (DC) cable / per cent contained oil filled cable

Environmental analysis report is available

from (Heco) for the ~~HAWAII~~ HOWE study.

4.7" DIA
@ 17.3 #/ft

[cost \$60-70 / foot for the cable]

\$200-400 million total cost.

→ 250 MW ~~per~~ for each cable with 3 cables
laid across, 2 in operation with 1 for
spare; assuming 500 MW produced on
the island of Hawaii.

500 MW figure based on Oahu's need not on
Hawaii island's potential.

Gerald Sumida (attorney)

projected completion of HDWC 5-7 yrs from today.

Financing of cable:

- terrain map of cable system to find legal barriers and costs

- channel waters are international waters

3 miles out from shore subject to international law

- Federal laws; Coastal zone mgmt, Natl Environmental Protection act, etc. Land use

- County & State laws

- proposes a "one time" permitting process for Federal, State & County to facilitate develop

- Develop an agency to develop and run the cable or a private organization to manage the project.

- How to pay for HDWC?

use a mix of public & private funds

rather than pure public funded project.

Conclusion

payments, ownership, operation & regulation suggests a coordinated approach w/ develop of geothermal energy; cable

Piping material

- 1) carbon steel ($> 800^{\circ}\text{F}$)
- 2) Fiberglass epoxy ($< 400^{\circ}\text{F}$)

- insulated vs. uninsulated (assume it is buried)
($1/4 - 1^{\circ}\text{F}/\text{mile loss}$) ($2 - 10^{\circ}\text{F}/\text{mile Loss of Heat}$)

Corrosion or scaling

- under pressure is best
- prevent addition of oxygen

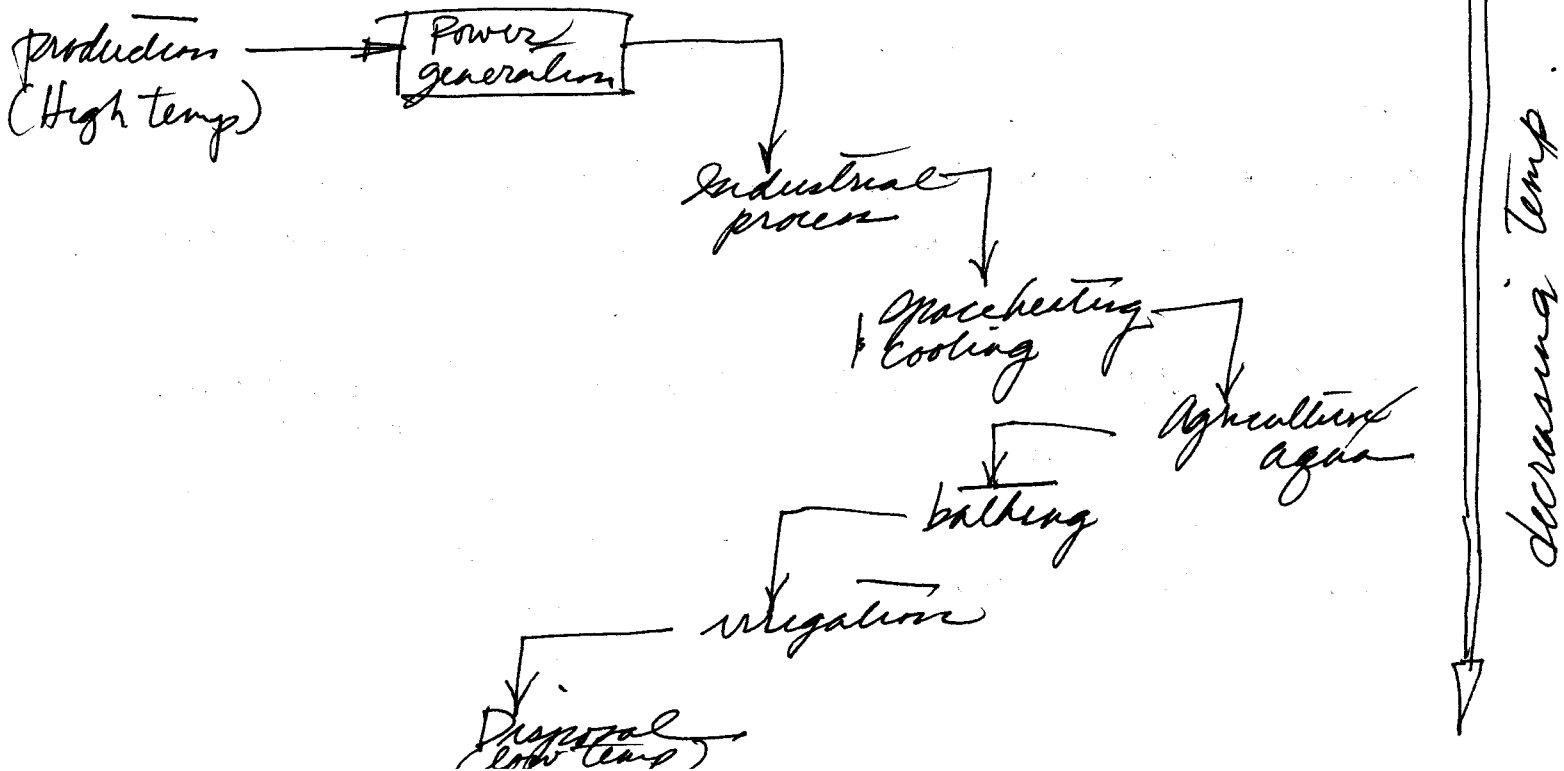
Use of Heat pumps

water to water: boost 60 to 80°F

Cooling

titanium bromide absorption
to 40°F

Cascading (multistage utilization)



Direct use of geo-heat in Hawaii
(recommended)

10/24

I Low Temperature (above 90°F)
Aquaculture

- prawns
- Catfish (80-82°F)
- Tropical fish (90-95°F)

II Intermediate Temp (above 150°F)
Food processing

- fruits, vegetables, milk (pasteurization)

III High Temp (above 250°F) ammonia/water system

- Refrigeration (cold storage)
- Ice production (ice house)

Geo-Heat Center
Oregon Inst. of Technology
Klamath Falls, Oregon

97601

- for publication list of articles
- 1) Technology transfer
 - 2) Application Analysis
- "free services available"

200-300' feet depth wells up to 2000' ft maximum

Joaquin Perez

Methanol energy Bridge between

"Hawaii and Oahu"

- Biomass to Methanol Synthesis using Geo-Energy²¹

1) biomass gasification

Dr. Pat Jakelashki - Director of HNEL

early reservoir engineer

1) use of waste fluids

Puna Geoth Research Facility to be situated next to HEP-1

- to use hi-press, low press brine, etc.

\$ 325,000 state

\$ 250,000 HEI (Heco)

\$ 26,000 Hawaii County

Funding for project, a US DOE funding subject to approval

esp. perhaps double dipping processing for Puna area

10/24

Geith. Industrial Park Case Study

Jim Moreau (OPED)

\$ 125,000 DOE money spent

+ 30,000 donations

Objectives - to determine the parks potential

Market identification

8 processes:

(based on the fol criteria: 1) heat intensive

2) low cost

3) etc)

- A) Tilapia aqua-farm
- B) Cement bonded wallboard
- C) Ethanol plant
- D) Cattle feedmill by sugar cane trash & bagasse
- E) Freeze dry Kona coffee
- F) Dry KOA lumber
- G) Papaya process
- H) protein recovery
- I) geo-applications research laboratory

Final Concept

- 1) ethanol plant, 20,000 GPD fuel-grade, ^{from wood,} bagasse, etc
- 2) papaya process: puree, refining, dehydration
- 3) research facility develop

Conclusion

- 1) develop an Industrial Park
- 2) utilize an "anchor industry"
- 3) no guarantee of ~~success~~ success due to the risk

Hawaii TRIBUNE-HERALD

51ST YEAR — NO. 249

HILO, HAWAII, TUESDAY, OCTOBER 16, 1984

2 SECTIONS—24 PAGES 25 CENTS

Park service still favors land swap

National Park Service officials appreciate the elimination of the geothermal power plant and wells proposed to be built closest to the Thurston Lava Tube, and an increased buffer zone, but still support the idea of a land exchange for the Campbell Estate's geothermal project.

In a September letter to state Department of Land and Natural Resources Chairman Susumu Ono, park service western region director Howard Chapman suggested that it would be worthwhile to consider exchanging Kahauale'a land for property within the Puna Forest Reserve.

According to Chapman, Kahauale'a would make an outstanding state forest reserve due to the high quality of its ohia forest, whereas the Puna forest area is of a much lesser forest quality.

Chapman said the park service is pleased with the increasing of the buffer zone from 1,000 feet to 2,000 feet between the Campbell Estate project and the Hawaii Volcanoes National Park.

Some 5,300 acres at Kahauale'a—a conservation district owned by Campbell Estate adjacent to the National park—is one of the proposed geothermal resource subzones.

Chapman also said "a major issue remaining for the entire state is the industrialization of conservation lands. When it can be stated that economic benefit can 'outweigh any impact on the conservation district,' then conservation zoning has little significance.



United States Department of the Interior

NATIONAL PARK SERVICE

WESTERN REGION

450 GOLDEN GATE AVENUE, BOX 36063
SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO:

N40 *Geothermal*

September 18, 1984

Mr. Susumu Ono
Chairperson, Department of Land and
Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

We would like to comment on the recently published report on geothermal resource subzones; in particular on the subzone designated within Kahauale'a adjacent to Hawaii Volcanoes National Park. The State of Hawaii has taken a major positive step in assessing all potential geothermal sites on a statewide basis. In this manner they can be ranked in priority based on all the factors you considered. As shown in the report, it appears clear that the subzone in lower Puna would be the desirable place to begin geothermal development on the Big Island. It also appears that your hearings confirm this, considering the strong public support for the lower Puna subzone.

We are pleased that the upper east rift subzone eliminates the power plant and wells adjacent to the Thurston Lava Tube section of the National Park. We also appreciate the extension of the buffer zone from 1,000 feet from the park boundary to 2,000 feet. Strict adherence to all controls already established by the Board for the previously determined permitted use zone should be followed.

At this time, Kahauale'a is still a large area of closed canopy *ohi'a* forest of high biological and aesthetic value. It would make an outstanding state forest reserve if it could be exchanged for the Puna Forest Reserve which has been shown by biologists to be of much less value. If that were done, a larger development could be built as originally planned for Kahauale'a.

A major issue remaining for the entire state is the industrialization of conservation lands. When it can be stated that economic benefit can "outweigh any

impact on the conservation district," then conservation zoning has little significance.

We appreciate the opportunity to comment on the proposed Geothermal Resource Subzones. We encourage you to continue to carefully weigh Hawaii's important natural and scenic values along with economic needs.

Sincerely,

Howard H. Chapman
Regional Director, Western Region