

DIRECT-USE GEOTHERMAL IN AGRICULTURE

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OVERVIEW

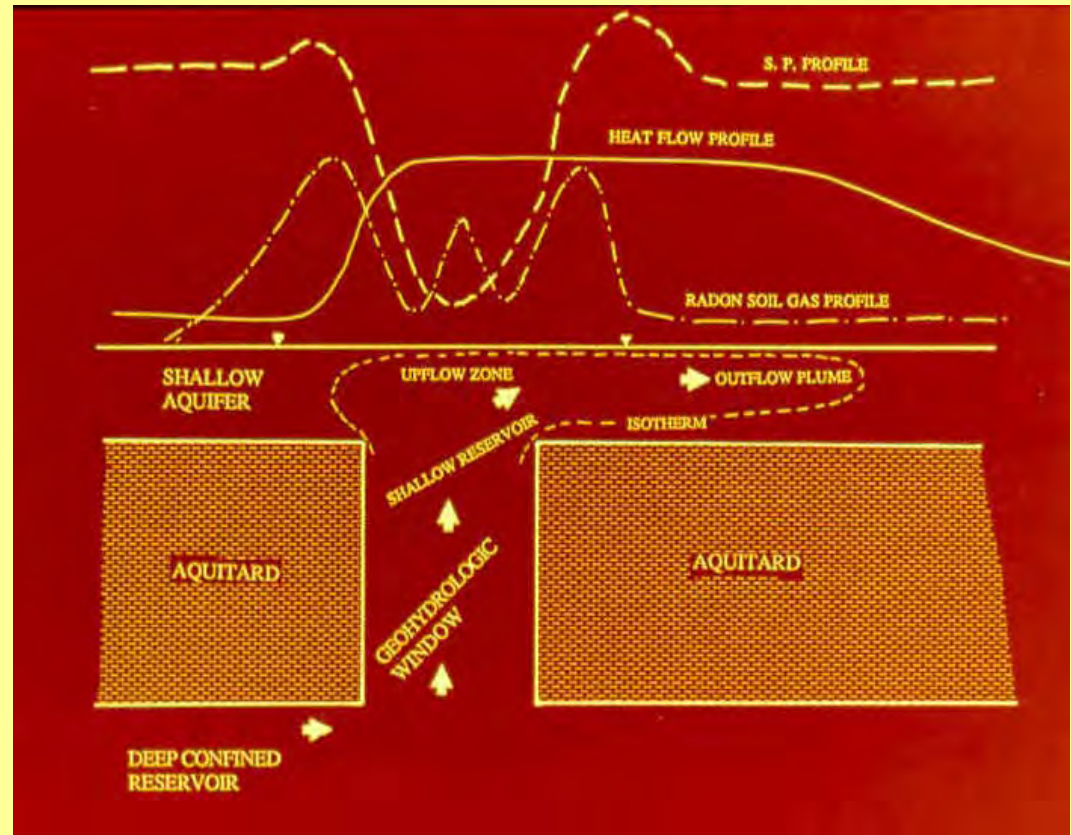
- 1) USES
- 1) TECHNOLOGY
- 2) ENERGY SAVINGS
- 3) RURAL ECONOMIC DEVELOPMENT POTENTIAL



**Business Incubator Greenhouse,
New Mexico State University
Las Cruces, New Mexico**

GEOHERMAL RESOURCE CLASSIFICATION

- HIGH TEMPERATURE > 180°C
- INTERMEDIATE TEMPERATURE 90 to 180°C
- LOW TEMPERATURE < 90°C



Example Resource and Exploration Model

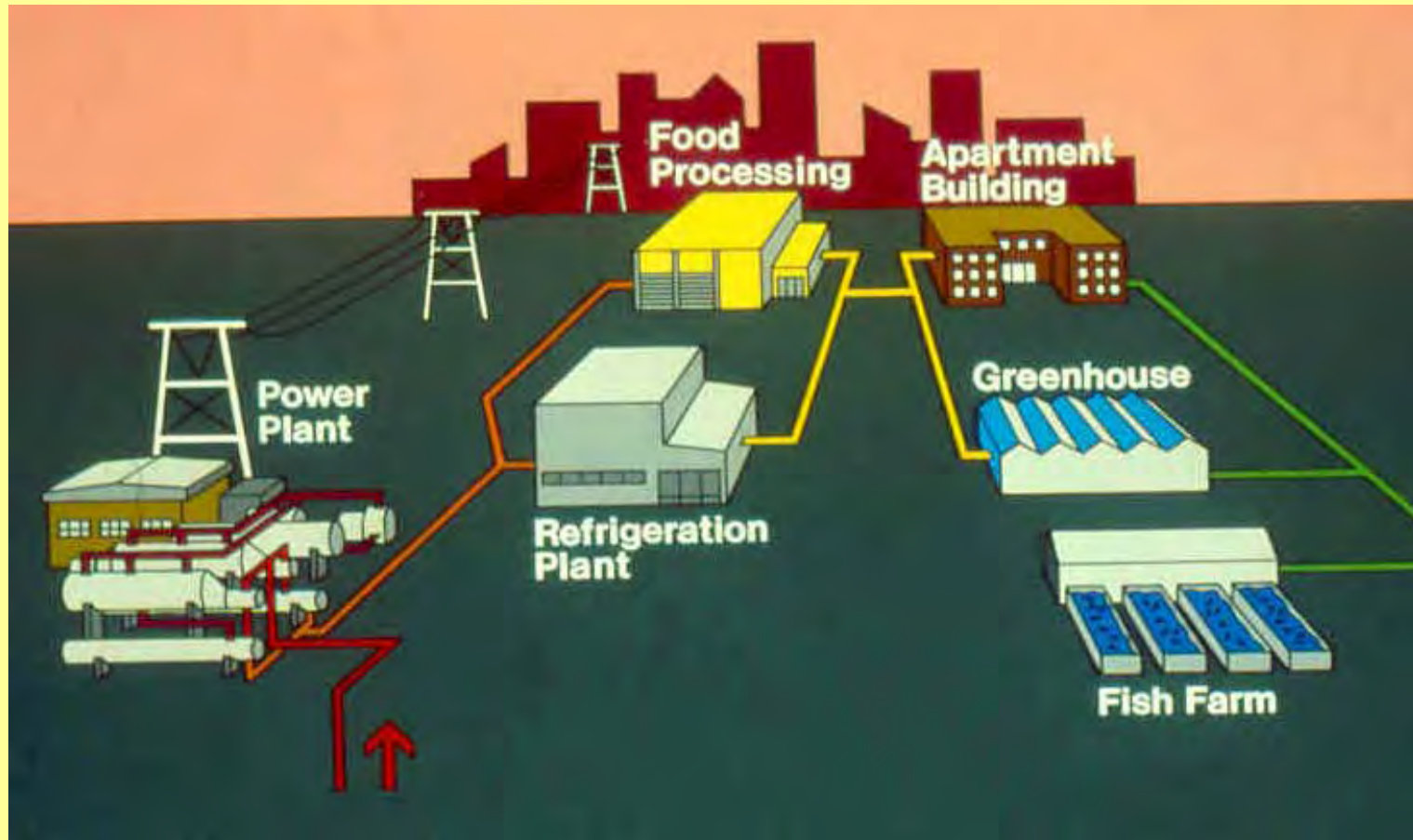
PURPOSE

THE PRIMARY OBJECT OF
GEOTHERMAL USE IN
AGRICULTURE IS TO
GROW OR PROCESS THE
BEST QUALITY PRODUCT
SAFELY AND
PROFITABLY WITH
ENERGY SAVINGS

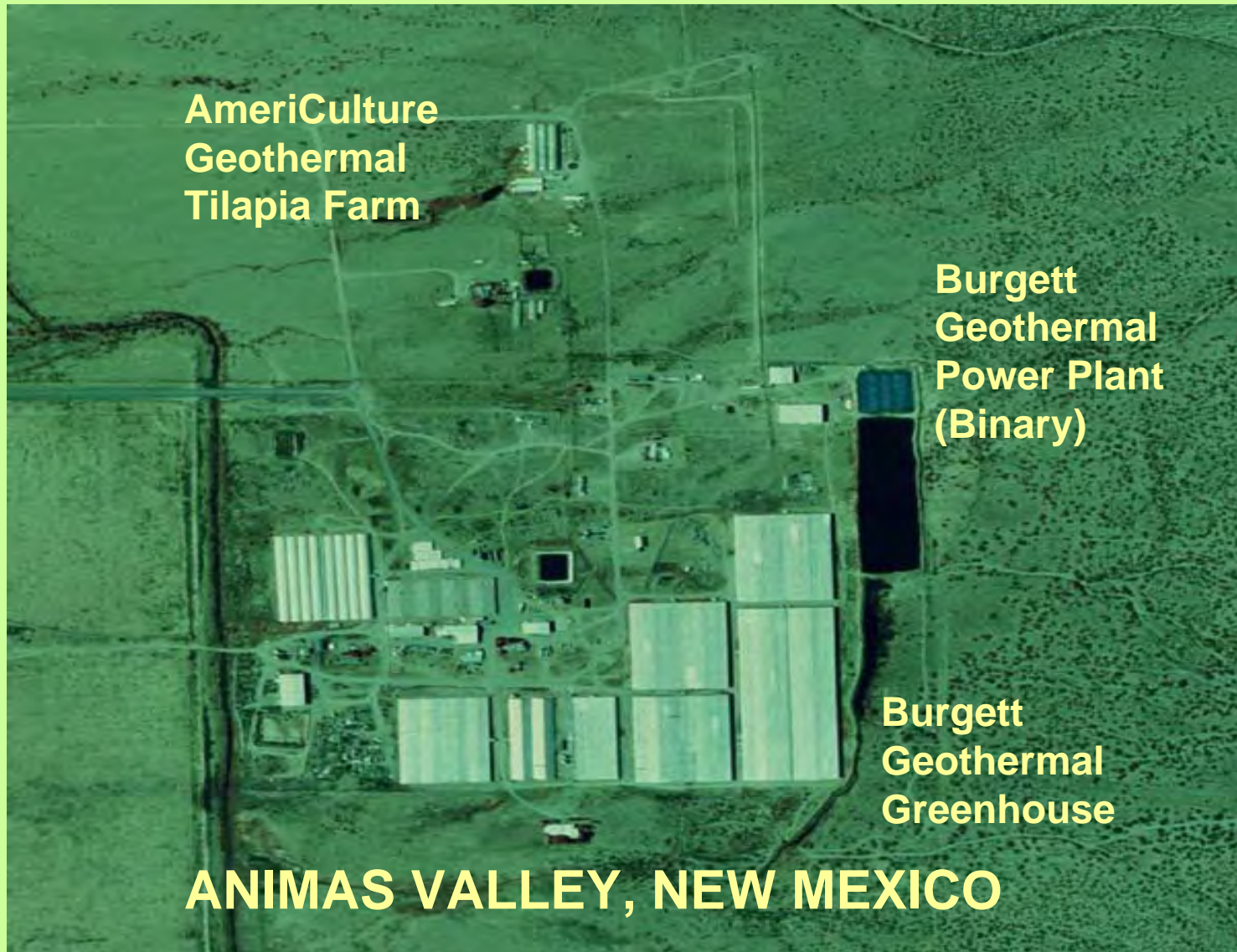


Masson Geothermal Greenhouse,
Radium Springs, New Mexico

THE CONCEPT



EXAMPLE



**AmeriCulture
Geothermal
Tilapia Farm**

**Burgett
Geothermal
Power Plant
(Binary)**

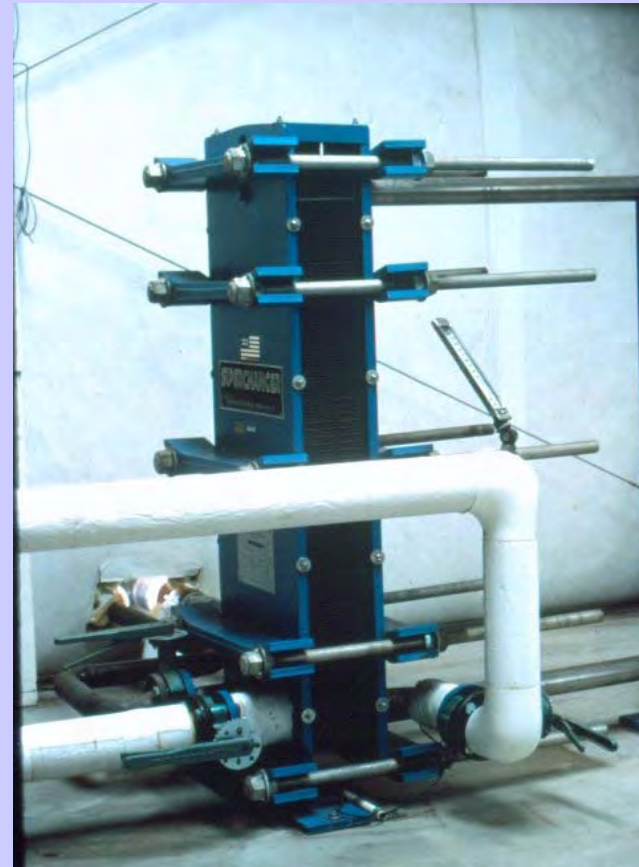
**Burgett
Geothermal
Greenhouse**

ANIMAS VALLEY, NEW MEXICO

AGRICULTURE GEOTHERMAL APPLICATIONS

- GREENHOUSES
- AQUACULTURE
- DRYING AND PROCESSING
- ANY PROCESS THAT REQUIRES LARGE AMOUNTS OF LOW GRADE HEAT

Plate and Frame Heat Exchanger
Business Incubator Greenhouse,
New Mexico State University
Las Cruces, New Mexico



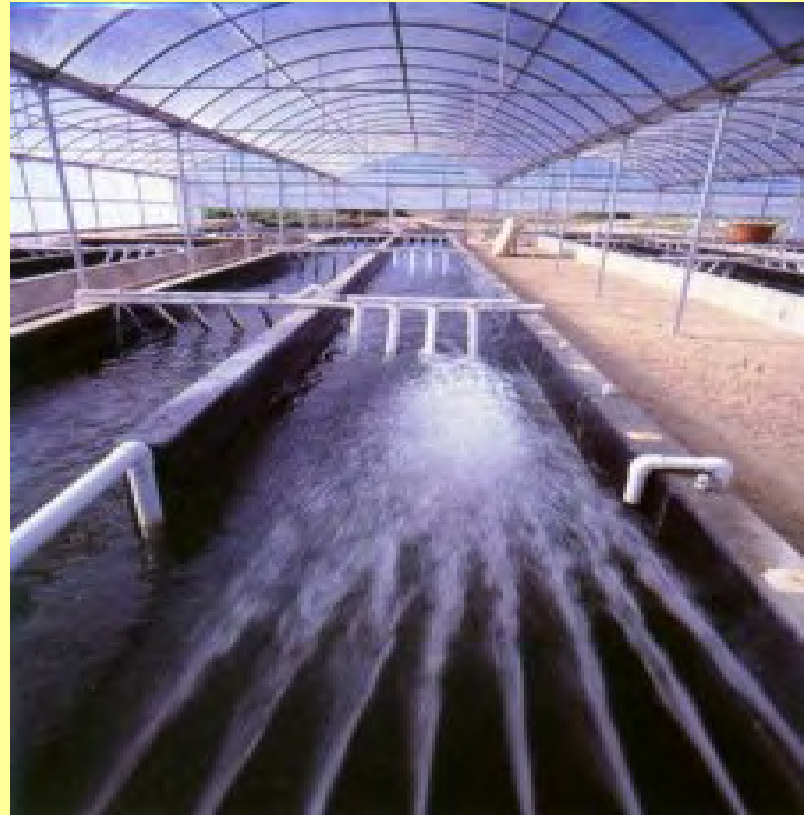
GEOHERMAL AQUACULTURE

AmeriCulture Tilapia Farm,
Animas Valley,
New Mexico



GEOHERMAL AQUACULTURE ADVANTAGES AND OPTIONS

- **CONTROL TEMPERATURE
FOR OPTIMAL GROWTH**
- **GROWING MARKET
POTENTIAL AS NATURAL
FISHERIES ARE STRESSED**
- **MANY POTENTIAL SPECIES**
Shrimp, Lobster, Eels,
Tilapia, Stripped Bass,
Oysters, Algae, etc.
- **CASCADED MODE WITH
OTHER GEOHERMAL
APPLICATIONS**



**Raceway Geothermal Shrimp
Farm, Gila Bend, Arizona.**

GEOHERMAL GREENHOUSING



Masson Geothermal Greenhouse, Radium Springs, New Mexico

GEOHERMAL GREENHOUSE HEATING

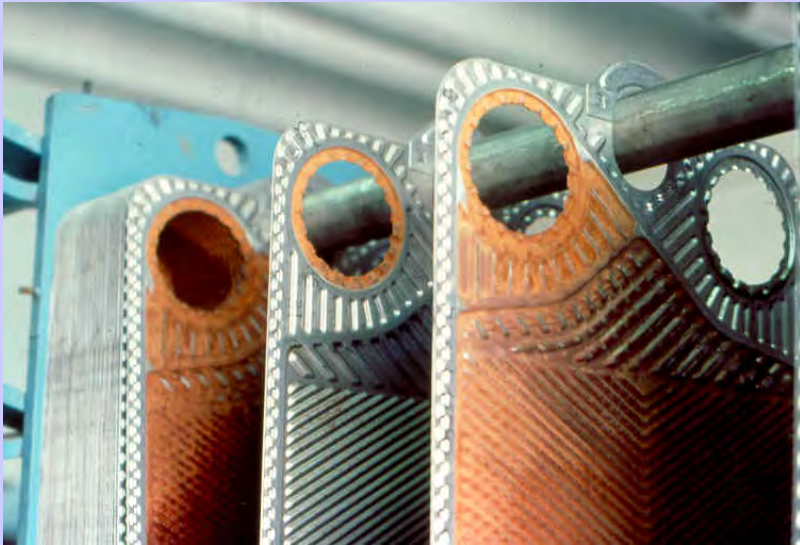
- CENTRAL HOT WATER SYSTEM
- GEOHERMAL WELLS AND HEAT EXCHANGERS REPLACE CONVENTIONAL FOSSIL FUEL BOILER



Masson Geothermal Greenhouse,
Radium Springs, New Mexico

GEOHERMAL IS AN ECONOMIC DEVELOPMENT TOOL IN RURAL AREAS

GREENHOUSE EXAMPLE



**Plate and Frame Heat Exchanger
Disassembled for Cleaning**

**ANNUAL SALES (wholesale)
\$325,000 to \$850,000 per acre**

**EMPLOYMENT
4 to 8 employees per acre**

**ENERGY SAVINGS \$46,200/yr
per acre in southern New
Mexico**

**4,200 MMbtu/yr/acre at
less than \$1.50/MMbtu**

**Natural gas \$12.50/MMbtu
(boiler inefficiency
included)**

GEOHERMAL DRYING AND PROCESSING



Onion Dryer, Brady Hot Spring, Nevada



GEOHERMAL CHILE DRYING

EXAMPLE OF LARGE HEAT LOAD WITH GEOHERMAL ADVANTAGE



- Single Stage Continuous Feed Tunnel Dryer
- 30,000 lbs/day - Wet Input
- 6,000 lbs/day - Dry Output
- Tunnel Air Drying Temperature - 180°F (entry) to 150°F (exit)
- Fan Coil Blower (heats air to 180°F)
- Useful Geothermal Heat Delivered - 35,937,500 Btu/hr
- Annual Load Factor - 0.5
- Well Production – 1,200 gpm at 220°F
- Capital Costs of Production Well (2000 ft), Injection Well (650 ft), and Production Well Pump (105 hp) - \$860,000
- 20 year COE \$0.81 MMBtu - 8% interest rate
- Annual displaced cost of natural gas \$1,337,953 at \$8.50 MMBtu

DEVELOPMENT INFRASTRUCTURE

- PRODUCTION WELLS
- INJECTION WELLS
- HEAT EXCHANGERS
- PIPE LINES



Drilling AmeriCulture State 2,
Animas Valley, New Mexico,
AmeriCulture Geothermal Tilapia
Farm

A photograph showing a tall drilling rig in a desert landscape. In the background, there is a large plume of white steam rising from the ground. The sky is clear and blue.



Drilling Masson Federal
36, Radium Springs, New
Mexico, Masson
Geothermal Greenhouse,

A photograph showing a drilling rig in a desert landscape. In the foreground, there is a bright light source, possibly a flare or a wellhead. The background features rolling hills and a clear sky.

DEVELOPMENT APPROACH

- RESOURCE ASSESSMENT AND RESERVOIR CONFIRMATION
- ENGINEERING FEASIBILITY
- PERMITTING
- BUSINESS AND MARKETING PLAN
- RESOURCE MANAGEMENT PLAN



Alligator Aquaculture, Mosca, Colorado

ADDITIONAL INFORMATION

- Texas Geothermal Resource Information
Southern Methodist University Geothermal Lab
<http://www.smu.edu/geothermal>
- Direct-Use Technology and Engineering Design
Oregon Institute of Technology GeoHeat Center
<http://geoheat.oit.edu/>
- Growing, Processing, and Marketing Information
Texas A&M Agriculture Extension
<http://texasextension.tamu.edu/>
Texas Department of Agriculture
<http://www.agr.state.tx.us/>
- Business Plans and Financing
Bob Lawrence and Associates
<http://www.geothermal-biz.com/>
- USDA Grants and Loans
<http://www.rurdev.usda.gov/rd/farmbill/9006resources.html>
- USDOE Geothermal Program and Geopowering the West
<http://www.eere.energy.gov/geothermal/>
http://www.eere.energy.gov/geothermal/deployment_gpww.html