Progress Report

GEOTHERMAL ENERGY
AND THE EASTERN U.S.
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GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN U.S.

PROGRAM REVIEW – 2 JUNE 80

I. REGIONAL, STATE AND LOCAL PLANNING

II. ANALYSIS OF STATE-BY-STATE POTENTIAL AND THEIR DEVELOPMENT PLANS

III. ECONOMIC AND BARRIER ANALYSIS

IV. PROGRAM MONITOR, ETC.

V. MARKET ASSESSMENT

VI. HYDROTHERMAL APPLICATIONS

VII. OUTREACH + TECHNICAL ASSISTANCE

VIII. PROGRAM SUPPORT
INTRODUCTION AND HISTORY

A. M. STONE

TASKS

I. & II. STATE & LOCAL ASSISTANCE

F. C. PADDISON

III. ECONOMIC AND BARRIER ANALYSIS

S. KANE

IV. PROGRESS MONITOR, ETC.

F. C. PADDISON

V. MARKET ASSESSMENT

W. TOOTH

VI. HYDROTHERMAL APPLICATIONS

F. C. PADDISON

VII. OUTREACH/TECHNICAL ASSISTANCE

VIII. PROGRAM SUPPORT
HISTORICAL REVIEW OF APL/JHU PARTICIPATION IN THE NATIONAL GEOTHERMAL PROGRAM

In addition to general support or ERDA, DOE/DGE and DOE/RA, the following specific tasks were undertaken.

<table>
<thead>
<tr>
<th>Period</th>
<th>Auspices</th>
<th>Scope</th>
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</thead>
<tbody>
<tr>
<td>Sept 1976</td>
<td></td>
<td>2. Nonelectric user requirements</td>
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<td>3. Nonelectric geothermal system requirements</td>
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<tr>
<td>Dec 1977</td>
<td></td>
<td>2. Development of initial scenarios</td>
</tr>
<tr>
<td></td>
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<td>3. Hierarchal array of regional scenarios</td>
</tr>
<tr>
<td></td>
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<td>4. Scenarios for selected resources</td>
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<tr>
<td></td>
<td></td>
<td>5. Regional progress monitor architecture</td>
</tr>
<tr>
<td>Jan 1978–</td>
<td>R. Oliver/</td>
<td>1. Energy use survey</td>
</tr>
<tr>
<td>Dec 1978</td>
<td>L. Werner</td>
<td>2. Energy use analysis</td>
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<td>3. Economic assessment</td>
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<td>4. Market penetration assessment</td>
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<td></td>
<td></td>
<td>5. Preliminary engineering analyses of geothermal use</td>
</tr>
<tr>
<td>Jan 1979–</td>
<td>R. Oliver/</td>
<td>1. Monitor federal and state exploratory programs</td>
</tr>
<tr>
<td>Dec 1979</td>
<td>W.L.R. Rice</td>
<td>2. Produce subregional scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Aggregate geothermal potential and time-phasing for Eastern U.S.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. IBM MINIPERT software for regional progress monitor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Expand subregional scenarios, including social impact, environmental, etc.</td>
</tr>
</tbody>
</table>

(continued)
The common thread running through these almost five years of support is commercialization planning, economic and outreach activity. Very little advantage has been taken of the Laboratory’s exceptional talent in engineering, simulation, modelling and geophysics. This would be understandable in light of similar skills of other DOE contractors (LASL, LBL, Stanford, etc.) -- but in five years none of their skills has been applied systematically to the Eastern United States. We particularly are keenly conscious of the pressing need for reservoir engineering and management of eastern geothermal resources.
HISTORICAL REVIEW OF APL/JHU PARTICIPATION
IN THE NATIONAL GEOTHERMAL PROGRAM

<table>
<thead>
<tr>
<th>Period</th>
<th>Auspices</th>
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<tr>
<td>April 1976-Sept 1976</td>
<td>R. Toms</td>
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<td>Oct 1976-Dec 1977</td>
<td>R. Oliver</td>
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<td>Jan 1978-Dec 1978</td>
<td>R. Oliver/ L. Werner</td>
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<tr>
<td>Jan 1979-Dec 1979</td>
<td>R. Oliver/ W.L.R. Rice</td>
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</tbody>
</table>
GEOTHERMAL ENERGY IN THE EASTERN U.S.

TASK I  REGIONAL, STATE AND LOCAL PLANNING
COORDINATION WITH DOE REGION II, III & IV
STATE PROSPECTUS
STATE TEAM ORGANIZATION — DE, VA, MD
TECHNICAL SUPPORT NCSL — LEGISLATIVE WORKSHOPS
DE, MD
COORDINATION FEDERAL INSTALLATIONS — NAVFAC, NASA

TASK II  STATE-BY-STATE POTENTIAL
ORDER POTENTIAL OF SEDIMENTARY BASINS
SUPPLY TECHNICAL DATA STATE PROSPECTUS
SUPPORT STATE TEAMS
INTRODUCTION
DESCRIPTION OF THE RESOURCE
POTENTIAL HYDROTHERMAL ENERGY BENEATH DELMARVA
RESERVOIR PARAMETERS FOR GEOTHERMAL ENERGY RETRIEVAL
GEOTHERMAL WELLS AND WELL PUMPING SYSTEMS
APPLICATIONS ENGINEERING AND ECONOMICS
TECHNICAL AND REGULATORY STEPS FOR DEVELOPMENT
DISCUSSION OF CURRENT ENVIRONMENTAL, FINANCIAL AND LEGAL INFRASTRUCTURE
INITIATIVES REQUIRED FOR GEOTHERMAL DEVELOPMENT
LIST OF CONTACTS FOR ASSISTANCE IN GEOTHERMAL DEVELOPMENT
Potential geothermal resource areas - Eastern United States

- Basement depth greater than 4000 ft below surface*
- Approximate areas of thermal anomalies under investigation by Costain et al (VPI&SU)**
- Limit of coastal plains sediments

* Contours adapted by JHU/APL from basement map of N. America - 1967 AAPG & USGS
** From Report DOE/NVO/1558-7(12/79), Gruy Federal, Inc.
REVISED EVALUATION OF GEOTHERMAL RESOURCE AREAS IN THE EASTERN UNITED STATES
### The Bases of Comparison

**Data Elements**
- Depth to Basement
- Geothermal Gradient
- Population
- Town & Cities
- Degree Days', Heating
- Value Added in Manufacturing

**Derived Elements**
- Temperature
- Extractable Heat Flow
- Well Cost
- Present Energy Use
- Residential
- Commercial
- Industrial

*BuCENSUS, CURRENT POPULATION REPORTS, SERIES P-25
†BuCENSUS, COUNTY & CITY DATA BOOK, 1972
METHODOLOGY

- CROSSPLOT GRADIENT AND DEPTH
- SELECT COUNTIES BY GRADIENT AND DEPTH
- COLLECT DATA FOR COUNTIES
- CALCULATE DERIVED ELEMENT
- PERFORM WEIGHTED RANKING
## SELECT PROSPECTS UNDER DIFFERENT CRITERIA

39 COUNTIES IN 7 STATES RANKING IN THE FIRST TWENTY FIVE UNDER AT LEAST ONE CRITERION

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<th>State</th>
<th>Overall</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
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<td>Vermillion</td>
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<tr>
<td>West Virginia</td>
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</tbody>
</table>
SIGNIFICANT DOCUMENTS AND RESULTS THROUGH FY 1980

TASKS I AND II STATE AND LOCAL ASSISTANCE

1. STATE PROSPECTUS DELMARVA STATES – STRUCTURAL FRAMEWORK, PUBLISHED
2. STATE TEAM FORMATION – DE, MD AND VA IN PROCESS
3. DELAWARE GEOTHERMAL ACT PASSED STATE SENATE MODEL FOR COASTAL PLAIN STATES
4. MD TO CONVENE LEGAL WORKSHOP – REVIEW ACT PAPER ON OWNERSHIP ISSUE – WRITTEN
5. REVISED REPORT ORDERING POTENTIAL OF EASTERN SEDIMENTARY BASINS – COMPLETED NY, PA
6. ESTABLISHED WORKING RELATION WITH DOE REGIONAL OFFICE III
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN U.S.

TASK III – ECONOMIC AND BARRIER ANALYSIS

COST MODELING
- GREES
- GRITS

DEMAND MODELING
- HOUSING DENSITY
- CAPITAL STOCK OBSTACLE
- INCENTIVES

IDENTIFICATION OF LEGAL AND INSTITUTIONAL BARRIERS
- OWNERSHIP, INSURANCE, TAXES
- MARYLAND GRA
TASK III — ECONOMIC AND BARRIER ANALYSIS
HOW GRITS WORKS

INPUTS

RESOURCE

DEMAND

FINANCIAL

GRITS

OUTPUTS

DISCOUNTED AVERAGE COST

NET PRESENT VALUE
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN U.S.

TASK III – ECONOMIC AND BARRIER ANALYSIS

GRITS – INPUTS

RESOURCE
- NUMBER OF PRODUCTION AND REINJECTION WELLS
- WELL DEPTH
- FLOWRATE*
- TEMPERATURE*
- DRAWDOWN*

DEMAND
- USER TYPE
- LOCAL WEATHER CONDITIONS
- RATE OF MARKET PENETRATION*
- LEVEL OF MARKET SATURATION
- UTILIZATION LEVEL OF RESOURCE

FINANCIAL
- INTEREST RATE
- INFLATION RATE
- DISCOUNT RATE*
- COST OF PURCHASED ENERGY*
- LENGTH OF EVALUATION PERIOD

*TIME DEPENDENT
GRITS OUTPUTS

TASK III – ECONOMIC AND BARRIER ANALYSIS

GRITS OUTPUTS

– ANNUALIZED COSTS FOR SYSTEM COMPONENTS

– ANNUAL ENERGY SUMMARY

  NUMBER OF CUSTOMERS
  ENERGY SALES
  PEAKING ENERGY NEEDS
  PUMPING ENERGY USED

– DISCOUNTED AVERAGE ENERGY COST ($ PER MILLION BTU)

– NET PRESENT VALUE OF DISCOUNTED COST AND REVENUE STREAMS
## COMPARISON OF GRITS ESTIMATES WITH FRENCH ESTIMATES

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<thead>
<tr>
<th>Resource</th>
<th>French</th>
<th>GRITS</th>
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<tr>
<td><strong>Temperature</strong></td>
<td>65°C (149°F)</td>
<td>149°F*</td>
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<tr>
<td>Production well depth</td>
<td>1800 m (5905 ft)</td>
<td>5900 ft*</td>
</tr>
<tr>
<td>Reinjection well depth</td>
<td>1800 m</td>
<td>5900 ft*</td>
</tr>
<tr>
<td>Output</td>
<td>200 m³/h (880 gal/min)</td>
<td>880 gal/min*</td>
</tr>
<tr>
<td><strong>Users</strong></td>
<td></td>
<td></td>
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<tr>
<td>Number of apartments</td>
<td>2500</td>
<td>2159</td>
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<tr>
<td>Design temperature</td>
<td>6°C (43°F)</td>
<td>41°F*</td>
</tr>
<tr>
<td>Energy, total supplied</td>
<td>$146 \times 10^6$ MJ</td>
<td>$116 \times 10^9$ Btu</td>
</tr>
<tr>
<td>Percentage geothermal</td>
<td>75%</td>
<td>88%</td>
</tr>
<tr>
<td><strong>System costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total capital</td>
<td>10 MF ($2.2 million)</td>
<td>$2.0 million</td>
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<tr>
<td>Cost per user</td>
<td>4000 F ($880)</td>
<td>$908</td>
</tr>
<tr>
<td>Fuel oil for peaking system (cost per unit)</td>
<td>0.014 F/MJ ($1.25/10^6 Btu)</td>
<td>$4.50/10^6 Btu*</td>
</tr>
<tr>
<td>Electricity costs (pumping)</td>
<td>0.160 MF ($35 200)</td>
<td>$43 960</td>
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<tr>
<td>Maintenance</td>
<td>0.100 MF ($22 000)</td>
<td>$19 600</td>
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<tr>
<td>System energy cost</td>
<td>0.0135 F/MJ ($3.14/10^6 Btu)</td>
<td>$3.23/10^6 Btu</td>
</tr>
</tbody>
</table>

* Input condition
TASK III — RATES OF MARKET PENETRATION VERSUS TIME

- \( \beta = 1.00 \)
- \( \beta = 0.667 \)
- \( \beta = 0.333 \)

- \( V=0.038 \)
- \( V=0.009 \)
Task III — Net Present Value of District Heating System Versus Rate of Market Penetration (Incentives Included)

Net Present Value (N.P.V.) (10^9)

Initial Percentage Market Penetration Followed by '5% Annual Increase

a = N.P.V. for utility exploiting high quality resource when no bonus paid
b = N.P.V. for high quality resources when bonus based on no fuel price advantage
c = N.P.V. for utility exploiting fair quality resource when no bonus paid
d = N.P.V. for fair quality resource when bonus based on no fuel price advantage
TASK III — NET PRESENT VALUE OF DISTRICT HEATING SYSTEM VERSUS RATE OF MARKET PENETRATION [NO INCENTIVES]

INITIAL PERCENTAGE MARKET PENETRATION FOLLOWED BY 5% ANNUAL INCREASE

<table>
<thead>
<tr>
<th>RESOURCE PARAMETERS</th>
<th>GOOD RESOURCE</th>
<th>FAIR RESOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESOURCE TEMPERATURE (F°)</td>
<td>170</td>
<td>135</td>
</tr>
<tr>
<td>MAXIMUM FLOW (GPM)</td>
<td>500</td>
<td>200</td>
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<tr>
<td>AVERAGE DRAWDOWN (FT)</td>
<td>75</td>
<td>575</td>
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GOOD RESOURCE

FAIR RESOURCE
TASK III — GRITS ANALYSIS OF AVERAGE COST VERSUS FLOW RATE FOR RESIDENTIAL AND INDUSTRIAL SECTORS
TASK III — GRITS ANALYSIS OF AVERAGE COST VERSUS FLOW RATE FOR RESIDENTIAL SECTOR GIVEN DIFFERENT RESOURCE TEMPERATURES
REMAINING EFFORT THRU SEPTEMBER 1980

- UPDATING COST ESTIMATION MODELS
- SUPPLEMENTING PAST PRICE PROJECTIONS
- ELABORATING ON MARKET PENETRATION MODELS
- STUDYING DENSITY OF SOUTHERN HEATING UNITS CONVERTIBLE TO GEOTHERMAL
- CONTINUING SUPPORT OF NCSL
- RESEARCHING BARRIERS TO DEVELOPMENT IN MD, DE, AND VA
COST ESTIMATION MODELS

**GREES** (Geothermal Resource Economic Evaluation System)
- provides average and marginal cost estimates of delivered energy
- permits examination of the sensitivity of costs to varying conditions
- clearly treats real and nominal dollars
- allows changes in saturation level to reflect density of customers

**GRITS** (Geothermal Resource Interactive Temporal Simulation)
- allows changes in resource and economic conditions during project lifetime
- refinement of component costs and system design
- calculates and displays annual energy summary, annualized costs for system components
- calculates and displays discounted average costs and net present value of discounted cost and revenue streams

**DSM** (Demand Specified Model)
- modification of commercial portion of GRITS
- allows specification of heating requirements to be served by each well and calculates the flow rate required to meet demands

**BIG MAC** (Basic Interactive Geothermal Model with Aquifer Characterizations)
- further refinement of DSM
- incorporates aquifer characteristics to determine drawdown and pumping energy requirements given a prespecified demand
PUBLICATIONS

COST MODELING


DEMAND MODELING


IDENTIFICATION OF LEGAL AND INSTITUTIONAL BARRIERS


GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN U.S.

TASK IV PROGRESS MONITOR, ETC.

INPUT EASTERN PROGRESS
STATE FACT BOOKS (50 STATES)
IGCC ANNUAL REPORT (EASTERN INPUTS)
OTHERS
DATA TO ESTABLISH DGE DEVELOPMENT OBJECTIVES
ENGINEERING AND ECONOMICS RESEARCH, INC
NEW MEXICO ENERGY INSTITUTE

SIGNIFICANT DOCUMENTS AND RESULTS

1. REVISED (50 STATE) STATE FACT BOOKS — COMPLETE EXCEPT FOR CA & HI
2. INPUTS TO PROGRESS MONITOR REPORTS NO. 1, 2, AND 3 TO DATE
3. INPUT TO FY-80 IGCC ANNUAL REPORT
4. DATA TO EER
5. MARKET SURVEY DATA TO NMEI
OUTLINE

GEMS OBJECTIVES AND TASKS
SURVEY RESULTS
RECOMMENDATIONS
SUMMARY
OBJECTIVES:

- DETERMINE APPLICATIONS FOR GEOTHERMAL ENERGY IN:
  SOUTHEASTERN NEW JERSEY
  DELMARVA PENINSULA
  NORFOLK, VA. AREA
  EASTERN NORTH CAROLINA

- RECOMMEND BEST RESOURCE AREA ON BASIS OF MARKET POTENTIAL

- ASSIST DOE/DGE AND VPI&SU IN SITE SELECTION OF DEEP WELL

- PREPARE FINAL REPORT

1/10/79
THE FOUR AREAS OF INTEREST IN THE ATLANTIC COASTAL PLAIN.

Southeast New Jersey
Delmarva Peninsula
Norfolk, Virginia
Eastern North Carolina
TASKS:

- MARKET DEFINITION:
  ENERGY USE SURVEY
  ENERGY USE ANALYSES
  ENGINEERING ANALYSES

- MARKET PENETRATION:
  PRICE PROJECTIONS OF CONVENTIONAL FUELS
  GEOTHERMAL ENERGY COSTS
  MARKET PENETRATION
SURVEYED ENERGY USES

RESIDENTIAL SPACE AND WATER HEATING
COMMERCIAL SPACE AND WATER HEATING
MILITARY SPACE AND WATER HEATING
AGRICULTURE
CROP DRYING
GREENHOUSES
POULTRY HATCHERIES
BROILER HOUSE SPACE HEATING
INDUSTRIAL PROCESS HEAT
RESIDENTIAL SPACE
AND WATER HEATING REQUIREMENTS

SPACE HEATING
SINGLE FAMILY RESIDENCES  5640 Btu/DEGREE (F) - DAY/PERSON
MULTI-FAMILY RESIDENCES  3740 Btu/DEGREE (F) - DAY/PERSON

WATER HEATING
ALL RESIDENCES  6.00 x 10^6 Btu/PERSON/YEAR

KARKHECK, BEARDSWORTH AND POWELL, 11th IECEC, 1976
COMMERCIAL WATER HEATING
COMMERCIAL SPACE HEATING
RESIDENTIAL WATER HEATING
RESIDENTIAL SPACE HEATING

SCALE:
1 DOT = 10^{10} Btu/yr

128
502
38
40
17

MILES

1/15/79
RESIDENTIAL AND COMMERCIAL SPACE AND WATER HEATING DENSITIES FOR NORFOLK, VA.
### TOTAL AGRICULTURAL HEAT DEMANDS IN THE FOUR RESOURCE AREAS (10^{10} \text{ Btu/yr})

<table>
<thead>
<tr>
<th></th>
<th>SE NEW JERSEY</th>
<th>DELMARVA</th>
<th>NORFOLK AREA OF VIRGINIA</th>
<th>EASTERN NORTH CAROLINA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CROP DRYING</td>
<td>2.0</td>
<td>43.9</td>
<td>4.8</td>
<td>95.5</td>
</tr>
<tr>
<td>GREENHOUSES</td>
<td>56.8</td>
<td>12.9</td>
<td>4.8</td>
<td>1.3</td>
</tr>
<tr>
<td>POULTRY HATCHERIES</td>
<td>6.3</td>
<td></td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>BROILER HOUSES</td>
<td>1.5</td>
<td>115.3</td>
<td>0.5</td>
<td>11.3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>60.3</strong></td>
<td><strong>178.4</strong></td>
<td><strong>10.1</strong></td>
<td><strong>108.1</strong></td>
</tr>
</tbody>
</table>
INDUSTRIAL CATEGORIES INCLUDED IN THE SURVEY

FOOD AND KINDRED PRODUCTS
TOBACCO MANUFACTURERS
TEXTILE MILL PRODUCTS
LUMBER AND WOOD PRODUCTS
   (INCLUDING FURNITURE)
PAPER AND ALLIED PRODUCTS
CHEMICALS AND ALLIED PRODUCTS
VARIOUS OTHERS AS IDENTIFIED
<table>
<thead>
<tr>
<th></th>
<th>SOUTHEAST</th>
<th>DELMARVA</th>
<th>NORFOLK</th>
<th>EASTERN NORTH CAROLINA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL COMPANIES INITIALLY SELECTED</td>
<td>174</td>
<td>279</td>
<td>144</td>
<td>260</td>
<td>857</td>
</tr>
<tr>
<td>COMPANIES INCLUDED IN SURVEYED AREAS</td>
<td>124</td>
<td>240</td>
<td>106</td>
<td>204</td>
<td>674</td>
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<tr>
<td>COMPANIES CONTACTED</td>
<td>99</td>
<td>208</td>
<td>102</td>
<td>124</td>
<td>533</td>
</tr>
<tr>
<td>COMPANIES WITH POTENTIAL APPLICATIONS FOR GEOTHERMAL</td>
<td>49</td>
<td>147</td>
<td>55</td>
<td>66</td>
<td>317</td>
</tr>
<tr>
<td>COMPANIES WITH DEMANDS GREATER THAN $1 \times 10^{10}$ Btu/yr</td>
<td>17</td>
<td>52</td>
<td>15</td>
<td>18</td>
<td>102</td>
</tr>
</tbody>
</table>
INDUSTRIAL MARKETS FOR GEOTHERMAL ENERGY IN SOUTHEASTERN NEW JERSEY

THERMAL REQUIREMENTS BELOW 250° F (BTU/YR)

<table>
<thead>
<tr>
<th>ESTIMATED USAGE</th>
<th>ACTUAL USAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>■</td>
</tr>
<tr>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

CUMBERLAND COUNTY

V—VINELAND

B—BRIDGETON

MILES

0 10 20 30
INDUSTRIAL MARKETS FOR GEOTHERMAL ENERGY
ON THE DELMARVA PENINSULA

THERMAL REQUIREMENTS BELOW
250°F (BTU/yr)

ESTIMATED ACTUAL
USAGE

- 0.5-1.0 x 10^{11}
- 1.5 x 10^{10}
- 1-10 x 10^9
- < 10^9
INDUSTRIAL MARKET FOR GEOTHERMAL ENERGY
IN THE NORFOLK AREA

THERMAL REQUIREMENTS BELOW
250°F (BTU/YR)

<table>
<thead>
<tr>
<th>ESTIMATED USAGE</th>
<th>ACTUAL USAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ ○ ○ ○ ○ ○</td>
<td>■</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○ ○ ○</td>
<td>0.5-1.0 x 10¹¹</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○</td>
<td>□</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○ ○ ○</td>
<td>1.5 x 10¹⁰</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○</td>
<td>□</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○ ○ ○</td>
<td>1-10 x 10⁹</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○</td>
<td>□</td>
</tr>
<tr>
<td>○ ○ ○ ○ ○ ○ ○ ○</td>
<td>&lt; 10⁹</td>
</tr>
</tbody>
</table>

SCALE:
0 2 4 6
MILES
INDUSTRIAL MARKETS IN EASTERN NORTH CAROLINA

THERMAL REQUIREMENTS BELOW 250°F (BTU/YR)

ESTIMATED ACTUAL USAGE

- 0.5-1.0 x 10^11
- 1.0 x 10^10
- 1.0 x 10^9
- < 10^9

MILES
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Company</th>
<th>City</th>
<th>Sic/Product</th>
<th>Employees</th>
<th>Process heat requirements</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>☮</td>
<td>Campbell Soup Co.</td>
<td>Salisbury</td>
<td>2037 Frozen Foods</td>
<td>706</td>
<td>160°F water for various processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Preheat boiler feed water</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>Chesapeake Foods Inc.</td>
<td>Wango</td>
<td>2016 Poultry Processing</td>
<td>700</td>
<td>128°F scalding water</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>180°F cleanup water</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>99.5°F egg hatching</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>200°F cleanup water</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>English Company</td>
<td>Salisbury</td>
<td>2051 Bakery 2099 Food Service</td>
<td>280</td>
<td>Cleanup water</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>Green Giant Company</td>
<td>Fruitland</td>
<td>2033 Canned Foods</td>
<td>355</td>
<td>Preheat boiler feed water</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>190°F topping water</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170°F blanching peas and beans</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cleanup</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Space heating</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>H. B. Kennerly &amp; Son Inc.</td>
<td>Nanticoke</td>
<td>2092 Frozen Seafood</td>
<td>39</td>
<td>146°F water for gaping oysters</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Preheat boiler feed water</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>Nanticoke Seafood Co., Inc.</td>
<td>Nanticoke</td>
<td>2092 Frozen Seafood</td>
<td>48</td>
<td>Year round operation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Potential heat recovery from Soybean Plant could supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>most of requirements on Zion Road</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>Pepsi-Cola Bottling &amp; Canning Co.</td>
<td>Salisbury</td>
<td>2086 Soft Drinks</td>
<td>95</td>
<td>165°F bottle washer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>70°F bottle warmer</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>Perdue, Inc.</td>
<td>Salisbury</td>
<td>2075, 2082 Soybeans &amp; grain</td>
<td>2200</td>
<td>Grain drying</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Preheat boiler feed water</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hatchery heating</td>
<td></td>
</tr>
<tr>
<td>☮</td>
<td>Fanticoke Seafood Co., Inc.</td>
<td>Salisbury</td>
<td></td>
<td></td>
<td>128°F scalding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>160-180°F cleanup water</td>
<td></td>
</tr>
</tbody>
</table>
### DISTRIBUTION OF COMPANIES IN THE FOUR SIZE CATEGORIES

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOUTHEASTERN</td>
<td>5</td>
<td>12</td>
<td>15</td>
<td>17</td>
<td>49</td>
</tr>
<tr>
<td>NEW JERSEY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DELMARVA</td>
<td>13</td>
<td>39</td>
<td>47</td>
<td>48</td>
<td>147</td>
</tr>
<tr>
<td>PENINSULA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NORFOLK, VA</td>
<td>4</td>
<td>11</td>
<td>22</td>
<td>18</td>
<td>55</td>
</tr>
<tr>
<td>EASTERN NORTH</td>
<td>9</td>
<td>9</td>
<td>16</td>
<td>32</td>
<td>66</td>
</tr>
<tr>
<td>CAROLINA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>31</td>
<td>71</td>
<td>100</td>
<td>115</td>
<td>317</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size Category</th>
<th>ANNUAL ENERGY CONSUMPTION AT TEMPERATURES LESS THAN 250°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GREATER THAN $5 \times 10^{10}$ Btu/year</td>
</tr>
<tr>
<td>2</td>
<td>$1.0 \times 10^{10}$ to $5.0 \times 10^{10}$ Btu/year</td>
</tr>
<tr>
<td>3</td>
<td>$1.0 \times 10^{9}$ to $1.0 \times 10^{10}$ Btu/year</td>
</tr>
<tr>
<td>4</td>
<td>LESS THAN $1.0 \times 10^{9}$ Btu/year</td>
</tr>
</tbody>
</table>
### PROCESS HEAT DEMAND (1 x 10^{11} \text{ Btu/yr}) BY SIZE CATEGORY

<table>
<thead>
<tr>
<th>SIZE CATEGORY</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOUTHEASTERN NEW JERSEY</td>
<td>5.94</td>
<td>2.76</td>
<td>0.52</td>
<td>0.05</td>
<td>9.27</td>
</tr>
<tr>
<td>DELMARVA</td>
<td>12.72</td>
<td>9.05</td>
<td>1.75</td>
<td>0.06</td>
<td>23.58*</td>
</tr>
<tr>
<td>NORFOLK AREA OF VIRGINIA</td>
<td>5.98</td>
<td>2.38</td>
<td>1.04</td>
<td>0.05</td>
<td>9.45</td>
</tr>
<tr>
<td>EASTERN NORTH CAROLINA</td>
<td>11.35</td>
<td>1.80</td>
<td>0.62</td>
<td>0.07</td>
<td>13.84</td>
</tr>
<tr>
<td>TOTAL</td>
<td>35.99</td>
<td>15.99</td>
<td>3.93</td>
<td>0.23</td>
<td>56.14</td>
</tr>
</tbody>
</table>

*INCLUDES 5.23 x 10^{11} \text{ Btu/yr CONSUMED IN GRAIN AND FEED MILLS AND HATCHERIES}

\[
\frac{16}{5} = 3.2 \times 10 \times 56.14 = 98.2\%
\]
## DELMARVA'S ENERGY DEMAND BY PROCESS TEMPERATURES

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>100-150°F*</th>
<th>151-200°F</th>
<th>201-250°F</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Demand</td>
<td>6.3</td>
<td>14.9</td>
<td>2.4</td>
<td>23.6</td>
</tr>
<tr>
<td>% of Total</td>
<td>27%</td>
<td>63%</td>
<td>10%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*INCLUDES HATCHERY REQUIREMENTS AT 99.5°F
<table>
<thead>
<tr>
<th>Region</th>
<th>Residential and Commercial</th>
<th>Military</th>
<th>Agriculture</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.E. New Jersey</td>
<td>307.5</td>
<td>25.0</td>
<td>6.0</td>
<td>9.3</td>
</tr>
<tr>
<td>Delmarva Peninsula</td>
<td>135.2</td>
<td>8.2</td>
<td>17.8*</td>
<td>18.4*</td>
</tr>
<tr>
<td>Norfolk Area</td>
<td>207.9</td>
<td>96.5</td>
<td>1.0</td>
<td>9.5</td>
</tr>
<tr>
<td>E. North Carolina</td>
<td>83.8</td>
<td>15.1</td>
<td>10.8</td>
<td>13.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>734.4</strong></td>
<td><strong>141.8</strong></td>
<td><strong>35.6</strong></td>
<td><strong>51.0</strong></td>
</tr>
</tbody>
</table>

*If grain and feed mills and poultry hatcheries are included in the industrial sector, the totals become 12.6 and 23.6, respectively.*
### Total Current Demands Below 250°F (1 x 10^6 BBL)

<table>
<thead>
<tr>
<th></th>
<th>Residential and Commercial</th>
<th>Military</th>
<th>Agriculture</th>
<th>Industrial</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.E. New Jersey</td>
<td>5.49</td>
<td>0.45</td>
<td>0.11</td>
<td>0.17</td>
<td>6.22</td>
</tr>
<tr>
<td>Delmarva Peninsula</td>
<td>2.41</td>
<td>0.15</td>
<td>0.32*</td>
<td>0.32*</td>
<td>3.20</td>
</tr>
<tr>
<td>Norfolk Area</td>
<td>3.71</td>
<td>1.72</td>
<td>0.02</td>
<td>0.17</td>
<td>5.62</td>
</tr>
<tr>
<td>E. North Carolina</td>
<td>1.51</td>
<td>0.27</td>
<td>0.19</td>
<td>0.27</td>
<td>2.21</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.11</strong></td>
<td><strong>2.59</strong></td>
<td><strong>0.64</strong></td>
<td><strong>0.19</strong></td>
<td><strong>17.25</strong>†</td>
</tr>
</tbody>
</table>

*If grain and feed mills and poultry hatcheries are included in the industrial sector, the totals become 0.22 and 0.42, respectively.

†Equivalent to about 47,260 barrels of oil per day.
THE DELMARVA PENINSULA IS THE MOST ATTRACTIVE AREA FROM A MARKET POINT-OF-VIEW

INITIAL EFFORTS AT COMMERCIALIZATION SHOULD BE DIRECTED PRIMARILY AT THE INDUSTRIAL SECTOR

AN AGGRESSIVE RESOURCE EXPLORATION PROGRAM WHERE WELLS ARE TURNED OVER TO USERS

INTERAGENCY COOPERATION FOR IMMEDIATE EXPLORATION OF RESOURCE QUALITY AT LARGE GOVERNMENT AND MILITARY FACILITIES

DOE PROGRAM FOR EDUCATING PUBLIC SECTOR ON BENEFITS OF DISTRICT HEATING AND FOR PUTTING SUCH SYSTEMS IN PLACE
SUMMARY

- Survey is done in the four northern resource areas
- Economic modelling available
- Results reported in a series of reports
  Six published or in process
  Three more planned soon
- Efforts to be continued into other resource areas
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN U.S.

TASK VI HYDROTHERMAL APPLICATIONS

UTILITY OF CRISFIELD RESOURCE
EASTERN GEOTHERMAL DRILLING PROGRAM
USER COUPLED RESOURCE CONFIRMATION PROGRAM
1980 PRDA – INDUSTRIAL USE
FORGIVABLE LOAN – QUESTIONS TO FRENCH
— PLAN FOR EASTERN STATES

SIGNIFICANT DOCUMENTS AND RESULTS

1. DELMARVA SURVEY PRIOR TO EASTERN GEOTHERMAL DRILLING
   PROGRAM ANNOUNCEMENT
2. DISTRIBUTION LISTS
   EASTERN GEOTHERMAL DRILLING PROGRAM
   USER COUPLED RESOURCE CONFIRMATION PROGRAM
   1980 PRDA
3. FORGIVABLE LOAN GUARANTEE PROGRAM
   PLAN FOR EASTERN SEDIMENTARY BASINS
   ANSWERS FROM FRANCE
TASK VII – OUTREACH AND TECHNICAL ASSISTANCE

UPON USER REQUEST

DISSEMINATE EXISTING/AVAILABLE INFORMATION
PERFORM CONCEPTUAL SYSTEM DESIGN
ESTIMATE TECHNICAL FEASIBILITY
  ECONOMIC FEASIBILITY
  SYSTEM COST
  INTERFACE BETWEEN USERS, DOE AND OTHERS
FINANCIAL ASSISTANCE AND INSURANCE PROGRAMS
  GEOTHERMAL LOAN GUARANTEE
  FARMERS HOME LOAN
  NATIONAL ENERGY ACT
OTHERS
<table>
<thead>
<tr>
<th>COMPLETED STUDIES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPACE HEATING</strong></td>
<td></td>
</tr>
<tr>
<td>CRISFIELD HIGH SCHOOL</td>
<td>DEEP WELLS</td>
</tr>
<tr>
<td>PITTSVILLE MIDDLE SCHOOL</td>
<td>DEEP WELLS</td>
</tr>
<tr>
<td>HOT SPRINGS (ARK)-BATH HOUSE</td>
<td>NATURAL ARTESIAN FLOW – POTABLE WATER</td>
</tr>
<tr>
<td>NEW HOPE (PA)</td>
<td>GROUND COUPLED HEAT PUMP</td>
</tr>
<tr>
<td>BELLOWS FALLS (VT)</td>
<td>COMMUNITY HEATING, AQUIFERS-STORAGE OF RIVER WATER</td>
</tr>
<tr>
<td>LEBANON SPRINGS (NY)</td>
<td>EXTRACTION BY HEAT PUMP</td>
</tr>
<tr>
<td><strong>INDUSTRIAL</strong></td>
<td></td>
</tr>
<tr>
<td>LNG VAPORIZATION</td>
<td>LARGE QUANTITY USE</td>
</tr>
<tr>
<td><strong>AGRICULTURE/MARICULTURE</strong></td>
<td></td>
</tr>
<tr>
<td>OYSTER-CLAM FARMING</td>
<td></td>
</tr>
<tr>
<td><strong>MULTI-USE</strong></td>
<td></td>
</tr>
<tr>
<td>LEWES (DE)</td>
<td>SPACE HEATING</td>
</tr>
<tr>
<td></td>
<td>INDUSTRIAL PROCESSING</td>
</tr>
<tr>
<td></td>
<td>CHEMICAL RECOVERY</td>
</tr>
<tr>
<td></td>
<td>MANICULTURE R&amp;D</td>
</tr>
</tbody>
</table>
A = Geothermal well
B = Reinjection well
C = Hospital/nursing home
D = High school
E = Elementary school
F = Intermediate school
() = Accumulate miles

Plumbing to heat three schools and a hospital with airport wells,
DEEP GEOTHERMAL TEST WELL — CRISFIELD

LOCATION

CRISFIELD MUNICIPAL AIRPORT
3+ MILES FROM HIGH SCHOOL

RESULTS

AQUICLUDE BETWEEN 2500 AND 2700 ft
THREE POTENTIAL PRODUCTION ZONES — UNCONSOLIDATED SAND

<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Net Depth</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>3798 – 3846 ft</td>
<td>44 ft</td>
<td>128°F</td>
</tr>
<tr>
<td>3986 – 4032 ft</td>
<td>86 ft</td>
<td>133°F</td>
</tr>
<tr>
<td>4148 – 4223 ft</td>
<td>62 ft</td>
<td>135°F</td>
</tr>
</tbody>
</table>

TRANSMISSIBILITY — MID-ZONE — 348 gpd/ft
PERMEABILITY — 110 MILLIDARCIES
WATER CHEMISTRY
SIMILAR TO SEA WATER — TWICE AS SALTY

STATUS

WELL ABANDONED

CONCLUSIONS

SAND CONTROL REQUIRES WATER WELL COMPLETION, i.e.,
GRAVEL PACK — SCREEN
WELL DRAWDOWN MUST BE MINIMIZED —
INTERMITTENT USE
MODERATE WITHDRAWAL RATES — USE WITH PEAKING SYSTEM
REINJECTION REQUIRED
TEMPERATURES ADEQUATE FOR SPACE HEAT
NEW WELLS RECOMMENDED NEAR USER
COST EFFECTIVE FOR BASELOAD SPACE HEAT MODERATE SIZE BUILDING
ANNUAL TEMPERATURE VERSUS DURATION, TYPICAL OF SALISBURY, MARYLAND

Ambient Temperature (°F)

Time at Temperature (Hours)

Degree Days – 3939
CRISFIELD, MARYLAND
GEOTHERMAL WELL DRAWDOWN VERSUS
TIME – SPACE HEATING HIGH SCHOOL

FLOW RATE MAX – 100 GPM
DESIGN HEATING DAYS – 4000
MAXIMUM HEATING RATE – $3.6 \times 10^6$ Btu/Hr
ANNUAL HEATING REQUIREMENT $5 \times 10^9$ Btu
   BASED ON 57,600 GALLONS OF OIL @ 70% EFFICIENT FURNACE
BASE ANNUAL HEATING – GEOTHERMAL SYSTEM – 97.5% ANNUAL TOTAL
AMBIENT TEMPERATURE – BEGIN PEAKING 30°F
PEAKING SYSTEM ANNUAL HEATING:
   2.5% ANNUAL TOTAL OR
   1400 GALLONS OF No. 2 OIL
FUEL OIL DISPLACED – 56,200 GALLONS
PUMPS TO WITHDRAW GEOTHERMAL WATER

- DOWN-HOLE PUMP & MOTOR
- TRANSFORMER
- SERIES OF PUMPS
- WATER LEVEL
- SUPPORT BEARINGS
- ONLY PUMP DOWN-HOLE
- MOTOR
- VARIABLE SPEED DRIVE
- MOTOR
1. **CAPITAL COSTS**

   - ADDITIONAL RADIATORS: $110K
   - NEW WELLS - WITH SCREEN AND GRAVEL PACK: $250K
     - PRODUCTION (4200 ft): ($125K)
     - REINJECTION (3000 ft): ($100K)
     - (WITH SMALL DIAMETER EXTENSION TO 4200 ft)
   - TESTING AND LOGGING: ($ 25K)
   - PUMPING WELLS TO SCHOOL (1 MILE): $200K
   - HEAT EXCHANGER, PUMPS, WELLHOUSE, ETC.: $100K
   - ARCHITECTS AND ENGINEERING: $ 70K

   **SUBTOTAL**
   - $730K

   - PRODUCTION WELL PUMP, MOTOR, VARIABLE SPEED DRIVE: $ 22K

   **TOTAL CAPITAL COSTS**
   - $752K

2. **ANNUAL OPERATING COSTS**

   - ELECTRICAL PUMPING ENERGY: $ 3.5K
   - ANNUAL INSPECTION OF PUMPS: $ 2.5K

   **TOTAL**
   - $ 6.0K

3. **PEAKING SYSTEM OIL — 1400 GALLONS/YEAR**

4. **FUEL OIL DISPLACED — 56,200 GALLONS/YEAR**

   - 1979–1980 SAVINGS @ 75 ¢/GALLON = $42K

5. **FIRST YEAR SAVINGS TO AMORTIZE CONVERSION** — $36K
CAPITAL - $752K @ 7%
ANNUAL MAINTENANCE &
OPER. $6K (1979 $)
FUEL USED - 1418 GALLONS
FUEL SAVED 56,203 GALLONS
ANNUAL PAYMENT FROM OIL
SAVED 1979 @ 75 CENTS/GAL
= $42K
### TASK VII — OUTREACH AND TECHNICAL ASSISTANCE

**STUDIES IN PROGRESS**

<table>
<thead>
<tr>
<th>Location</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORFOLK (VA) – NAVAL AIR REWORK FACILITY</td>
<td>SPACE HEATING</td>
</tr>
<tr>
<td>WALLOPS ISLAND FLIGHT TEST CTR (VA)</td>
<td>SPACE HEATING</td>
</tr>
<tr>
<td>AUBURN (NY)</td>
<td>SPACE HEATING</td>
</tr>
<tr>
<td>MONTEZUMA (NY)</td>
<td>WET CORN MILLING</td>
</tr>
<tr>
<td>ALCOHOL DISTILLATION (AL)</td>
<td>GASOHOL</td>
</tr>
</tbody>
</table>
SIGNIFICANT DOCUMENTS AND RESULTS

TASK VII OUTREACH AND TECHNICAL ASSISTANCE

PRELIMINARY MEETINGS – HELP TO CONTINUE

ALCOHOL DISTILLATION – AL
PAMLICO REFINERIES – NC
NASA – WALKOPS FLIGHT TEST CENTER
KINGS BAY – GA
TOWN OF AUBURN – NY
CLINTON CORN PRODUCTS MONTEZUMA – NY
ASSISTANCE REQUESTED
FORTY FORT (PA) — PUBLIC BLDGS
SPACE HEATING
FLOODED MINES + HEAT PUMP

OCEAN CITY (MD) — SENIOR CITIZENS CTR
SPACE HEATING

SALISBURY (MD)
INDUSTRIAL PARK
MALL
PUBLIC BLDGS
SPACE HEATING

HARLAN (KY)
SPACE HEATING / HEAT PUMPS

STATE OF INDIANA
ESTIMATE GEOTHERMAL POTENTIAL

GAINESVILLE (FL)
GEOTHERMAL POTENTIAL

NORTH CAROLINA
GEOTHERMAL + WOOD
WET CORN MILLING

PAMLICO REFINERIES

KINGS BAY (GA)
TRIDENT BASE
SPACE HEATING

WORCESTER CO (MD)
NEW JAIL
SPACE HEATING
TWO MIDDLE SCHOOLS
SPACE HEATING

DOVER AIR FORCE BASE (DE)
SPACE HEATING + AIRPLANE WASH
SIGNIFICANT DOCUMENTS AND RESULTS

TASK VII – OUTREACH AND TECHNICAL ASSISTANCE

PRESENTATIONS
GA POWER
DELMARVA POULTRY ASSN.
DELAWARE PE ASSN
TEXTILE INSTITUTE – CLEMSON UNIV
UNIV. OF MD – HORN POINT
VA ENERGY OFFICE AND OTHERS
MD OFFICE OF SCHOOL CONSTRUCTION
DE ENERGY OFFICE AND OTHERS
DE STATE HOSPITAL AND HEALTH CARE – MEETING – ENERGY AUDIT
NATIONAL GEOGRAPHIC

MAILINGS OF DATA ON EAST WITH REFERENCE TO VPI&SU AND GRUY
PROGRAMS – TOO NUMEROUS TO LIST

TECHNICAL ASSISTANCE

LETTERS OR VISITS RECOMMENDING ACTION
NEW HOPE (PA)
BELLOWS FALLS (VT)
LEBANON SPRINGS (NY)
LEWES (DE)
KINGS BAY (GA)

REPORTS AND PAPERS
CRISFIELD HIGH SCHOOL*
PITTSVILLE MIDDLE SCHOOL
HOT SPRINGS, AR – SPACE HEATING
COLUMBIA LNG CORP*
CEDA CORP – MARICULTURE*
NARF – NORFOLK

*GRC PAPER – 1980 ANNUAL MEETING
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN U.S.

TASK VIII PROGRAM SUPPORT

TECHNICAL INFORMATION INTERCHANGE MEETING
OCTOBER 1979 – BERKELEY SPRINGS, W. VA.
MEMBER OF ASTM COMMITTEE
PUBLISH EASTERN DATA GRC
FOUR PAPERS IN 1980 ANNUAL MEETING
GASOHOL WORKSHOP PARTICIPATION AND INFORMATION DISSEMINATION
NEA CONSERVATION GRANTS
UDAG* PROGRAM – INFORMATION DISSEMINATION

SIGNIFICANT DOCUMENTS

MINUTES OF TECHNICAL INFORMATION INTERCHANGE MEETING
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*URBAN DEVELOPMENT ACTION GRANT