

**Public Interest Energy Research (PIER) Program
FINAL PROJECT REPORT**

**STRUCTURING A DIRECT
GEOHERMAL HEATING DISTRICT
FOR THE TOWN OF MAMMOTH
LAKES FINAL REPORT 2009**

Prepared for: California Energy Commission
Prepared by: The Town of Mammoth Lakes with the assistance of
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Preface

The California Energy Commission's Geothermal Resources Development Account Geothermal Planning Projects support local and regional planning and policy development and implementation necessary for compliance with programs required by local, state, or federal laws and regulations, including preparation or revision of geothermal resource elements, or geothermal components of energy elements, for inclusion in the local general plan, zoning and other ordinances, and related planning and environmental documents.

Structuring a Direct Geothermal Heating District for the Town of Mammoth Lakes is the final report for the Town of Mammoth Lakes project grant number GEO-05-005 conducted by the Town of Mammoth Lakes with assistance by the High Sierra Energy Foundation. The information from this project contributes to GRDA's Feasibility/Marketing Studies.

For more information about the Geothermal Resources Development Account Geothermal Planning Projects, please visit the Energy Commission's website at <http://www.energy.ca.gov/geothermal/index.html> or contact the Energy Commission at 916-327-1551.

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Abstract

This planning study developed an organizational and financial structure for a geothermal heating district in the town of Mammoth Lakes that was both cost effective for investors and lenders and evaluated a financing source for property owners to make the transition to geothermal district heating. Project activities included the assessment of various organizational and financial structures, legal implications of those structures, financing sources and cost effectiveness, and the marketing research needed to gain acceptance and participation in the heating district by new and existing property owners.

This project determined that the most successful legal and business structure for a geothermal heating district is a separate utility department established by the town of Mammoth Lakes, a California municipal corporation. Such utility department would administer all aspects of the heating district system, through contracts or a formal joint venture, and would evaluate and provide options, as required, for sources of transition funding to new and existing property owners. Decisions regarding long term financing for the geothermal district heating system would be determined by the town of Mammoth Lakes and may include public and private sources. The town of Mammoth Lakes and/or a public entity, in a joint venture, may contract with a private contractor to conduct the geophysical analysis and geothermal production well development.

Keywords: Mammoth Lakes, geothermal, heating district, organizational and financial structure, cost effectiveness, marketing research, transition funding, utility department

Executive Summary

The town of Mammoth Lakes is located in Mono County in the eastern Sierra Mountains of California at an elevation of 8,000 feet, has a development footprint of 4.4 square miles, and is surrounded by public lands. It is a four-season tourist destination with skiing in the winter at the Mammoth Mountain Ski Area and fishing, hiking, and biking in the other three seasons. The year round population is around 8,000, and the major local businesses, other than Mammoth Mountain Ski Area, are lodging, retail, and restaurants. The population of the town of Mammoth Lakes swells to over 35,000 on many weekends. Unlike most of the state, energy use peaks in the winter with heating load.

Principal energy sources are propane and electricity. This planning study focused on how to convert a significant portion of this heating load to renewable geothermal energy.

Since the 1970s, geothermal district heating has been considered for the Town of Mammoth Lakes. Various studies have all demonstrated that substantial geothermal fluids exist beneath the town of Mammoth Lakes, and that a district heating project may be economically feasible and could bring significant benefits to customers and to the Town of Mammoth Lakes community.

These studies, however, fail to address the complexity of the business of delivering geothermal district heating not only in the town of Mammoth Lakes, but in any other location in California with geothermal potential. Specifically, the town of Mammoth Lakes, with the assistance of the High Sierra Energy Foundation (collectively, the “team”), identified four barriers to implementation that must be removed in order for district heating to proceed:

- Organization and management.
- Capital and operational financing.
- Market perceptions.
- Financing the transition to a geothermal heating district.

None of these barriers have been previously addressed in the Town of Mammoth Lakes because a geothermal heating district has always been considered only as a vague concept, without specifics as to marketing, operations, financing and implementation.

Purpose and Goals

This project was to provide the foundation to create an organizational, financial, and marketing entity that can deliver geothermal district heating to the town of Mammoth Lakes. Achieving this goal will result in the formation of a geothermal heating district in Mammoth Lakes and the opportunity to replace heat produced by propane and

electricity by significant amounts, measured in million of British Thermal Units (BTUs), depending on the level of market penetration.

As heating load is slightly more than 50 percent of total energy consumption, the replacement of BTUs produced by propane and electricity will move the town of Mammoth Lakes toward being independent of traditional energy sources. However, there will be a cost of the geothermal heat, and one of the principal tasks in this study was to determine customer sensitivity to various geothermal pricing proposals.

This project focused on the organization, management, financial, and marketing structure necessary to implement geothermal district heating in Mammoth Lakes. This project:

- Defined the organizational and management structure for a geothermal heating district.
- Assessed the financing issues related to the construction and working capital necessary for district heating.
- Conducted qualitative and quantitative market research to better understand the needs and wants of potential district heating customers.
- Determined district heating customers' need for funds to pay for the transition to district heating.

A geothermal heating district in Mammoth Lakes will replace existing fossil sources of energy by using the geothermal resources beneath Mammoth Lakes. This use of geothermal resources will reduce the overall demand for electric energy and propane in the Town of Mammoth Lakes and California. The project will not generate electricity, but will free up capacity to be used elsewhere in the state.

This project provides a roadmap for the business of implementing a geothermal heating district in the Town of Mammoth Lakes that will overcome historical barriers to success. The project also provides a showcase for other cities and towns in California, the nation, and internationally.

Significant External Changes

The final section of the Executive Summary outlines the conclusions and recommendations of this project. There have been, however, several significant external changes that require explanation, as they impact the conclusions and recommendations.

In the analysis conducted in 2007, Mammoth Community Water District, Iceland America Energy, Inc., and Mammoth Pacific, L.P., were all ranked highly as potential operators of the geothermal heating district. Mammoth Pacific, L.P., which is owned by ORMAT, a publicly traded company, declined to participate in the project because its sole goal is the generation of electricity, all of which is sold into the Southern California Edison Company electrical grid. The Mammoth Pacific, L.P., plant and its owners have no interest or expertise in designing and implementing a geothermal heating district,

although they have indicated a willingness to consider the sale to the heating district of a portion of the heat from its geothermal sources before reinjection. The potential sale of such heat to the heating district is still under consideration.

As discussions with Iceland America Energy, Inc., and Mammoth Community Water District progressed, the town of Mammoth Lakes became very interested in being part of the heating district and, in fact, entered into a memorandum of understanding with Iceland America Energy, Inc., for the development of a geothermal heating district. Given this new interest by the town of Mammoth Lakes, the team then proposed the idea of a Joint Powers Authority between the Town of Mammoth Lakes and Mammoth Community Water District, as both entities had the requisite powers. Such joint powers authority would manage the heating district and contract with an experienced geothermal contractor to design, implement and operate the heating district. The joint powers authority concept, however, was abandoned when the Mammoth Community Water District declined to participate in the project until concerns about potable water were better understood and addressed. The main focus of the Mammoth Community Water District is the protection and maintenance of the potable water supply within Mammoth Lakes.

When Mammoth Community Water District declined to participate in a joint powers authority, the town of Mammoth Lakes, having invested in both (Heat Sink and Fans) HSF and this study, decided to form a Town of Mammoth Lakes utility department with the anticipation that the Mammoth Community Water District would eventually revisit the possibility of forming a joint powers authority.

Another significant change was the impact of the global financial crisis on Iceland America Energy, Inc. In 2007 and through the first half of 2008, the team worked closely with Iceland America Energy, Inc., with the understanding that Iceland America Energy, Inc. would serve as a full-service contractor to the heating district operator and would provide expertise in engineering, design, operations, and financing. Iceland America Energy, Inc., was 80 percent owned by Icelandic financial companies that suffered tremendous losses in the global financial meltdown in the fall of 2008. As a result, Iceland America Energy, Inc.'s, participation in the geothermal heating district became problematic. However, in the first quarter of 2009, Iceland America Energy, Inc., was reorganized and is now 80 percent owned by Reykjavik Energy Invest, a subsidiary of the municipal utility Reykjavik Energy. Given these changes, Iceland America Energy, Inc., still intends to participate in the geothermal heating district but will likely have a more limited role. Consequently, the team will also be seeking qualifications from other full-service geothermal contractors.

In reading the remainder of this report, the team cautions the reader to be aware of these significant external changes when reviewing and evaluating the analyses conducted in 2007 set forth in this report.

Conclusions and Recommendations

The team conducted qualitative and quantitative market research among the residents and businesses of Mammoth Lakes to better understand the needs and wants of potential district heating customers. This research indicated that potential customers, while enthused about the environmental benefits of geothermal heating, still expected that geothermal heating would lower their heating costs. In fact, when costs were lower, about 70 percent of residents and businesses wanted to participate; but, when costs were higher, participation declined to 20 percent. This finding argued for two ongoing tactics. First, outreach strategies should emphasize the environmental benefits of geothermal heating and the indirect benefits to the image of Mammoth Lakes. Second, the pricing emphasis should be on reducing monthly costs and not subsidizing initial set-up or transition costs.

The team also conducted an in-depth analysis of potential heating district operators, with the leading entities being the Mammoth Community Water District, Iceland America Energy, Inc., and Mammoth Pacific, L.P. Initially, a joint powers authority between the town of Mammoth Lakes and Mammoth Community Water District was considered to be the preferred arrangement. However, for the reasons explained above, the concept of a joint powers authority with Mammoth Community Water District as well as the idea of cooperation with Mammoth Pacific, L.P., were abandoned. Consequently, town of Mammoth Lakes management decided to provide leadership in moving the project forward by advocating for the formation of a town of Mammoth Lakes utility department.

As a result of the above analysis, the initial lack of participation by Mammoth Community Water District and Mammoth Pacific, L.P., and the renewed interest of the Town of Mammoth Lakes in implementing a geothermal heating district, certain changes to the original list of tasks and deliverables were recommended for this project. The original task list provided for additional financial and legal analysis and assistance in creating a straw man entity (A front ; a third party who is put up in name only to take part in a transaction. Nominal party to a transaction) to manage the heating district. It was determined that creation of a straw man entity was no longer a useful task, and that the funds allocated to such task should instead be spent on (1) supplemental market research to gauge changed attitudes among town residents and businesses regarding a potential heating district and (2) the work necessary to begin the process of forming a town of Mammoth Lakes utility department, which was ultimately the entity proposed to manage the geothermal heating district.

The town of Mammoth Lakes management will look to High Sierra Energy Foundation for project leadership. Additionally, the town of Mammoth Lakes considers High Sierra Energy Foundation to be its energy champion and provides annual funding to High Sierra Energy Foundation to assist in these efforts.

Title 13.4 of the Town of Mammoth Lakes Municipal Code already identifies a geothermal utility, but provides no details. Implementation of this project will include

the drafting of new town ordinances to include in Title 13.24 of the town of Mammoth Lakes Municipal Code to create the actual utility and establish its rules and regulations. The town of Mammoth Lakes believes that concerns articulated by the Mammoth Community Water District about the unknown effects of a geothermal heating district on potable water supplies will be adequately addressed by required California Environmental Quality Act or National Environmental Policy Act compliance requirements.

The town of Mammoth Lakes is exploring contracting with a full service geothermal contractor to design, implement, and operate the geothermal heating district. To that end, the town of Mammoth Lakes and the selected contractor will negotiate and adopt a business plan and a contractual agreement for the operation and maintenance of the heating district, subject to the following conditions:

- The town of Mammoth Lakes, most likely through contracting with Mammoth Community Water District (if it eventually elects to participate in some manner in the heating district) or another entity, would be responsible for customer service and billing operations.
- Project and long-term financing would be defined in the agreement, including any equity contributed by the contractor, and anticipated returns would be clearly defined and transparent to future geothermal heating district ratepayers.
- The town of Mammoth Lakes or the Mammoth Community Water District (if it eventually elects to participate in some manner in the heating district) would be the lead agency for any required California Environmental Quality Act or National Environmental Policy Act compliance requirements.

CHAPTER 1: Introduction

The Town of Mammoth Lakes

The Town of Mammoth Lakes (TML) is located in Mono County in the eastern Sierra Mountains of California at an elevation of 8,000 feet, has an area of 4.4 square miles, and is surrounded by public lands. It is a four-season tourist destination with skiing in the winter at the Mammoth Mountain Ski Area (“MMSA”) and fishing, hiking, and biking in the other three seasons. The full time population is around 8,000 and the major local businesses, other than MMSA, are lodging, retail, and restaurants. The population of the TML swells to over 35,000 on many weekends. Unlike most of the state, energy use peaks in the winter with heating load.

The TML relies on propane and electricity for winter heat. The TML energy use breaks down as follows:

Table 1-1: Energy Use in Mammoth Lakes

Source Energy	2008 (12 months ending February) MBTUs	Estimated Heating Load MBTUs	Approximate Value of Heating Load (\$ Millions)
Propane	506,500	379,900	\$ 7.5
Electricity	444.800	110,200	\$ 4.5
TOTAL	951,300	490,100	\$ 12.0

Source: Electricity use derived from actual data provided by Southern California Edison Company; Propane use derived from TML sales tax collections; excludes MMSA.

Source: Analysis by HSF

Propane and electricity are largely dependent on fossil fuels and tend to be very expensive for businesses and residents of the TML. Numerous studies have demonstrated that there are adequate geothermal fluids available below the TML for a geothermal heating district, but no organizational structure has been created to deliver those resources.

A geothermal heating district in the TML will replace existing fossil sources of energy by utilizing the geothermal resources beneath the TML. This use of geothermal resources will have the effect of reducing the overall demand for electric energy in the TML and the State of California. The project will not generate electricity, but will free up capacity to be used elsewhere in the state.

Previous Geothermal Studies

Within the last 20 years, at least three studies have addressed geothermal heating in the TML and the likelihood of local geothermal sources. Additionally, ORMAT’s Mammoth Pacific, L.P. geothermal power plant is located two miles east of the TML and has about 40 megawatts of generating capacity. The electricity generated at the Mammoth Pacific, L.P. plant is sold under long-term contract to Southern California Edison Company.

The previous studies have all demonstrated that there is a potential for a geothermal heating district in the TML. Reference to these studies was made in the TML's initial application for the GRDA grant. The intent of including references to these studies was to show the availability of geothermal heating sources in the area of the TML rather than to complete a technical evaluation of each study. The following summarizes the purposes, methodologies, and conclusions of each study:

- *Geothermal District Heating Project, 1990* by Cascadia Exploration Corporation. The purpose of this study was to assess the availability of geothermal fluids in the TML and was funded by the Energy Commission. "Elevated mercury within soils has been found in Long Valley and elsewhere to be related to underlying geothermal activity. A soil mercury geochemical survey was conducted across all of Mammoth Lakes and outlying areas. Two hundred fifty-one soil samples were collected and analyzed for mercury. Statistical analyses and plotting of results revealed six areas of anomalous soil mercury concentration." Test wells were completed in the second phase of the study in the identified sites and there was evidence of geothermal fluids, although the actual flow rates of a production well could not be determined. The conclusions were to "perform a demonstration project," "establish a limited district heating system," "expand the district heating system," and "operate and maintain a district heating system." There were no specifics on how to accomplish these conclusions.
- *Conceptual Design of a Geothermal District Heating System in Mammoth Lakes, 2000* by Black & Veatch Corporation, funded by the Mammoth Community Water District ("MCWD"). "The scope of this study is to develop a conceptual energy transmission design and to perform a cost estimate to support the evaluation of this project." The study evaluated data from previous studies and conducted a survey of businesses that might convert to geothermal heating. A heating load of 234,000 MBTUs was identified. (Note: about 48 percent of current heating load.) System construction costs were estimated at about \$10 million and study assumptions indicated geothermal energy would be less costly than current propane and electric sources. Sentences in the concluding paragraphs are particularly important to the goals of this study: "...the most important factor may be the long term vision of the involved parties. Involved parties would include the local geothermal electric power producer, Mammoth Community Water District, engineers, contractors, end users, etc. All parties must determine what their vision is for this project, what resources they are willing or not willing to commit to the project, and what roles they are willing to accept for the next 20 years or so."
- *Geothermal District Heating in Mammoth Lakes: Feasibility Analysis, 2002* by FVB Energy Inc. This study was funded by and completed for the MCWD. Customer data provided by MCWD was reviewed and the study concluded that "geothermal district heating is potentially economically feasible," "significant capital costs must be invested," "combining construction of a geothermal district heating supply pipe to supply the Caso Diablo power plant with MCWD water for evaporative cooling is not feasible due to high capital costs," and a "smaller potentially feasible system has an estimated capital cost of \$6.7 million."

Financing alternatives were suggested, but there was no detailed implementation plan.

All of these studies concluded that sufficient geothermal resources existed to support a district heating project in the TML, but such studies all lacked guidance on the proper business structure for such a district heating project or how such a district heating project could be implemented. The conclusions from these studies trivialized the complexity of the business of delivering geothermal district heating not only in the TML, but also in any other location in California with geothermal potential. Consequently, no steps were taken by MCWD or any other entity to implement a district heating system as a result of these studies.

Barriers to Implementation

Four barriers to implementation need to be addressed in order for district heating to proceed:

- **Organization and Management.** Specifically, it will be necessary to:
 - Select an appropriate entity to manage the heating district, and determine the goals of such entity and the type of board (appointed or elected) to manage such entity.
 - Establish an ongoing management budget for such entity and determine how the costs of such budget will be recovered (for example, through rates).
 - Ascertain the role of the TML Town Council in organizing and managing the geothermal heating district.
 - Obtain rights of way for distribution lines, possibly through the exercise of eminent domain.
 - Confirm ownership of rights to geothermal resources and required royalties, if any.
 - Establish appropriate interface among the TML, MCWD and federal agencies such as the Bureau of Land Management (“BLM”) and the Forest Service, in operating the heating district.
- **Capital and Operational Financing.** Specifically, it will be necessary to:
 - Secure construction capital, possibly through the issuance of tax free bonds by a tax free entity, and establish the terms of and the security for any such bonds.
 - Determine if grant funds are available from the Energy Commission or the Department of Energy for initial construction and how and when to apply for such funds.
 - Investigate if a private entity would be interested in financing the project for a share of the operational revenue.
 - Locate source of working capital to be used during the ramp-up period to actual construction.

- Establish the utility rates and geothermal revenues necessary to support the required financing, and determine the length of time necessary to reach the required levels of revenues and customers to support the required financing.
- **Market Perceptions.** Specifically, it will be necessary to:
 - Resolve how to motivate businesses, residents and other property owners to participate in the geothermal heating district, and determine if market segments differ appreciably in their perceptions and desires for a geothermal heating district.
 - Decide if either short-term or long-term substantial discounts to electricity or propane heating will be required to bring customers into the geothermal heating district, and evaluate possibility of reducing discount pricing by emphasizing the environmental benefits of using a renewable resource.
 - Ascertain how concerned customers are about the transition costs associated with geothermal district heating, including the costs of hook-ups, metering, thermostats and interior piping, and what assistance customers expect with these transition costs.
- **Financing the Transition to a Geothermal Heating District.** Specifically, it will be necessary to:
 - Determine the range of transition costs for different types of customers.
 - Evaluate the possibility of creating a fund to advance transition costs to customers, and establish how such transition costs will be repaid and at what rate.
 - Determine the method of recovering such costs, for example as a line item on the utility bill or aggregating all transition costs and recovering such costs through rates.
 - Resolve how transition financing costs will be managed when property changes hands, for example by passing such costs on to the new owner or by settling such costs at closing.

None of these barriers have previously been addressed in the TML because a geothermal heating district has always been considered only as a vague concept, without specifics as to marketing, operations, financing and implementation. If these barriers can be addressed, a strong organization can be established to lead the development of district heating in the TML.

Goals and Actions

The goal of this project was to provide the foundation to create an organizational, financial, and marketing entity that can deliver geothermal district heating to the TML. Achieving this goal will result in the formation of a geothermal heating district in the TML and the opportunity to replace heat produced by propane and electricity by significant amounts, measured in millions of BTUs, depending on the level of market penetration.

Table 1-2: Potential for Geothermal Replacement of MBTUs

Energy Source	Percentage of Market Penetration		
	30%	50%	70%
Propane	113,954	189,924	265,894
Electricity	33,061	55,101	77,141
TOTAL	147,015	245,025	343,035
\$ Millions*	\$ 3.6	\$ 6.3	\$8.5

- Based on prices paid in 2008 for electricity and propane

Source: Analysis by HSF

This project develops the organization, management, financial, and marketing structure necessary to implement geothermal district heating in the TML. The major goals and actions and measurement criteria of this project are set forth in the table below.

Table 1-3: Goals, Actions and Measurement Criteria

Goals	Actions	Measurement
Define the organizational and management structure for a geothermal heating district.	Analyze the options, including the feasibility of using the TML, Mono County, MCWD, or a private sector partner as the operational entity.	A ranking of the options utilizing scoring that emphasizes governance, tax status, and management flexibility.
Assess the financing issues related to the construction and working capital necessary for district heating.	Determine the gross financing needs from previous feasibility studies and review the taxable and non-taxable sources of funding.	Presentation of analyses that illustrate the cost of financing at various levels of investment and time horizons.
Conduct qualitative and quantitative market research to better understand the needs and wants of potential district heating customers.	Conduct focus groups with different property owner segments and follow up with a larger universe telephone survey.	Detailed findings with statistical validity.
Determine district heating customers' need for funds to pay for the transition to district heating.	Complete <i>pro formas</i> for various options, including repayment through the bill and a fund that would be available to all and collected through rates.	Specific costs and benefits to customers from the availability of transition financing.

Source: Analysis by HSF

This project establishes the foundation for creating a geothermal heating district in the TML, which supports the Energy Commission's goal of better utilizing geothermal resources.

CHAPTER 2:

Market Research

Summary

The first challenge in structuring a direct geothermal heating district for the TML was to understand the market for geothermal heating in the TML. To assess the market for geothermal heating, the team conducted a market research plan, including (1) focus groups consisting of business and hospitality owners, residents and government officials, (2) a qualitative market review based on the results of the focus groups, (3) a telephone survey of 200 businesses and residents in the TML, (4) a quantitative market review based on the results of the telephone survey, and other activities, all as described below.

The results of the market research showed that, while the citizens and businesses of the TML were generally very receptive to the idea of a geothermal heating district, there were many questions about implementation and cost. These themes emerged in the qualitative focus groups conducted in October, 2006 and were further tested in 200 telephone surveys conducted in December, 2006. The conclusions of the telephone survey became the foundation for the following market assessment:

- The concept of geothermal heating is seen as environmentally friendly.
- However, consumers perceive geothermal heating as less convenient and harder to maintain.
- Despite the environmental benefits, customers still expect that geothermal heating will lower their costs. When costs are lower, about 70 percent want to participate, but when costs are higher participation declines to 20 percent.

This assessment argued for two ongoing tactics. First, outreach strategies should emphasize the environmental benefits of geothermal heating and the indirect benefits to the image of the TML. Second, the pricing emphasis should be on reducing monthly costs and not subsidizing initial set up costs.

This first phase of work made the argument for a geothermal heating district, but pointed to the ongoing operating costs as the key variable. Or, as one focus group participant stated "even environmentalists have to save money."

Qualitative Survey; Focus Group Findings

The purpose of the qualitative market review conducted in October, 2006 was to meet with a sampling of the TML residents and businesses to assess their awareness and interest in a geothermal heating district for the TML. The meetings were professionally facilitated and followed the focus group format. Contractor Bovitz Research Group ("Bovitz"), with lists provided by HSF, recruited participants.

On October 11 and 12, 2006, four focus groups were moderated with a total of about 30 participants, broken down as follows:

- Commercial Property Owners, including those that:
 - Had been in business in the TML for more than one year.
 - Were primarily responsible for or had input in making decisions regarding utility selection for their organization or business.
- Hospitality Businesses, including those that:
 - Had been in business in the TML for more than one year.
 - Were primarily responsible for or had input in making decisions regarding utility selection for their organization or business.
- Government Officials, including local and regional officials at various levels of government.
- Residents, including those who:
 - Had their primary residence in the TML.
 - Were between the ages of 25-65.
 - Currently used electricity or propane for a heating source.
 - Had lived in the TML for more than one year.
 - Were primarily responsible for or had input in making decisions regarding utility decisions for their home.

Each focus group session was about two hours long and the moderator (who had no geothermal expertise) guided the discussion and worked to bring out the opinions of all of the participants. The findings from the focus groups indicated that, overall, the people in the TML were supportive of the geothermal heating district concept, given the right financial, environmental, and social conditions. Residents agreed that in theory the concept itself was a good proposition. However, most residents wanted more specific information about the logistics of how the system would work and its benefits before they would actually endorse or adopt the concept of a geothermal heating district. It was determined that, to gain acceptance from the residents and businesses of the TML, a strategically targeted communication plan should be developed. The key areas to focus on included:

- Demonstrating to residents that geothermal energy is feasible in the TML.
- Providing upfront and clear information about the costs associated with the implementation, service and maintenance of the geothermal heating district both for residents and businesses in the TML.
- Providing detailed information on the requirements, processes and timelines for retrofitting existing homes and buildings.
- Designing visual models or examples of how the geothermal heating district will work. Models would include images of the wells and main structures as well as retrofitted homes, businesses and other areas where this system is currently in use (for example, Klamath Falls, Oregon, Boise, Idaho).
- Providing detailed information and credentials for the party responsible for designing and implementing the heating district.

A complete analysis of the focus group findings can be found in the Bovitz Geothermal Heating System Concept Evaluation – Qualitative Report. This qualitative information provided the foundation for developing a questionnaire for an in depth telephone survey of residents and businesses in the TML.

Survey Questionnaire

Based on the findings from the first focus groups, a survey questionnaire was prepared by Bovitz. Such survey questionnaire was a complex document with many branches, qualifying points, and excluded questions. In practice, the questionnaire was programmed into a computer and the telephone interviewer was guided through the process by computer-generated instructions. The structure of the telephone interview started with the interviewer reading the following geothermal heating district "concept:"

USING RENEWABLE GEOTHERMAL ENERGY TO HEAT HOMES AND BUSINESSES IN MAMMOTH LAKES

The local nonprofit High Sierra Energy Foundation and the Town of Mammoth Lakes are working together to explore a new heating source called geothermal energy to heat buildings and reduce the town's dependence on propane and electricity. Geothermal energy uses hot water that is pumped from the ground to heat buildings. It has already been proven from a geologic standpoint that this type of system would work in the Town of Mammoth Lakes.

Here is how it would work:

Hot water will be pumped out of the ground, then pumped through a system of pipelines throughout the town to heat buildings. Once the water has been used to heat buildings it will be returned back to the ground to ensure the continuation of the geothermal resource. In order to develop this system, two to four wells will be drilled in areas in or adjacent to the town. Two additional wells will be drilled to return the water back to the ground. When the wells are being drilled, there will be a lot of construction-like activity for about 10 months, but when the wells are in place they will be housed in a very small structure that will hardly be noticed.

The first buildings serviced by the pipeline system will be major public government and institutional buildings and then larger retail and residential areas, including supplying heat to melt snow on sidewalks on Old Mammoth Road and other areas. As the system grows, more and more areas of town will be covered.

Institutions, residents and businesses participating in the system would have to convert their existing heating systems to utilize geothermal energy. Generally speaking, buildings that use boilers will be relatively easy to convert while homes or businesses using 100% electricity will be very difficult.

As geothermal energy does not rely on oil, the only major cost is system maintenance and, as oil becomes scarcer and the price increases, geothermal heating will become a relatively low cost source for heating that is both environmentally friendly and sustainable. Therefore, while there may be some significant set up costs, over time the system will become more cost effective.

Following the reading of the concept, the interview respondents answered a series of questions on their view of this type of heating. Those responses were the basis of the quantitative results.

Quantitative Survey

Between November 28 and December 10, 2006, 200 persons were interviewed about the geothermal heating district concept using the survey questionnaire. The interviewees were broken down as follows:

- 54 Businesses, the owners of which:
 - Had to be over the age of 18.
 - Must have been in business in the TML for more than one year.
 - Were primarily responsible for or had input in making decisions regarding utility selection for their organization or business.
- 146 residents, who:
 - Were over the age of 18.
 - Were primarily responsible for or had input in making decisions regarding utility decisions for their home.
 - Had lived in the TML for more than one year.
 - Currently used electricity or propane for heating source.

Working with Bovitz, HSF identified the following information objectives for this survey:

- Gauging the appeal of a geothermal district heating system.
- Determining what people like about the idea.
- Identifying any barrier to sign up.
- Providing input to the pricing strategy.

The report from Bovitz was entitled “Geothermal Heating System Concept Evaluation – Quantitative Report”. The findings in such report allowed the team to focus the heating district to be most responsive to the needs of the end user/customers. Notable findings from the survey included:

- The geothermal heating system is highly appealing to the TML community and is seen as much more environmentally friendly.
- However, geothermal heating is perceived as less convenient and harder to maintain.
- Pricing was tested in relation to customers desire to sign up for geothermal heating and when prices were lower than current heating costs 70 percent of respondents expressed interest, but when the costs were higher than current costs, sign ups plummeted to about 20 percent.

These findings led to two recommendations that were very helpful in refining our customer approach on the geothermal system:

1. Communications strategy should focus on reinforcing perceptions of environmental advantages.

2. The waiving of geothermal set up and transition costs should be avoided as that strategy would tend to increase monthly operating costs.

The second recommendation differed from the original hypothesis that customers would want to minimize their initial upfront transition costs by rolling set up costs into monthly rates. The recommendation not to waive set up and transition costs was incorporated into the team's pricing model as they moved into that phase of this study.

Participants in the qualitative market research were very interested in seeing the results of the focus groups and other findings in the study. Consequently, HSF used the ongoing results of the market research survey to increase awareness and community visibility about geothermal through various press releases and articles.

Supplemental Market Research

As a follow up to the qualitative and quantitative market reviews of residents and businesses in the TML conducted in October, 2006, Bovitz convened two new focus groups in September, 2008 for the purpose of evaluating the revised geothermal heating district concept and gauging current public opinion of the project.

Each of these focus groups consisted of approximately 12-15 participants, all of whom were recruited by HSF. The participants were from a variety of occupations and agencies within the TML and all participants owned their homes and were primarily responsible for or had input in making decisions regarding utility decisions for their homes or businesses in the TML. Prior to the focus group sessions, Bovitz sent an email invitation to each participant explaining the purpose of the new focus group discussions, attaching an edited project summary based on information provided by potential geothermal contractor, Iceland America Energy, Inc. ("IAE"), and asking each participant to respond to three questions and to bring those responses to the focus group as a basis for discussion in the sessions. Each focus group session was about two hours long and the moderator guided the discussion and worked to bring out the opinions of all of the participants.

The results of this additional qualitative research are set forth in Bovitz's Geothermal Heating District Concept Evaluation Phase II Focus Groups report. The report identified several areas where participants were very enthusiastic, including:

- Promotion of the TML as a "clean and green" town moving toward energy independence and self-sustainability.
- Importance of utilizing an alternative and renewable energy source that will hopefully cut energy costs and provide construction and maintenance job opportunities to the area.
- Ability to rely on fixed heating costs.

The report also identified several key concerns that needed to be addressed in order to gain acceptance of the geothermal heating district by residents and businesses, including:

- Size of the project and timing and schedule of the construction and implementation of the project.
- Specific costs to convert or retrofit homes and businesses to geothermal heat and to provide geothermal as a source of heat for such homes and businesses.
- Pricing of the heat and how enrollment in the heating district will be effected (voluntary or involuntary).
- Aesthetics and reliability of the heating district.
- Potential contractor's experience in implementing and managing a geothermal heating district, given state and federal permitting and regulatory constraints.
- Information about who will operate and maintain the heating district.

Conclusions

Based on the findings from the second two focus groups, the team determined that a key next step in moving the geothermal heating district closer to reality would be the development by the TML and a geothermal heating district contractor of a detailed and complete business and implementation plan for the geothermal heating district that addressed, among other things, the concerns and issues cited above. It was very important to residents of the TML that the process of developing the geothermal heating district be completely transparent so that they felt that they had a participatory role in the process and that there was no hidden agenda. In that regard, the team also suggested that the TML, in cooperation with its heating district contractor, contemplate the development of a website specifically dedicated to news and information on timing, schedule, costs, location sites of wells and heat exchangers, and other details regarding the proposed geothermal heating district. These activities will commence once the TML utility department has been established and a geothermal contractor has been selected.

CHAPTER 3:

Finance and Legal

Summary

Following the initial marketing surveys conducted in 2006, the team analyzed nine distinct candidates that could run the geothermal heating district. The analysis, conducted in 2007, was subjective and was based on interviews with the candidates and supporting analyses and conversations with subcontractors, Lagerlof, Senecal, Gosney & Kruse LLP (legal) and William Garnett of National City Energy Capital (finance). The team also investigated the necessity for payment of royalties for geothermal sources.

In the subsequent ranking of the candidates, and re-ranking after considering financial and borrowing strength, two entities were consistently in the top two: MCWD and IAE. MCWD is a public entity with an elected board and IAE is a privately held corporation with majority ownership by Icelandic companies. Both of these organizations have unique strengths and specific weaknesses. The TML was ranked in the seventh position as a heating district operator and in the fifth position as a potential financier. However, both the political leadership and town management of the TML were extremely interested in being involved in any geothermal heating district and wanted to be included in any organizational structure.

Consequently, organizational alternatives included an individual entity, such as a TML utility department, a Joint Powers Authority, and a Special Act District that would be passed by the California Legislature. The team initially contemplated a Joint Powers Authority between MCWD and the TML, which would then contract with an experienced geothermal contractor to design and build the heating district. Ultimately, for reasons explained below, the proposed entity to operate a geothermal heating district was a new TML utility department.

Royalties

Royalty payments for geothermal resources depend on who owns the land with the resources, as summarized in the following steps:

- If the subsurface rights are owned by a private entity (such as MMSA), the annual royalty based on sales will be in the 2-3 percent range, according to discussions with Gordon Bloomquist, U.S. Department of Energy Geopowering the West consultant (in 2006), and Jess Senecal, senior partner at Lagerlof, Senecal, Gosney & Kruse LLP.
- If the subsurface rights are managed by the BLM, the following lease process is applicable (quoted from Federal Register 3205.6 "When may BLM issue a direct use lease to an applicant?):

- a. *The lands included in the lease application are open for geothermal leasing.*

- b. *BLM determines that the lands are appropriate for exclusive direct use operations, without sales, for purposes other than commercial generation of electricity.*
 - c. *The acreage covered by the lease application is not greater than the quantity of acreage that is reasonably necessary for the proposed use.*
 - d. *BLM has published a notice for the land proposed for a direct use lease for 90 days before issuing the lease.*
 - e. *During the 90-day period beginning on the date of publication, BLM did not receive any nomination to include the lands in the next competitive lease sale following that period for which the lands would be eligible.*
 - f. *BLM determines there is no competitive interest in the resource.*
 - g. *The applicant is the first qualified applicant.*
 - h. *However, if BLM determines that the land for which the applicant has applied under this subpart is open for geothermal leasing and is appropriate only for direct use operations, but determines that there is a competitive interest in the resource, it will include the land in a competitive lease sale with lease stipulations limiting operations to exclusive direct use.*
- The royalty payments for the direct use lease will be nominal according to Cheryl Seath, geologist with BLM, who was involved in drafting the regulation. Further conversations with Gordon Bloomquist and Ms. Seath place this direct use royalty rate in the \$100/year range.

One potential issue, however, is that BLM or Forest Service lands directly bordering the TML may not be included in a known geothermal resource area and may not be in compliance with the regulation that “the lands included in the lease application are open for geothermal leasing (point (a.) above).” The team discussed this issue with BLM and found that a joint Forest Service/BLM programmatic Environmental Impact Report was being prepared and subsequently issued in December 2008. Despite a request that the areas to the north and west of the slim holes drilled in 1991, and to the west and north of the Eagle Lodge development and Berner Street be included in the evaluation for geothermal direct use, they were not included in the Forest Service/BLM report and will have to be resolved individually with BLM.

Initially, the team had hoped that the section in the Energy Policy Act of 2007 that addresses noncompetitive leases for direct use would be a way that the TML could easily acquire the resources needed without payment of royalties. However, the BLM has indicated that these leases could only be let if the geothermal fluids were distributed at no cost. There are no exceptions for cost recovery or some like provision, although the team is now seeking administrative relief from the new administration, as operation of the heating district would not involve the actual sale of geothermal fluids.

Potential Heating District Operators

The team identified nine potential candidates to operate a geothermal heating district in the TML, including:

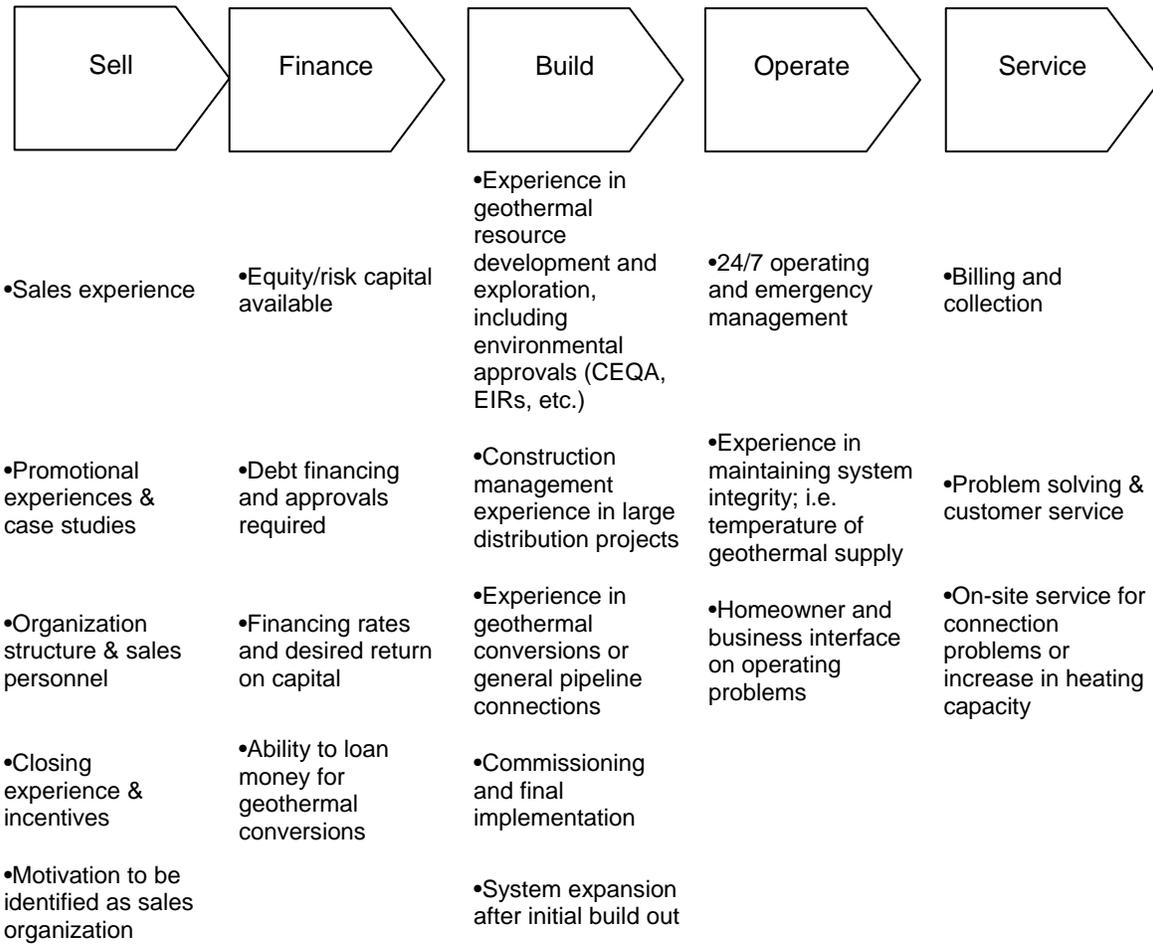
- 1) **Iceland America Energy, Inc. ("IAE")**: California corporation focused on geothermal projects in heating and electric generation; majority ownership by Icelandic owners with minority interest by U. S. owners; headquartered in Los Angeles.
- 2) **Mammoth Community Water District ("MCWD")**: water utility within the boundaries of the TML that has the specific authority under California state legislation to distribute geothermal resources for space heating (California Water Code Section 31013.5).
- 3) **Mammoth Mountain Ski Area ("MMSA")**: owner and operator of the Mammoth Mountain Ski Resort; largest company in the TML.
- 4) **Mammoth Pacific, L.P. ("Mammoth Pacific")**: operator of the local 40 megawatt geothermal plant; owned by ORMAT (an Israeli company) and Constellation Energy; ORMAT is the managing partner.
- 5) **Mono County**: county surrounding the TML with a permanent population of about 15,000 and governed by five County Supervisors and an appointed Administrator.
- 6) **Rock Creek Energy**: Texas company, with a construction affiliate, that operated a propane distribution system in areas adjacent to Chair 15 and the new Eagle Lodge development. (Sold franchise to Amerigas in February, 2009.)
- 7) **Southern California Edison Company ("SCE")**: regulated, public utility that provides electric service to the TML.
- 8) **Town of Mammoth Lakes ("TML")**: municipal corporation with a population of about 8,000, representing the bulk of the concentrated heating load and governed by a five person Town Council and an appointed Town Manager.
- 9) Propane providers **Amerigas** and **Turner Propane** (considered as one for this analysis): local sellers of propane and operators of distribution systems in selected neighborhoods.

With the exception of IAE all of these entities have a strong presence in the TML area. IAE was included because it has unique geothermal experience.

Strengths and Weaknesses of Potential Heating District Operators

In interviewing each of the nine candidates, the team utilized a business system approach to analyze how each entity would fit with the business of a geothermal heating district. On the following page is an illustration/summary of the geothermal business system:

Table 3-1: Geothermal Heating District Business System



Source: Analysis by HSF

After each interview the team evaluated each entity using a subjective scale ranging from a good fit to a poor fit. The summary results of the interviews are presented in Table 3-2 on the following page.

Table 3-2: Candidates to Operate Mammoth Lakes' Geothermal Heating District

In alphabetical order with summary evaluations:

● Good Fit ● Possible Fit ○ Poor Fit

Heating District Business System

Candidate	Sell	Finance	Build	Operate	Service	Desire?
IAE	○	●	●	●	○	●
MCWD	○	●	●	●	●	●
MMSA	○	○	○	○	○	○
Mammoth Pacific	○	●	●	●	○	○
Mono County	○	●	○	○	○	○
Propane Distribution Cos.	○	●	●	○	●	●
Rock Creek Energy	●	●	●	○	●	●
SCE	○	●	●	○	●	●
TML	○	●	●	○	○	●

Source: Analysis by HSF

Clearly, this was a qualitative evaluation and subject to different interpretations of skills and resources. The intention, however, was to evaluate the entities broadly so that those most interested and suitable would be the focus of the analysis in this study.

The team also included a category entitled “desire” to indicate the entity’s interest in moving forward as the operator of a geothermal heating district. Desire ranges from intense interest by MCWD and IAE to no interest at all from MMSA, Mammoth Pacific (only interest in electric generation from its facility near the TML) and Mono County. The remaining candidates might be interested if the financial terms and other benefits were consistent with their evolving missions and financial constraints.

The next step in the interview process was to evaluate the strengths and weaknesses of each candidate as summarized in Table 3-3 on the following pages.

**Table 3-3: Strengths and Weaknesses of Candidates
for Heating District Operator**

Candidate	Strengths	Weaknesses
IAE	<p>Engineering, design and construction staff has specific geothermal district heating experience in Iceland and other locations.</p> <p>Ties to Icelandic banks make debt and equity financing an easy process.</p> <p>IAE knows how to operate and regulate a heating district, including maintenance through a central heat center.</p> <p>IAE is very interested in a showcase operation in North America.</p>	<p>Being a foreign-controlled entity makes it unlikely IAE could be the sole operator.</p>
MCWD	<p>Already serves TML customers with water service, including maintenance, operations and service.</p> <p>Special state law specifically allows MCWD to distribute heat.</p> <p>Geothermal distribution system is similar to water system.</p> <p>Has tax free financing sources.</p> <p>Current board and management are very interested in expanding to geothermal.</p>	<p>Has no specific knowledge in operating a geothermal heating district.</p> <p>When established, the heating district revenues would be greater than water.</p> <p>MCWD board could change and political priorities might differ.</p>
MMSA	<p>Biggest business in the TML and controls many buildings with a heating load.</p>	<p>MMSA has no interest whatsoever in running a public heating district.</p>
Mammoth Pacific	<p>Operates the geothermal electricity plant several miles from the center of the TML.</p> <p>Proven expertise in finding and developing local geothermal resources.</p> <p>May have excess heat from electric generation that could be used for heating.</p>	<p>The managing partner of Mammoth Pacific is ORMAT and it has no interest in heating – only electricity.</p> <p>The Mammoth Pacific heat source is several miles from the center of the load and the pipeline and right-of-way questions eliminate any advantage of a proven resource.</p> <p>Mammoth Pacific would want contractual assurance that providing fluids for heat and reinjecting cooler fluids would not impact capacities for electric generation.</p>

**Table 3-3 (cont'd): Strength and Weakness of Candidates
for Heating District Operator**

Candidate	Strengths	Weaknesses
Mono County	Has tax free financing sources.	The TML is the only incorporated jurisdiction in Mono County and has the bulk of the heat load; Mono County has no direct involvement in the TML. County supervisors and management have little or no interest in taking on the responsibility of a heating district.
Propane Distribution Cos.	Both Turner Propane and Amerigas have existing propane distribution systems in the TML and geothermal distribution could be a natural extension Both companies have pipeline construction experience and work directly with businesses and homeowners.	As a geothermal district would possibly take heat load from existing propane customers, there is little immediate investment interest. Neither company has any experience in a heat distribution system such as geothermal.
Rock Creek Energy*	Rock Creek operates a propane distribution system in parts of the TML. The distribution system was constructed and engineered by an affiliate of Rock Creek. Management would consider a geothermal heating district a natural business extension, if financially attractive.	Rock Creek's primary interest is building the pipeline system and it has no direct experience in heating. Rock Creek has often been a target of criticism from big customers and would face political issues as the geothermal operator.
SCE	SCE may have a long term interest in geothermal heating as a way to provide more utility services to existing customers. Renewable or greenhouse gas credits could offer financial benefit to SCE. SCE is a very large company with both the engineering and financial resources to take a lead in geothermal.	SCE's interest is long term and there is little short-term interest in a heating district. SCE has central plant experience, but no direct geothermal experience. Customers may consider it a conflict to have SCE provide both heat and electricity.
TML	The heating district's customers would be the residents and businesses of the TML. Providing renewable energy to voters would be politically attractive. Has tax free financing sources.	The TML has limited engineering resources and no experience in operating a public utility district. The Town Council could change and political priorities might differ.

- In February 2009, Rock Creek Energy sold its franchise to Amerigas.

Source: Analysis by HSF

These strengths and weaknesses, as well as the evaluation of the business system, were the source data for the initial rankings of the candidates to operate the heating district.

Evaluation of Potential Heating District Operators

The analytical process in this portion of the study was to weigh each component of the business system, score the fit from 3 for a good fit to 1 for a poor fit.

The first ranking (Table 3-4a) gave 70 percent of the weight to the finance, build and operate components of the business system and MCWD and IAE were ranked #1 and #2, respectively.

Table 3-4a: Weighted Ranking of Candidates for Heating District Operator

Heating District Candidate Evaluation
Weighted 70%: Finance, Build & Operate

Candidate	Sell	Finance	Build	Operate	Service	Weighted
Weight	15	20	25	25	15	Rank
MCWD	1	3	3	2	3	2.45
IAE	1	3	3	3	1	2.40
Mammoth Pacific	1	2	3	3	1	2.20
Rock Creek Energy Propane Distribution Cos.	2	2	3	1	2	2.00
SCE	1	2	3	1	2	1.85
TML	1	2	2	1	1	1.45
Mono County	1	2	1	1	1	1.20
MMSA	1	1	1	1	1	1.00

Source: Analysis by HSF

The second ranking varied the weighted build, operate and service with 70 percent, but the rankings were identical which underlined the strengths of the two candidates that ranked at the top in Table 3-4b (on the following page) – MCWD and IAE.

Table 3-4b: Weighted Ranking of Candidates for Heating District Operator

Heating District Candidate Evaluation
Weighted 70%: Build, Operate & Service

Candidate	Sell	Finance	Build	Operate	Service	Weighted Rank
Weight	15	15	25	25	20	
MCWD	1	3	3	2	3	2.45
IAE	1	3	3	3	1	2.30
Mammoth Pacific	1	2	3	3	1	2.15
Rock Creek Energy Propane Distribution Cos.	2	2	3	1	2	2.00
SCE	1	2	3	1	2	1.85
TML	1	2	2	1	1	1.40
Mono County	1	2	1	1	1	1.15
MMSA	1	1	1	1	1	1.00

Source: Analysis by HSF

Financing Costs

The three factors used to gauge each entity’s ability to raise debt and equity capital were overall capacity, rate, and any political issues that may cause a lender to consider the entity a higher risk. The rankings were 3 for excellent and 1 for marginal, as indicated in Table 3-5 on the following page. The higher the ranking each candidate had, the better that candidate ranked for financing attractiveness.

**Table 3-5: Financing Abilities of Candidates
for Heating District Operator**

3=Excellent; 2=Good; 1=Marginal

Candidate	Debt Capacity	Rate	Political Issues*	Weighted Rank
Weight	35	35	30	
IAE **	3	3	1	2.40
MCWD	2	3	2	2.35
Mono County	2	3	1	2.05
SCE	3	2	1	2.05
TML	2	3	1	2.05
Mammoth Pacific	2	2	2	2.00
Propane Dist. Cos.	2	2	2	2.00
Rock Creek Energy	2	2	1	1.70
MMSA	1	2	1	1.35

*Only scores of 1 and 2 were appropriate, indicating many political problems (1) to some political problems (2)

** Update March 2009. Due to Iceland's financial crisis, IAE would no longer be considered a source of debt capital

Source: Analysis by HSF; William Garnett, National City Energy Capital

In today's credit marketplace, geothermal project financing is available, providing:

- The project economics provide a positive cash flow adequate to meet debt service.
- The length and terms of the geothermal heat purchase contracts that provide revenue to the geothermal district are long term and backed by sound credits (such as Mammoth Hospital or MMSA).
- The underlying credit of the entity that manages the geothermal district is sound and the balance sheet of that entity has sufficient strength to support the ups and downs of a growing geothermal heating district.

The most favorable rates for this type of project will be in the 4.5 percent to 5.5 percent in the current capital markets. Tax-free borrowing and taxable borrowing are currently in the same range because of the energy tax credits and accelerated depreciation available to taxable entities.

It is likely that permanent long term financing for the geothermal heating district will have both public and private sources. The most favorable structure would have a private contractor contributing at-risk equity for geophysical analysis and well development, while a public entity, using tax-free revenue bond financing, backed by long term geothermal heating contracts, would be the source of long term financing for the entire geothermal heating district.

Transition Funding

Transition funding involves offering a source of funds that district heating customers could use for financing the conversion from their current heating heat source, such as propane, to a geothermal system. The transition costs depend on whether the existing system is boiler-based, air-based, or electric. Generally speaking, boiler systems are more economical to convert while the conversion of electric resistance heating could be prohibitive.

The source of the transition funding could be either:

- A fund that would be created by the district heating operator where participating customers would pay all of the costs of the fund. The study's financial consultant, William Garnett of National City Energy Capital, suggested this might be a no interest loan secured by a lien on the property that would pass to successive owners. The cost of this fund would depend on whether the operating entity was a government jurisdiction or a private entity. Financing costs would be similar for both as a for-profit entity could take advantage of energy tax credits and accelerated depreciation. (Current market is about 4-5 percent per annum.)
- The district heating operator would pay for all conversion costs directly and collect from customers proportionately. The argument justifying this alternative is that it is for the greater good of the community and all users should share in those transition costs. Of course, those costs would be reflected in higher rates.

Previous studies in the TML conducted by MCWD concluded that transition costs were a major obstacle to the formation of a heating district. The quantitative market research, however, concluded the following:

“Waiving set up costs is not recommended as a strategy to motivate sign up; rather, the inclusion of reasonable set up costs should be part of a financial model to allow for lower ongoing monthly costs.”

Bovitz Geothermal Heating System Concept Evaluation – Qualitative Report, Bovitz Research Group, February 2007

This conflict between the conventional wisdom and the market research suggested that the eventual heating district entity should test various methods of transition financing and not adopt one method unilaterally.

Re-Rank Potential Heating District Operators

The only factor that changed in the analysis was each candidate's financial ranking, which did not change the ranking of any of the candidates. MCWD and IAE remained the most attractive candidates, as illustrated in Tables 3-6a and 3-6b on the following page.

Table 3-6a: Weighted Re-Ranking of Candidates for Heating District Operator
Heating District Candidate Evaluation

Weighted 70%: Finance, Build & Operate

Candidate	Sell	Finance	Build	Operate	Service	Weighted Rank
Weight	15	20	25	25	15	
MCWD	1	2.35	3	2	3	2.32
IAE	1	2.40	3	3	1	2.28
Mammoth Pacific	1	2.00	3	3	1	2.20
Rock Creek Energy Propane Distribution Cos.	2	1.70	3	1	2	1.94
SCE	1	2.05	2	1	2	1.61
TML	1	2.05	2	1	1	1.46
Mono County	1	2.05	1	1	1	1.21
MMSA	1	1.35	1	1	1	1.07

Source: Analysis by HSF

Table 3-6b: Weighted Re-Ranking of Candidates for Heating District Operator
Heating District Candidate Evaluation

Weighted 70%: Build, Operate & Service

Candidate	Sell	Finance	Build	Operate	Service	Weighted Rank
Weight	15	15	25	25	20	
MCWD	1	2.35	3	2	3	2.35
IAE	1	2.40	3	3	1	2.21
Mammoth Pacific	1	2.00	3	3	1	2.15
Rock Creek Energy Propane Distribution Cos.	2	1.70	3	1	2	1.96
SCE	1	2.05	2	1	2	1.61
TML	1	2.05	2	1	1	1.41
Mono County	1	2.05	1	1	1	1.16
MMSA	1	1.35	1	1	1	1.05

Source: Analysis by HSF

This re-ranking presented the question of how to combine the collective skills and resources of MCWD and IAE.

Straw Man Heating District Operator

The purpose of outlining the attributes of a Straw Man was to construct an entity that would combine the strengths of all of the entities that were previously identified, but would have none of the weaknesses identified in such entities. As indicated above in Table 3-6b, each of the heating district candidates was ranked in accordance with their capabilities in selling, financing, building, operating and servicing. The highest possible score was 3.0, but the top two entities had scores of 2.35 and 2.21, indicating weaknesses in some of their capabilities. A Straw Man entity, however, would exhibit none of those shortcomings and would have the following attributes:

Table 3-7: Attributes of Straw Man Heating District Operator

Selling	Would have an existing direct sales force that is based in the TML and would have existing relationships with businesses, residents, and government.
Financing	Would have an outstanding credit rating and be able to borrow at the most attractive rates – preferably in the tax free local government markets.
Building	Would have significant technical expertise in identifying geothermal resources and drilling test and production wells that have no impact on potable water sources.
Operating	Would have operated a geothermal heating district, including the regulation of heat, geothermal fluids, connection and conversion of existing structures.
Servicing	Would have the capability for 24 hour servicing of both the distribution network and the heating systems of all customers; would have a billing system in place for billing and collection of heating fees.

Source: Analysis by HSF

Obviously, this perfect Straw Man does not exist, but each of the entities has capabilities in each of the areas that might be attractive if partnered or combined with the capabilities of other entities, as outlined in the next section.

Comparison of Leading Potential Operators to Straw Man

In the section above titled “Re-Rank Potential District Heating Operators,” all of the potential candidates for heating district operator were ranked based on the criteria utilized to define the Straw Man: selling, financing, building, operating and servicing. The leading candidates were the MCWD, IAE and Mammoth Pacific, the operator of the local geothermal electric generating facility, of which ORMAT is the managing partner. Each of these entities has contrasting capabilities compared to the Straw Man. The team also determined that the political skills and capabilities of the TML were important elements in operating a heating district. To maximize acceptance, and possibly expedite any permitting for the heating district, the TML should participate in some way in the eventual heating district organization. Therefore, Table 3-8 on the following page compares the capabilities of the three top potential district heating operators, MCWD,

IAE and Mammoth Pacific, as well as the capabilities of the TML, in operating the heating district.

Table 3-8: Capabilities of Potential District Heating Operators

Attribute	MCWD	IAE	Mammoth Pacific	TML
Selling	Has no direct sales capabilities	Has no direct sales capabilities	Has no direct sales capabilities	Has no direct sales capabilities
Financing	Has access to tax free credit markets.	<i>Had</i> access to taxable credit markets and proven project record, but is now limited by economic crisis in Iceland.	Has access to taxable credit markets and proven project record.	Has access to tax free credit markets.
Building	Has extensive experience in identifying and drilling potable water wells.	Has extensive experience in identifying and drilling geothermal wells and protecting potable water sources.	Has extensive experience in identifying and drilling geothermal wells and protecting potable water sources.	No experience, but would envision contracting out this function to an experienced geothermal contractor.
Operating	Has experience in operating a potable water system only.	Has operated geothermal systems in Iceland, including distribution systems and heat control.	Has very significant experience in geothermal for electric production, but not for heating.	TML utility department would envision contracting out certain aspects of this function to an experienced geothermal contractor.
Servicing	Currently provides billing and system service for all potable water and waste water customers in the TML.	Has district heating servicing experience in Iceland.	No service expertise or experience.	No experience, but would envision contracting out this function, possibly to MCWD or other entity.

Source: Analysis by HSF

Unfortunately, none of the leading entities has any sales organization and that weakness will have to be addressed in the ultimate organizational structure. The sales function is particularly important for a geothermal heating district, as customers must make a long-term commitment to purchase geothermal heat. Additionally, new customers will have to convert to the geothermal source and a sales organization will be able to assist in facilitating that conversion.

The implications of this Straw Man analysis are addressed in the concluding section of this report that recommends an organizational alternative.

Evaluate Alternatives for Heating District Operator

The team focused on three organizational alternatives for further attention:

- Recommending one individual entity, such as a TML utility department, as the operator of the geothermal district heating project.
- Investigating a Special Act District (“SAD”) (enacted by the California Legislature) to fit the needs of the parties involved.
- Exploring the feasibility of a Joint Powers Authority (“JPA”) that might incorporate the strengths and weaknesses of several candidates.

The Straw Man analysis clearly outlined the reasons why no one entity could effectively do the job. Each of the leading candidates lacked skills in a key area and all lacked a sales organization. The question then became how to incorporate the strengths and

weaknesses of the leading candidates into a functioning structure for a geothermal heating district.

Initially, the team focused on a SAD or a JPA, either one of which could be structured to include the skills of MCWD and IAE and also incorporate the TML in order to have a more politically representative entity. IAE, or a similarly qualified organization, could provide its skills through a contractual arrangement with the SAD or JPA. Additionally, the SAD or JPA could be empowered to develop the necessary sales organization either by contract or direct employment.

Given that either a SAD or a JPA would meet the requirements for a geothermal heating district, the remaining question was how to choose between the two. The answer was straightforward if ease of formation and expediency are the applicable criteria. The JPA could be formed within weeks or months by mutual agreement of the involved public entities, while the SAD would require specific legislation to be crafted, carried to the California Legislature by a local representative, passed by the Legislature and signed by the governor. While passage of the SAD would be anticipated, as only local concerns would be included, the timing would be a minimum of one legislative cycle, and perhaps two, and involve years not weeks or months. Consequently, the recommended approach was to move forward with a JPA for the geothermal heating district.

Initially, the team anticipated that the members of the JPA would be the TML and MCWD. As both the TML and MCWD have the power to run a geothermal district heating facility through the California Constitution and a Special Act, respectively, the formation of a JPA would meet the required standard. The powers of that JPA would be developed during negotiations between the TML and MCWD. Ultimately, however, the TML and MCWD were not able to reach agreement on a JPA, mainly due to MCWD's concerns regarding legal liability and effects on the potable water sources in the TML. Nonetheless, MCWD adopted a verbal resolution of support of the heating district concept.

The TML has continued to express its interest in moving forward with a geothermal heating district and has indicated that concerns about potable water will be necessarily and adequately addressed through the permitting and environmental process required under the California Environmental Quality Act. In order to keep progress and discussions on a geothermal heating district moving forward, on July 2, 2008, the TML entered into a memorandum of understanding with IAE (the "MOU"), setting forth the understanding and mutual intent of the parties regarding the evaluation and potential implementation of a district heating project involving the utilization of geothermal energy for space heating in the TML.

Given the willingness of the TML to move forward with this project, the best alternative for a geothermal district heating operator would be a new TML utility department that would contract with an experienced geothermal company, such as IAE, to design, maintain, and operate the heating district system. In addition, the TML could create its own sales organization through hiring or could contract with an experienced sales organization to undertake the sales effort necessary to implement the geothermal heating district. The TML also has access to tax free credit and bond markets to assist in financing the geothermal heating district.

CHAPTER 4:

Recommendations

Summary

As noted above, the JPA structure for an organizational entity was initially the preferred choice as it was thought to combine the necessary political and operational powers and could be accomplished quickly. However, for reasons of legal liability and concerns about the unknown effects of a geothermal heating district on potable waters, the MCWD declined to participate in a JPA. Nonetheless, the TML continued its support of the project and, to keep progress and discussions on a geothermal heating district moving forward, on July 2, 2008, entered into the MOU with IAE setting forth the understanding and mutual intent of the parties regarding the evaluation and potential implementation of a district heating project involving the utilization of geothermal energy for space heating in the TML.

Pursuant to the California Constitution and several California state statutes, the TML has the power to establish and operate public works and utilities to furnish its inhabitants light, water, power and heat. In addition, the TML, as a municipal corporation, is authorized to establish whatever departments are necessary to assist in the administration of local affairs. Therefore, the team proposed to TML management that a new TML utility department operate the geothermal heating district. TML management accepted this recommendation and implementation will begin at the conclusion of this study. Legal support for this recommendation resulted from the team's work with William Kruse of the law firm of Lagerlof, Senecal, Gosney & Kruse, LLP to confirm that the TML, on its own, has the power to create and operate a utility district.

Proposed Heating District Operator

The proposed heating district operator will be a new TML utility department. The TML, as a California municipal corporation, is authorized by the California Constitution and several state statutes to establish and operate public works and utilities to furnish its inhabitants light, water, power and heat. Furthermore, a California municipal corporation is authorized to establish whatever departments are necessary to assist in the administration of local affairs.

In 1992, the TML adopted the Public Services section of the California Municipal Code (Title 13). Title 13.24 of the TML Municipal Code identifies a geothermal utility, but no details are provided. The TML Municipal Code will have to be amended by adopting new ordinances under Title 13.24 establishing the operational details and rules and regulations of a geothermal utility. Once the geothermal utility is established, the utility would negotiate a business plan and adopt a contractual agreement with a qualified geothermal contractor.

Success Factors for Heating District Operator

These success factors would apply whether significant functions were contracted or the entity operated the district independently. If, for example, the TML, through a TML utility department, were to contract with an experienced geothermal contractor, each of these factors that would need to be specifically noted in the contractual agreement:

- **Offering a constant source of heat with peaking capabilities and redundancy.** The heating district operator will have to ensure that sufficient geothermal fluids will be available at a temperature sufficient to transfer heat into customer facilities. In the event that the system cannot meet target temperatures during sustained below-normal temperature days, peaking sources of heat must be available, whether through a heat central or by utilizing existing equipment in the customers' facilities. These same peaking sources must also be able to provide redundant heat, if required. Pricing, however, will remain the same to the customer, regardless of the use of redundant air peaking heat.
- **Communicating regularly with customers on system status and costs.** Customers expressed desires to know the status of the system and the relevant cost comparisons with other sources of fuels. The successful heating district operator should maintain a website that would allow the customer to check on overall system status, as well as real time presentation of the relative costs of geothermal versus electricity, oil, or propane.
- **Providing billing systems that are easy to understand and that clearly disclose all operator costs and returns.** Customers want savings, simplicity, and freedom from volatility. Billing systems, however frequent, should be designed to meet customer needs and the successful operator will respond to these customer needs, as well as the anticipated returns to the operator and the TML utility department.
- **Managing a contracted service force that can rapidly respond to any service issues in customer facilities, as well as in rights of way.** The geothermal heating district will need to maintain a 24/7 customer service operation that can respond to system and billing questions during normal business hours and systems maintenance issues at any time. The heating district operator should handle system maintenance problems in rights of way and outside of the customer facilities. Problems, however, within customer facilities should be addressed by pre-qualified local contractors with the customer having the option of paying directly or spreading the maintenance cost over several billing cycles.

Heating District Rate Scenarios

The overriding assumption of the geothermal heating district is that business and residential customers will pay less annually for geothermal heat than they would if they were heating with fossil fuels such as propane or oil. Based on a private district proposal presented to MMSA in 2007 by IAE, the cost of geothermal heat will be less than propane or oil and IAE would have been able to recover costs both for establishing the system and for ongoing operating and capital costs. The market research described previously in this report also reinforces the fact that geothermal heat must cost less than competing sources or the residents and businesses of the TML will not adopt it.

Therefore, the assumption in this report is that geothermal heating will be cheaper than competing fossil energy sources.

A billing or rate methodology for delivering geothermal heat needs to reflect the savings, simplicity and stability of the geothermal heating source, so that:

- Savings versus a competing source will be clearly defined.
- Transparency of the billing system will be simplified and all customers' will be able to clearly understand their billing statement.
- The stability and lack of volatility in the cost of geothermal heat compared to other sources will be emphasized.

Communities around the world with geothermal heating districts have billed customers in a variety of ways. For example:

- Reykjavik, Iceland and Boise, Idaho (Warm Springs) charge a fixed fee based on the size of the pipe delivering the fluids and a fee per cubic meter of fluid used plus extra charges for supplemental uses such as pools or greenhouses.
- Klamath Fall charges fees based on a percentage of natural gas prices.
- Manzanita (Reno) charges fees based on housing square footage supplemented with BTU meters.

Interestingly, BTU meters are not in general use, either because of questions about reliability or the concern that charging for all BTUs used would place a disincentive on systems that encourage the customers to use all of the heat available for a given rate structure, such as in Reykjavik.

The applicable rate scenarios rely on either flow or heat (BTU), but none seem to address the obvious question of efficiency. If a rate system could be designed that would reward the customers that removed (with heat exchangers or other like-devices) a fixed amount of heat from the geothermal fluids, customers would be incentivized to use all of the heat for not only space heating, but also domestic hot water, spas, swimming pools and other uses. A fixed temperature drop also has the advantage that the heating equipment can be standardized and the overall system design would be able to assume a fixed temperature of the returning water after it has gone through the geothermal loop.

Another appropriate analysis would be to compare the flow, heat and hybrid methods utilizing the criteria of savings, simplicity and volatility, summarized below in Table 4-1.

Table 4-1: Heating Rate Scenarios

Scenario	Criteria		
	Savings	Simplicity	Volatility
Flow	Would generate savings over fossil sources.	As it is similar to water billing, would also be easy to understand.	Seasonal variability, but not subject to changes in fossil sources.
Heat (BTU)	Would generate savings over fossil sources.	Once customers understood that BTU is a unit – like gallons of propane – should be easy to understand.	Seasonal variability, but not subject to changes in fossil sources.
Hybrid	Would generate savings over fossil sources, but would offer the added advantage of incenting customers to use all of the available heat.	Customers would have to be educated on the advantage of using all of the heat.	Seasonal variability, but not subject to changes in fossil sources.

Source: Analysis by HSF

As the proposed TML heating district has the advantage of being designed from the ground-up with both the customer and efficiency in the forefront, a rate system that incorporates optimal efficiency and customer needs for simplicity and transparency should be the model rate scenario. Therefore, the team recommends the hybrid system. However, the hybrid system (discussed above) might be customized to include the following additional components:

- A fixed charge based on the size of the pipe delivering the heat and the number of heat exchangers (or like-devices) utilized in the business or residence coupled with a fixed flow based on the square footage of the business or resident.
- The inclusion of a measurement device so that the customer could easily measure the amount of heat removed from the delivered fluid.
- A billing system that would convert the energy used to a standard measurement and provide ongoing comparison with other fuel sources.

Customer Participation

In September 2008, the team completed the supplemental market research with respect to the geothermal heating district. The conclusions from the two qualitative focus groups convened on September 17, 2008 revealed that TML residents and businesses were enthusiastic about the potential for having fixed heating costs, utilizing renewable energy and promoting the TML as a cutting edge practitioner of a clean and green philosophy. However, residents and businesses were concerned about areas where information on the project continued to be limited or vague, including information on construction and implementation, the costs of set up, usage and maintenance, general aesthetics, and the ability of a geothermal development company to implement the project in light of the U.S. economy and pertinent federal and state regulations. Therefore, as the project moves forward, it will be important to keep TML residents and businesses apprised of the project through regular dissemination of information, either through town meetings and/or a specific website dedicated to the project.

The market research conducted by the team also made clear that potential customers are most concerned about lowering their monthly heating costs. Therefore, in order to encourage customer participation in the heating district, as different phases of the heating district are implemented, the heating district will need to develop various alternatives for funding transition and hook up costs for customers as such customers evaluate their decision to join the heating district.

HSE, in conjunction with the TML and the geothermal contractor hired to build the heating district, plans to design and establish a website dedicated to providing information on the design and operation of the heating district. More specifically, such website will include information on:

- Costs associated with implementation, service and maintenance of the geothermal heating district both for residents and businesses in the TML.
- Requirements, processes and timelines for retrofitting existing homes and buildings.
- Visual models or examples of how the geothermal heating district will work, including images of the wells and main structures as well as retrofitted homes, businesses and other areas where this system is currently in use (for example, Klamath Falls, Oregon and Boise, Idaho).
- Credentials of the contractor responsible for designing and implementing the heating district.
- Location and status of test wells drilled by the geothermal contractor to locate geothermal fluids.
- Phases of implementation of the heating district.
- Potential heating rates to be charged for customers who elect to join the heating district.
- Financing alternatives developed by the heating district to assist customers in transitioning their heating source to geothermal.

The team anticipates that residents and businesses in the TML will be enthusiastic participants in the heating district, provided that (i) all of the above issues are adequately addressed, (ii) heating district rates are competitive with other heating sources, (iii) low cost transition funding is provided, and (iv) residents and businesses feel they have a participatory role in development of the heating district.

In developing customer participation, however, the first emphasis will be to obtain contracts with the largest and easiest to serve loads, such as the Mammoth Hospital, the Mammoth schools, Cerro Coco Community College, the Mono County library, the new Mono County courthouse, the MCWD facilities and the Minaret Village mall which includes the TML town offices. From a financial standpoint, these large customers will provide the foundation for expanding into the remaining areas of the TML.

CHAPTER 5: Implementation

Establish New Mammoth Lakes Town Utility

As noted above, the proposed heating district operator would be a new TML geothermal utility department. The process to establish the geothermal utility is anticipated to be a minimum of two to three months, although additional time will most likely be required.

Title 13.24 of the TML Municipal Code already identifies a geothermal utility, but provides no details. To create the new utility, the TML Municipal Code must be amended by the adoption of new ordinances to include in Title 13.24 of such code to create the actual utility and to establish the rules and regulations applicable to the utility. The team has developed draft language for the ordinance to create the utility which includes the purpose of the utility, describes the powers and duties of the utility, and sets forth the administration and procedures applicable to the utility. The team has also developed draft language of an additional ordinance setting forth the rules and regulations applicable to the utility. The language of both ordinances will be finalized, in cooperation with the TML town staff, to determine the best structure of the utility. Once drafted, the ordinances will then be published in accordance with the procedures required under California law and will be presented to the TML Town Council for adoption. The team anticipates that this process will take at least two to three months, but likely longer, given the Town Council's desire for openness and transparency. The ordinances will become effective within 30 days after adoption by the TML Town Council.

Contractual Agreement with Geothermal Contractor

Once the geothermal utility has been established, the utility will negotiate and adopt a business plan and contractual agreement with a geothermal heating contractor. The team has developed draft language for such agreement, which sets forth the terms and conditions under which the contractor will operate the geothermal heating district on behalf of the new town utility, including such items as how rates are set, delivery requirements, indemnities (as necessary), and transparency of financial returns to the contractor. The selected contractor will be a specialized contractor, such as IAE, or a more general engineering and construction firm, such as Parsons Corporation. Again, the language of the contractual agreement will be finalized in consultation and cooperation with the TML town staff and will be subject to approval and adoption by the TML Town Council.

Phases of Implementation

The team anticipates that the geothermal heating district will be implemented in phases within the TML. The likely initial phase will involve the Mammoth Hospital, the Mammoth Lakes elementary, middle and high schools, Cerro Coso Community College, the Mono County library, the MCWD facilities, the new Mono County courthouse (to be built beginning in 2010 with a water-based heating system easily converted to

geothermal), and the Minaret Village mall which includes the TML town offices. All of these buildings are located within close proximity to one another and represent approximately 25% percent of the heating load of the TML. Once the initial phase of the heating district has been designed, built and implemented, the TML and the selected geothermal contractor will determine together how and when to expand the heating district to cover additional areas of the TML utilizing the following criteria, set forth in priority order:

- Size of the load and creditworthiness of the customer.
- Availability of the TML rights of ways for geothermal distribution piping.
- Ease of conversion to geothermal heating, which generally means the current heating system is water-based.
- Proximity to the existing heating district or other known and available geothermal resources.

Practically, these criteria would point to three directions for expansion:

Phase 1: The first expansion would include Mammoth Hospital, the Mammoth schools, Cerro Coso Community College, the Mono County library, the new Mono County courthouse, the MCWD facilities and the Minaret Village mall which include the TML town officers. This initial phase would be coupled with exploring expansion to adjacent residential areas, such as the Trails subdivision that is just east of the hospital and the schools. Additionally, Mammoth Hospital may be interested in being a joint venture partner and pursuing drilling wells on their property, subject to obtaining an appropriate BLM lease.

Phase 2: The second expansion would be centered on The Village at Mammoth with its significant hospitality load and surrounding housing and other commercial operations.

Phase 3: The third area for expansion would be the planned Eagle Lodge development on the western edge of town and the surrounding single and multifamily housing stock, including the planned Snowcreek 8 development near the intersection of Old Mammoth Road and Minaret Road.

Once these three phases are implemented the districts could be connected and the remaining heating load connected. Assuming the first phase could begin in the 2010-2011 timeframe, all of the planned expansions should be implemented by 2015. The phases 1, 2 and 3 are graphically represented in Figure 5-1 below:

Figure 5-1: Implementation Map for Town of Mammoth Lakes



GLOSSARY

BLM	Bureau of Land Management
Bovitz	Bovitz Research Group
HSF	High Sierra Energy Foundation
IAE	Iceland America Energy, Inc.
JPA	Joint Powers Authority
Mammoth Pacific	Mammoth Pacific, L.P. (subsidiary of ORMAT)
MCWD	Mammoth Community Water District
MMSA	Mammoth Mountain Ski Area
MOU	Memorandum of Understanding between the Town of Mammoth Lakes and Iceland America Energy, Inc.
SAD	Special Act District
SCE	Southern California Edison Company
team	Town of Mammoth Lakes, with the assistance of the High Sierra Energy Foundation
TML	Town of Mammoth Lakes