TECHNICAL REPORT
UCED 2005/06-9

DRAFT

ANALYSIS OF POTENTIAL INDUSTRIAL DEMANDS OF PINYON-JUNIPER RESOURCES IN LINCOLN AND WHITE PINE COUNTIES

UNIVERSITY OF NEVADA, RENO

ANALYSIS OF POTENTIAL INDUSTRIAL DEMANDS OF PINYON-JUNIPER RESOURCES IN LINCOLN AND WHITE PINE COUNTIES

Elizabeth Fadali
Thomas R. Harris
Kynda Curtis
Robert Dick
and
Simona Balazas

Elizabeth Fadali is a Research Associate in the University Center for Economic Development in the Department of Resource Economics in the College of Agriculture, Biotechnology, and Natural Resources at the University of Nevada, Reno.

Thomas R. Harris is a Professor in the Department of Resource Economics in the College of Agriculture, Biotechnology, and Natural Resources; State Extension Specialist in the College of Cooperative Extension; and Director of the University Center for Economic Development at the University of Nevada, Reno.

Kynda Curtis is an Assistant Professor in the Department of Resource Economics in the College of Agriculture, Biotechnology, and Natural Resources; and State Extension Specialist in the College of Cooperative Extension at the University of Nevada, Reno.

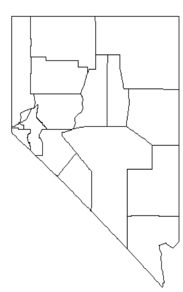
Robert Dick is an Instructor in the Department of Economics in the College of Business Administration at the University of Nevada, Reno.

Simona Balazas is a Graduate Research Assistant in the Department of Resource Economics in the College of Agriculture, Biotechnology, and Natural Resources at the University of Nevada, Reno.

January 4, 2006

This publication, *Analysis of Potential Industrial Demands of Pinyon-Juniper Resources in Lincoln and White Pine Counties*, was published by the University Center for Economic Development in the Department of Resource Economics at the University of Nevada, Reno. Funds for this publication were provided by the Lincoln County Regional Development Authority through funding provided by the Nevada Commission on Economic Development through U.S. Forest Service Grant 02-26-12-NFP-03 and the United States Department of Commerce Economic Development Administration under University Centers Program contract #07-66-05359. This publication's statements, findings, conclusions, recommendations, and/or data represent solely the findings and views of the authors and do not necessarily represent the views of the Lincoln County Regional Development Authority, Lincoln County Commissioners, U.S. Department of Commerce, the Economic Development Administration, University of Nevada, Reno, or any reference sources used or quoted by this study. Reference to research projects, programs, books, magazines, or newspaper articles does not imply an endorsement or recommendation by the authors unless otherwise stated. Correspondence regarding this document should be sent to:

Thomas R. Harris, Director
University Center for Economic Development
University of Nevada, Reno
Department of Resource Economics
Mail Stop 204
Reno, Nevada 89557-0105
Phone: 775/784-6499



UCED
University of Nevada, Reno
Nevada Cooperative Extension
Department of Resource Economics

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I:

INTRODUCTION

Introduction

Lincoln County Regional Development Authority, through funding provided by the Nevada Commission on Economic Development through U.S. Forest Service Grant 02-26-12-NFP-03, requested assistance of the University Center for Economic Development which is funded by the U.S. Economic Development Administration in analyzing industrial demand for Lincoln County and White Pine County pinyon-juniper resources to meet future industrial energy demands. The general purpose of this report is to provide an overview of industrial energy demands and opportunities for industrial utilization of pinyon-juniper derived from woodland thinning initiatives on public land in Lincoln and White Pine counties. Specific objectives of this report are:

a. Present an overview of past, current, and future biomass trends as well as results of a biomass energy questionnaire of Lincoln and White Pine counties; and background material for the formulation of a pinyon-juniper biomass economic cluster.

b. Produce an overview of socio-economic data trends in Lincoln and White Pine counties and how pinyon-juniper may play a part in the local economy,

c. Present an analysis of potential energy industrial demands that may use pinyon-juniper biomass derived from Lincoln and White Pine counties.

d. Discuss the pinyon-juniper supplies in Lincoln and White Pine counties, and

e. Summarize presented data for later use in selected detailed pinyon-juniper biomass feasibilities studies.

Results of this study could be used as a data source for detailed feasibility studies for selected pinyon-juniper business developments in Lincoln and White Pine counties.

The study is divided into six chapters. The outline of these chapters is presented below:

- Chapter I provides a brief introduction to the study.
- Chapter II discusses past, current, and future national biomass energy trends. Chapter II, also, presents results of a Lincoln and White Pine counties industrial survey pertaining to potential biomass use by local businesses. Finally, Chapter II

discusses cluster economic development and how a potential pinyon-juniper biomass industrial cluster could be formed in Lincoln and White Pine counties.

- Chapter III presents a socio-economic overview of Lincoln and White Pine counties with forecasts of population growth. These forecasted values could provide information as to future pinyon-juniper demands.
- Chapter IV provides a detailed analysis of potential pinyon-juniper demands. These potential demands could be used in a detailed feasibility study for a specific pinyon-juniper enterprise.
- Chapter V discusses potential available harvest supplies for pinyon-juniper in Lincoln and White Pine counties. Supply analysis can be used later in a detailed feasibility study.
- Chapter VI covers conclusions and summarizes information presented in the study. Also pinyon-juniper biomass opportunities are suggested. Detailed feasibility studies of selected pinyon-juniper biomass business opportunities need to be completed to assist Lincoln County Regional Economic Development Authority to focus on potential successful pinyon-juniper biomass ventures.

CHAPTER II:

NATIONAL BIOMASS ENERGY TRENDS, RESULTS OF LOCAL BUSINESS BIOMASS QUESTIONNIARE, AND CLUSTER ECONOMIC DEVELOPMENT

Introduction

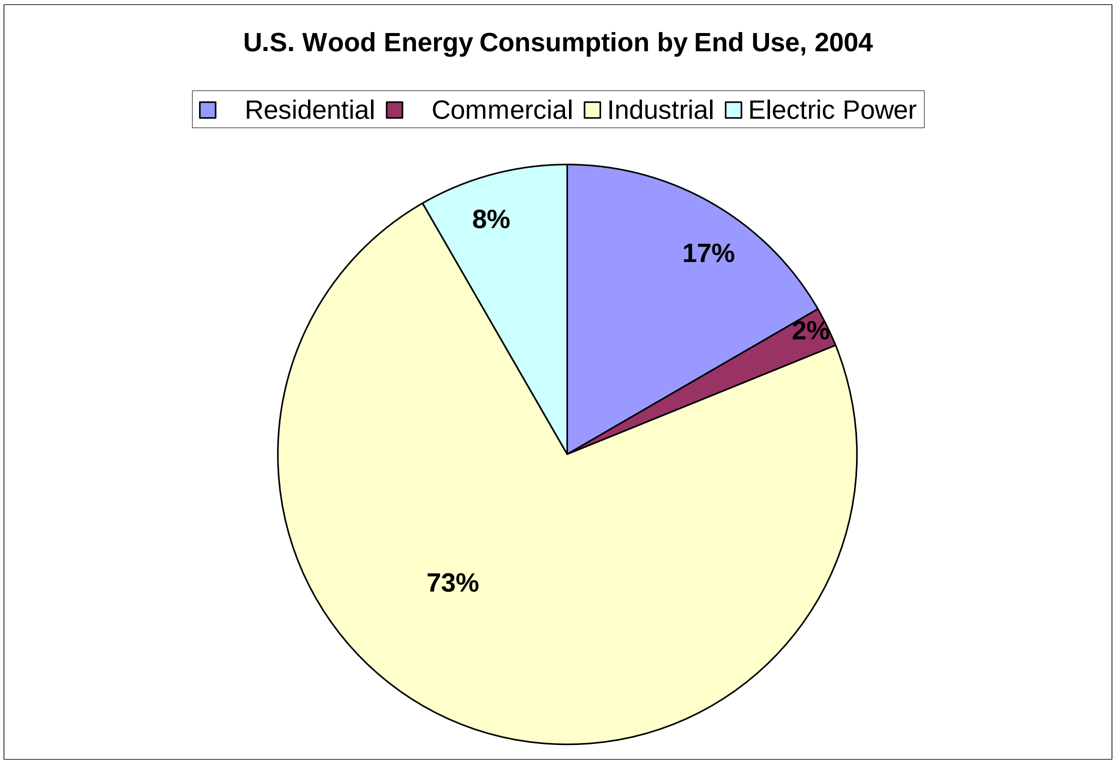
Communities are searching for new and alternative economic development and diversification strategies to promote local economic activity and stability. One potential strategy for economic activity and stability is the industrial development of local pinyon-juniper biomass resources. This chapter discusses past, current, and future national biomass energy trends. Also, this chapter will present results of a pinyon-juniper biomass questionnaire of Lincoln and White Pine counties' businesses. Additionally, the chapter will discuss cluster economic development and how a potential biomass economic development cluster could be formed for Lincoln and White Pine counties

Biomass Energy in the United States

Biomass may be used as a fuel for electric power generation, space heating, cogeneration of heat and electricity, or for feedstock in the production of ethanol and other liquid bio-fuels. In 2004, the amount of biomass energy used in the United States was 2,845 trillion Btus or approximately 2.9% of total energy consumption in the United States. Of the 2,845 trillion Btus, about 2,000 trillion Btus were supplied by wood energy, with the remaining 845 trillion Btus supplied by non-wood biomass such as corn. During 2003, close to 60% of energy supplied by wood biomass was obtained through cogeneration technologies and used in pulp and paper industry operations. Although biomass energy represented only a small proportion of the current total energy consumption in the United States, biomass energy represented almost half of the total *renewable* energy supply (Energy Information Administration, 2005, Haq, 2002).

Figure 1 shows consumption of wood energy in the United States by end use. In 2004, 73% of the energy produced from wood was used in industry, largely for cogeneration at paper, pulp and lumber mills where the energy from wood residues leftover from primary production processes can be used on-site. Residential use, primarily for home heating, made up 17% of total wood energy use.

Figure 1. United States Wood Energy Consumption by End Use, 2004

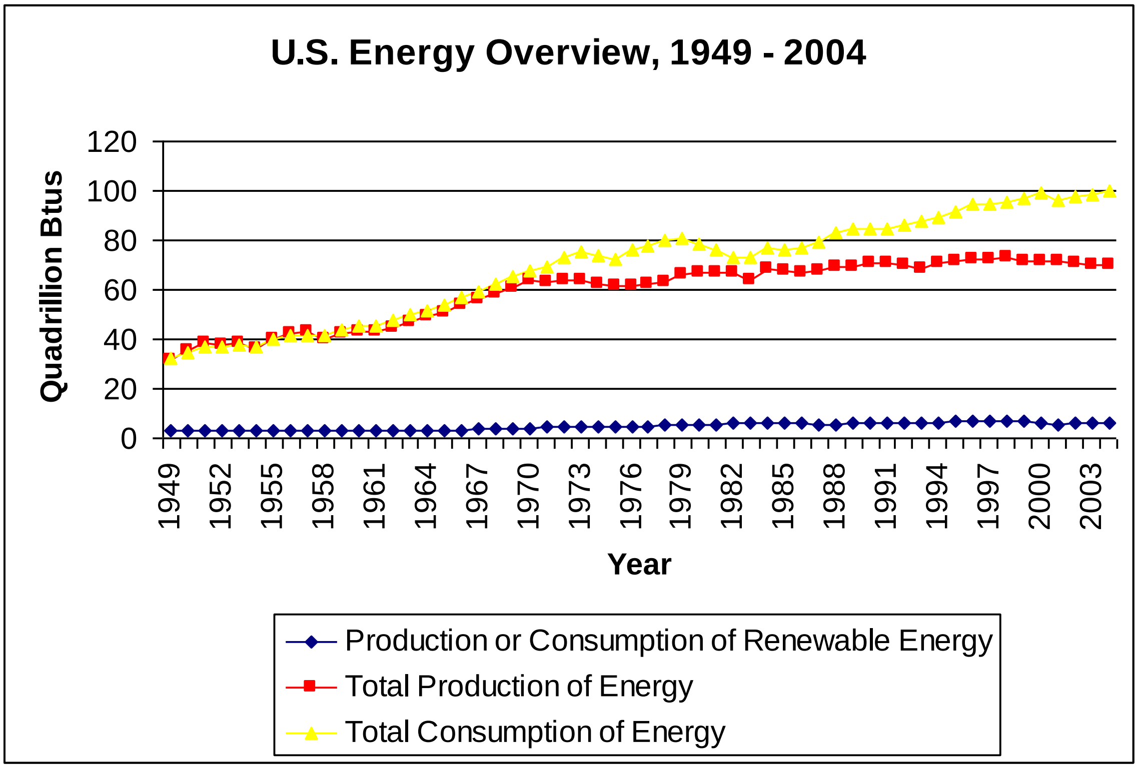


Source: Table 6, Renewable Energy Trends 2004, Highlights. (Energy Information Administration, 2005).

Historical Trends in Renewable Energy

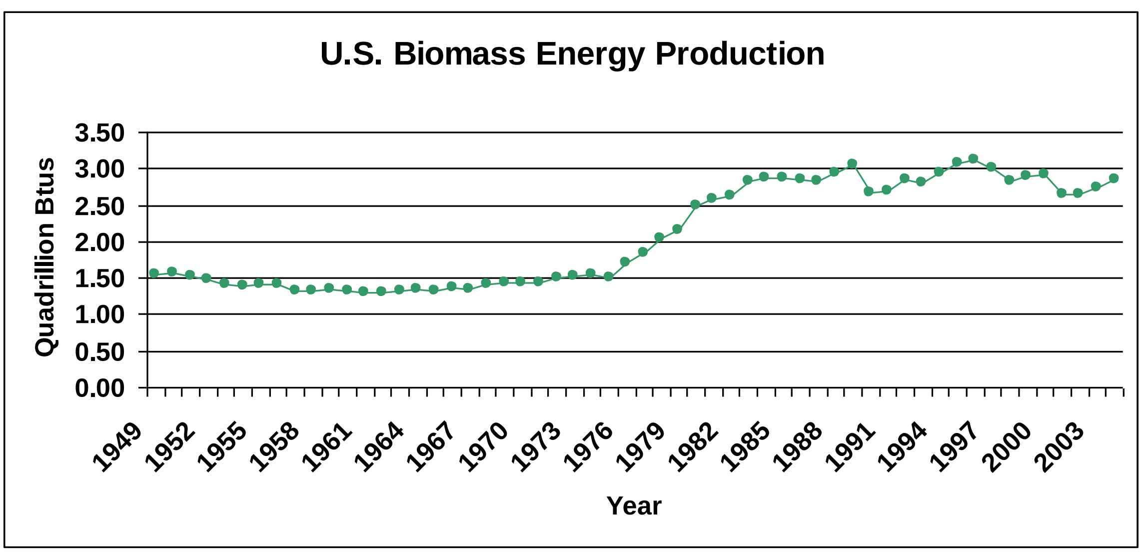
From 1949 to 2004 total U.S. energy consumption rose 212% from 32.0 to 99.7 quadrillion Btu (see Figure 2). Over the same period, U.S. energy production rose by 122% from 31.7 to 70.4 quadrillion Btu. Consumption increased at a faster rate than production. The growing gap between consumption and production was filled by increased net energy imports. Total renewable energy production includes hydroelectric, geothermal, solar, wind, wood and biomass and is equal to renewable energy consumption. Renewable energy production rose by 106% over the same period from 3.0 to 6.1 quadrillion Btu.

Figure 2. U.S. Total and Renewable Energy Production and Consumption, 1949 to 2004



Source: Data from Energy Overview, (Energy Information Administration, 2005), UCED Chart, 2005

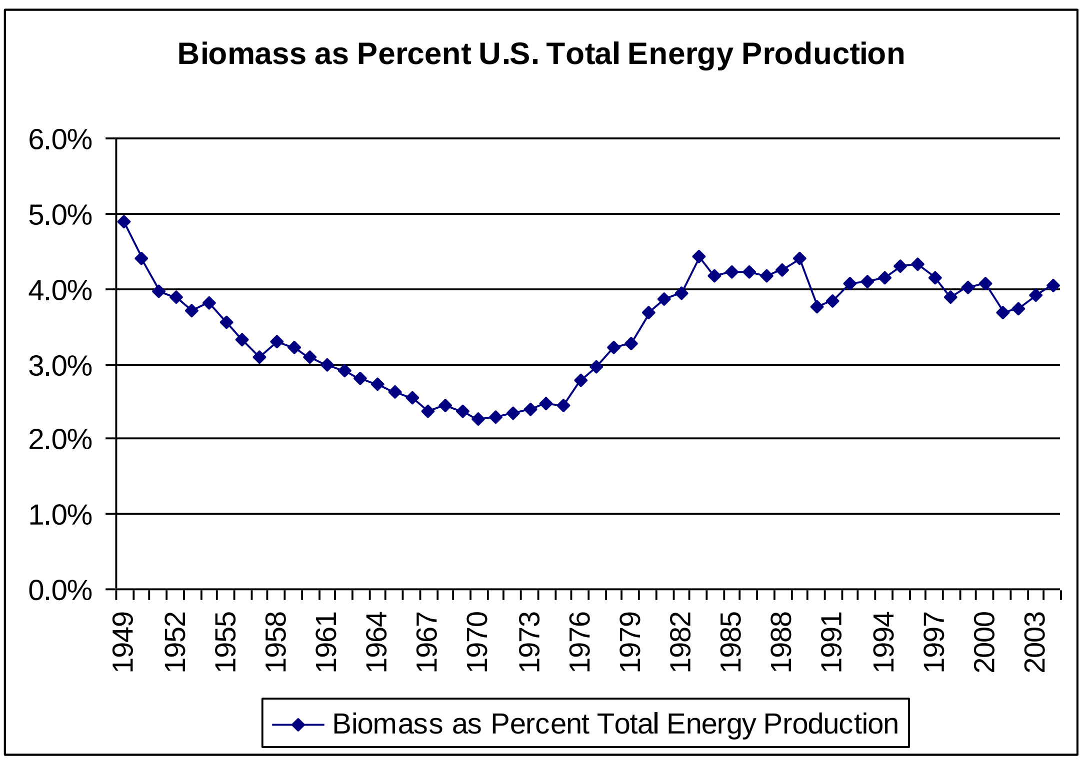
Figure 3 U.S. Biomass Energy Production



Source: Data from Energy Overview, (Energy Information Administration, 2005), UCED Chart, In 1949, the United States produced 1.55 quadrillion Btus of biomass energy (Figure 3). Levels of biomass energy production leveled off and even decreased until the 1970s when oil price shocks and changing regulation encouraged increased use of biomass energy. The peak production year for biomass energy was in 1996 when 3.13 quadrillion Btus were produced. Since 1996 biomass energy use as a whole has declined to 2.85 quadrillion Btu in 2004 (preliminary estimate). Decreased use of wood energy was largely responsible for this decline (see Figure 5 below).

As seen in Figure 4, in 1949, biomass energy, including wood and waste materials, made up almost 5% of total U.S. energy production. This decreased to a low in 1971 and 1972 of 2.3% of total energy production. After two oil shocks in the 1970s and changes in energy regulations, biomass energy production increased to 4.4% of total energy production in 1983. Since 1983 biomass energy production has fluctuated between 3.7% to 4.4% of total energy production. Sharp rises in oil prices over the past two years may again lead to a renewed interest in biomass energy production.

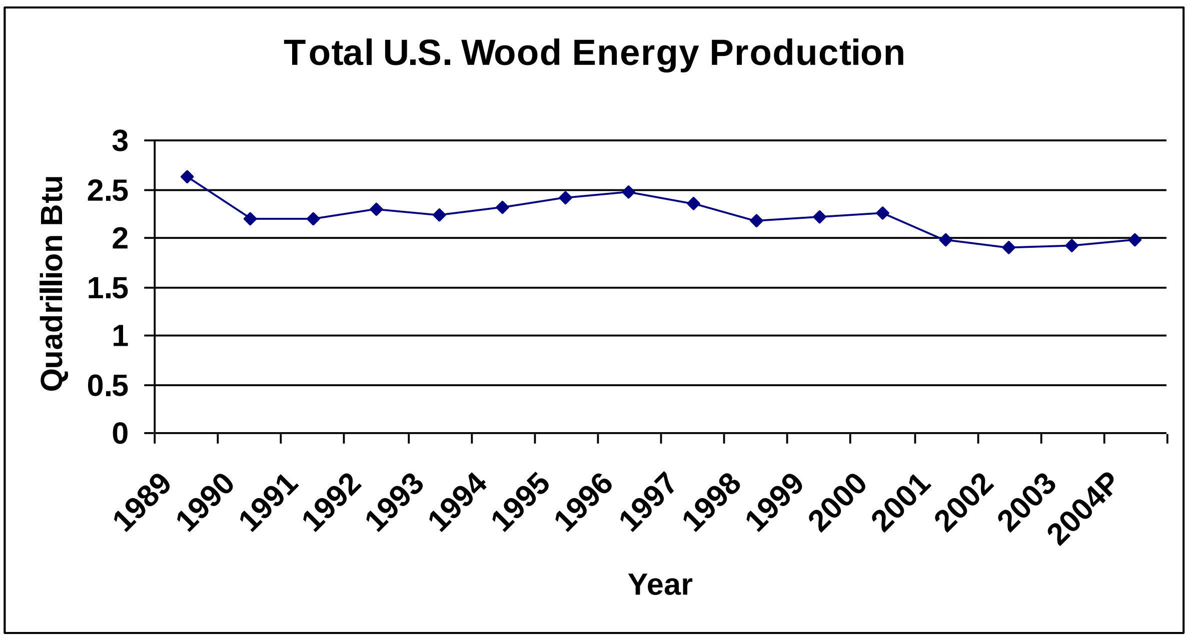
Figure 4. Biomass Energy as a Percentage of Total U. S. Energy Production, 1949 to 2004



Source: Energy Overview, (Energy Information Administration, 2005), UCED 2005 Calculations

Total wood energy production decreased nearly 25% from 1989 to 2004 from 2.5 to 2.0 quadrillion Btu (see Figure 5). Over the same period ethanol production, primarily from corn, increased over 300% and energy production from non-wood biomass increased by almost 60%. By 1995, half of the California biomass power industry shut down as a cost reduction strategy, according to the Energy Information Administration "Biomass Milestones". Low prices for fossil fuels over much of the 1990s, reductions in logging operations in some areas, the unwieldy and localized nature of some wood fuels, electric market deregulation and many other factors may play a role in the reduced wood energy production over the period (Morris, 2002).

Figure 5 Total U.S. Wood Energy Production

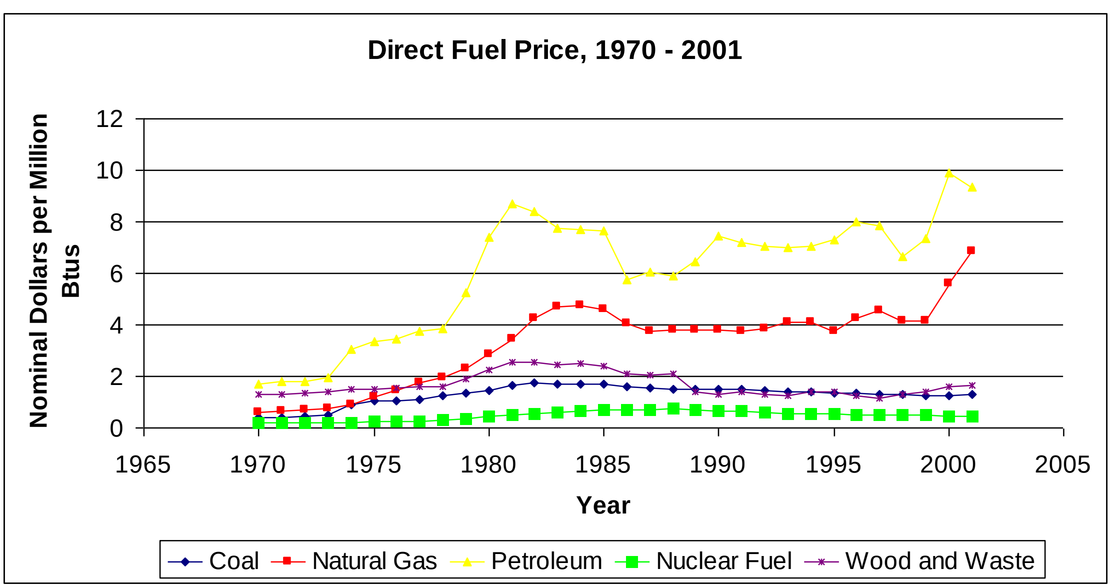


Energy Overview, Renewable Energy Trends, 2004, Highlights. Energy Information Administration, 2005 UCED calculations.

National Fuel Price Trends

Figure 6 compares the nominal direct price for a million Btu of energy for different fuel sources from 1970 to 2001. As seen in the figure, wood competes with coal as a low cost source of energy, particularly for electrical generation and industrial or commercial use. Coal is abundant and more energy dense than wood. Wood is also abundant, but is typically harvested over a larger acreage than coal. These factors tend to increase the cost of harvesting and transporting wood fuels in relation to mining and transporting coal. In addition, generating plants for producing electrical energy with fossil fuels are usually less costly in terms of initial capital costs and operation and maintenance. Exceptions occur where wood is already transported due to its demand for other purposes such as lumber or paper pulp. In these cases, wood residues leftover from primary production may be available at very low or even negative prices, since there may be a disposal cost of the wood otherwise. Paper and lumber mills may use wood residue from their production process to generate electrical energy and heat. This type of wood energy use typically has already been exploited and represents the largest proportion of wood energy use in the United States today. In a similar way, wood residues may also be available at lower cost when collection and transportation of the wood residue serves other socially desirable goals, such as the reduction of fire risks or increase in forest health, as may be the case in Lincoln and White Pine counties in Nevada. In this case, government entities such as the Bureau of Land Management may produce wood fuels as a byproduct of these other goals. Supplies of wood residues in this case will depend on government decision making processes. An additional market in which wood may successfully compete is as a fuel to replace currently expensive natural gas, propane, or oil for space heating.

Figure 6 Comparison of Nominal Direct Fuel Costs in the United States, 1970 - 2001



Source: Energy Information Administration, "State Energy Data 2001: Prices and Expenditures" (January 2005), U.S. Table 1.

The environmental benefits of using biomass may lead to increased use in the future. Because coal, as a competing energy source, will often be a lower cost option than wood, demand for wood energy may be driven more by environmental considerations and regulations than by factors such as higher prices for oil. Coal is a nonrenewable resource that will eventually run out. Burning coal also produces many undesirable emissions. In addition to being a renewable energy resource, environmental benefits of biomass energy include lower sulfur dioxide, nitrogen oxide and carbon dioxide emissions in comparison to coal. Carbon that is sequestered in wood while it is growing is released when it is burned, but is considered not to add any net increase in carbon dioxide emissions.[1] Any regulations adopted that increase renewable energy portfolio requirements for electricity generation will likely increase the demand for wood energy and the prices paid for wood fuels. The state of Nevada currently has a renewable energy portfolio law that requires that 20% of all electricity sales be derived from renewables by the year 2015. These are some of the most ambitious goals in the nation regarding renewable energy.

Regional Fuel Prices

Table 1. 2005 and 2010 Projected Average Fuel Prices, Mountain Region

Type of Fuel	**Average Fuel Price** (2003 dollars per million Btu)	
	2005	**2010 Projected**
Coal	1.16	1.12
Natural Gas	6.21	4.74
Distillate Fuel	7.85	6.24
Residual Fuel	6.21	4.50
Biomass	1.06	0.90

Sources: NewGen Data and Analysis, RDI Consulting/FT Energy (Boulder, CO, August 2000) and EIA, AEO2005 National Energy Modeling System run aeo2005.d102004a.

Region-wide, average prices for biomass as a fuel were projected to be about $1.06 per million Btu and to decrease to 90 cents per million Btu by 2010 (see Table 1). This implies an average price of about $19 per bone dry ton of wood chips used for fuel

[1] Any fossil fuel energy used to process or transport the wood will add to carbon emissions however.

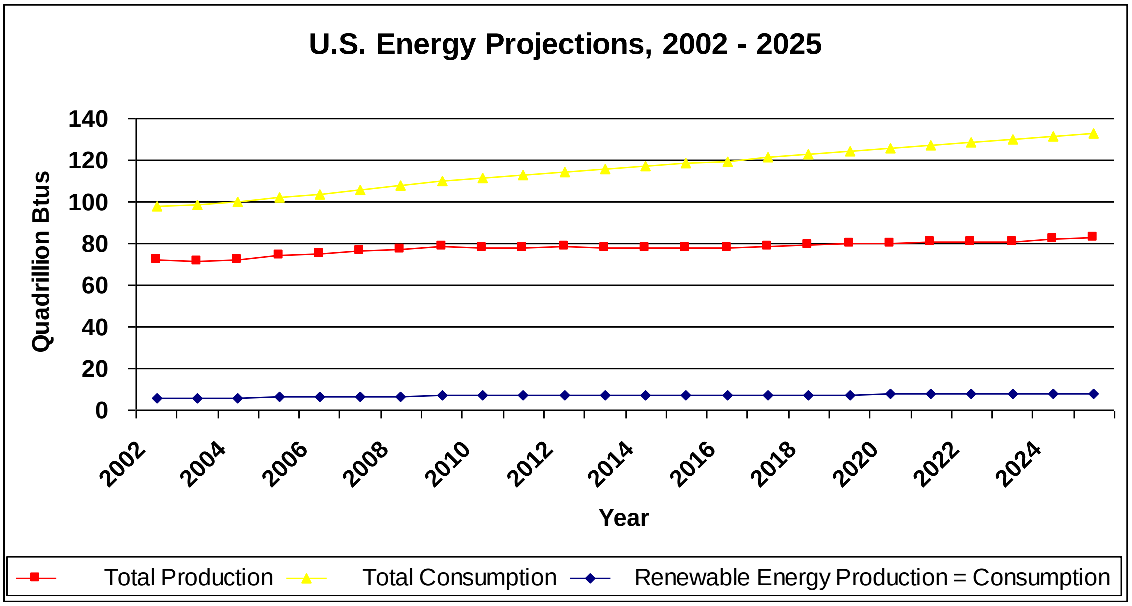
wood in 2005[2]. Actual specific quotes reported were a contracted $35 to $45 per delivered green ton in the case of the White Pine County School District to an estimated average of $35 to $40 per delivered bone dry ton for the Sierra Pacific Industries wood-fired electric plant in Loyalton, California (Carlton, 2005, Resource Concepts, 2004). Minimum bid value being used currently by the BLM Ely Field Office is $25 per green ton.

Projections of Future Biomass Energy Production

The Energy Information Administration at the Department of Energy produces projections of energy use and production by fuel type with the National Energy Modeling System (NEMS). In Figures 7 and 8 two NEMS scenarios of future U.S. energy consumption and production, as well as projected renewable energy production, are displayed in chart format. The first scenario (Figure 7) represents the reference projections while the second represents a case in which oil prices are assumed to be much higher. The reference scenario projects energy consumption to increase by about 1.4% a year to 133.2 quadrillion Btu in 2025. Energy production is projected to rise by about 0.7% a year to 82.7 quadrillion Btu with the shortfall in energy needs met by rising imports. Renewable energy consumption, which is assumed to be equal to renewable energy production, is forecast to rise about 1.5% per year at a slightly higher rate than consumption is predicted to rise. Total renewable production in 2025 is predicted to be 8.1 quadrillion Btu. Under the high oil price scenario, consumption in 2025 is projected to be lower at 131.5 quadrillion Btu. Under high oil prices, energy production would be expected to increase at a faster rate of 1.1 percent to 91.8 quadrillion Btu. Renewable energy production under a high oil price scenario is projected to be slightly higher by 2025, at about 8.3 quadrillion Btu.

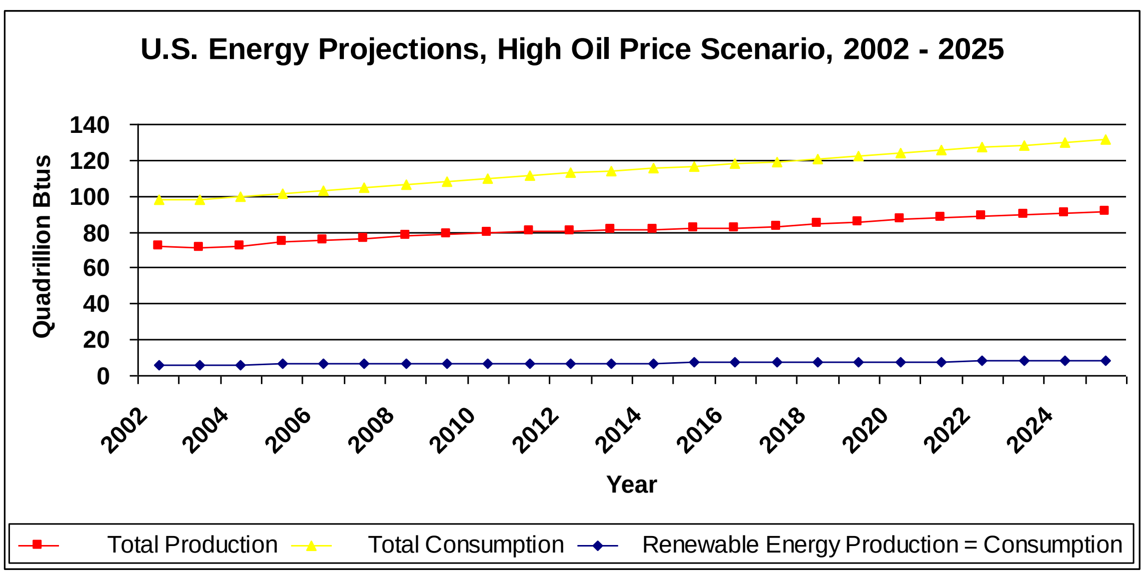
[2] The calculation is made using the conversion weight to energy equivalents heat value (100 percent efficiency) of 9,000 Btu per pound of dry wood suggested in Ffolliott, P. F., and W. P. Clary. "Pinyon-Juniper Woodlands in the Southwest." University of Arizona, School of Renewable Natural Resources..

Figure 7 Energy Use Projections for Production, Consumption and Renewable Energy, 2002 to 2025



Source: EIA, AEO2005 National Energy Modeling System run aeo2005.d102004a.

Figure 8 Energy Use Projections for Production, Consumption and Renewable Energy, High Oil Price Scenario, 2002 to 2025

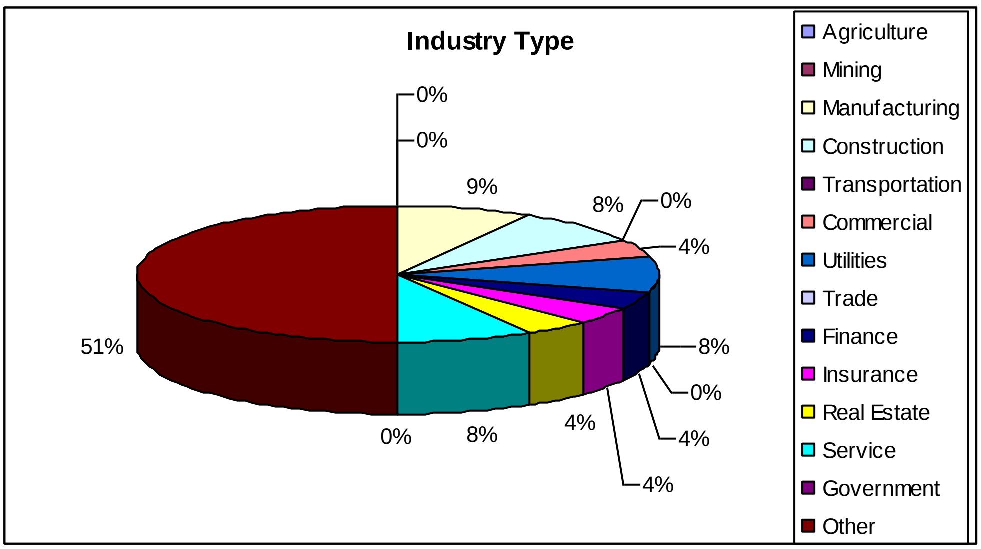


Source: EIA, AEO2005 National Energy Modeling System run vhw2005.d120304a.

Pinyon-Juniper Biomass Business Survey Results

In the summer of 2005 and using survey procedures outlined by Dillman (2000), businesses in Lincoln and White Pine Counties were surveyed as to their understanding of wildfire hazards with pinyon-juniper and potential use of pinyon-juniper as an energy resource. A copy of the business survey is shown in Appendix A. Approximately 150 businesses were sent questionnaires and out the 150 questionnaires, 24 questionnaires were useable for analysis.

Figure 9. Proportionate Share of Answered Questionnaires by Economic Sector.



From Figure 9, 50% of the respondents were from the government sector. The government sector covers federal, state, county, and local governments as well as the local school districts.

Of interest also, as given in Table 2, were answers to Question 7 on the business survey which is shown in Appendix A. Question 7 finds the familiarity of respondents as to pinyon-juniper woodlands wildfire issues. Respondents were asked to rank their familiarity from 1 to 10, with a ranking of 10 being "not familiar at all with wildfire issues" and a ranking of 1 being "very familiar" with wildfire issues. Approximately 42% of the respondents replied that they were not familiar with wildfire issues concerning pinyon-juniper. However, approximately 17% were very familiar with the wildfire issues concerning pinyon-juniper. If one of the premises for pinyon-juniper harvesting is to reduce combustible sources for rangeland fires, there seems to be a need for more education. With sufficient education on the need for pinyon-juniper harvesting to reduce wildfires, there may be potential to increase commercial and energy demand for pinyon-juniper resources.

Table 2. Proportionate Share Rank Familiarity of Pinyon-Juniper as a Wildfire Hazard Issue

Scale Values on Questionnaire	Percentage of Respondents
1 (very familiar)	16.67
2	4.17
3	4.17
4	4.17
5	8.33
6	0
7	8.33
8	8.33
9	4.17
10 (not familiar at all)	41.67

Questionnaire results also showed that only 12.5% of respondents would consider use of pinyon-juniper to produce their own electricity. However, with current energy price increases, the positive response to use of alternative fuels such as pinyon-juniper biomass may increase.

How to Develop Competitive Cluster Action

As an economic development alternative, pinyon-juniper harvesting falls within the definition of industrial cluster economic development. Biomass industrial development is an industrial cluster because pinyon-juniper biomass potentially has numerous interlinked local economic sectors, such as housing, electric power plants, industrial parks, and etc.

What are Clusters and Cluster-Based Economic Development?

Industry clusters have currently become popular as an avenue for economic development with the publication of Porter's book (1990). Porter has drawn together elements of rejuvenated theories of economic development with elements of business strategy.

Clusters are geographic concentrations of interconnected companies that work closely with each other, local suppliers, infrastructure providers, educational institutions, government agencies, and other relevant business groups. Cluster-development is based on the premise that a company (and their regions) can realize higher levels of competitiveness when it looks beyond its own limited capacity and strategically partners with other companies to support institutions to address challenges and solve problems that it is unable to solve when operating in isolation. It is a strategy that encourages companies who compete to come together and identify ways in which they can cooperate to their mutual benefit. Additionally, public sector entities such as the Lincoln County Commissioners, the White Pine County Commissioners, the Lincoln County Regional Development Authority, the White Pine Economic Diversification Council, the Nevada Commission on Economic Development, the U.S. Bureau of Land Management, the U.S. Forest Service and higher education systems such as the University and Community College Systems of Nevada can make themselves available to assist local clusters with collaborative problem solving and solution identification. A successful cluster-based economic development strategy with competitive cluster industries such as a pinyon-juniper biomass cluster would help Lincoln and White Pine counties to expand the number of high-paying jobs, increase the rate of new business formation, and enhance the innovative capacity for industries in the two county study area. Furthermore, and perhaps most importantly, cluster-based economic development provides a platform for long-term, sustained, economic growth.

Cluster-based development begins with the premise that a geographic region should identify a small number of economic sectors such as sectors within the pinyon-juniper biomass cluster to focus on a region's economic development strategy. For Lincoln and White Pine Counties, a firm in a competitive cluster is usually categorized into two areas. One is the cross-cutting firm who provides critical support to the region's economic base (agriculture, mining, and tourism). The second firm classification focuses on the productivity or delivery of a specific product or service.

How to Initiate Cluster Economic Development?

Having identified a competitive cluster, how does a cluster development get organized and supported? Support for a cluster can be provided in many ways. First, a **cluster champion** must be identified. This person would be a conduit for cluster activity. The champion must have knowledge of the industry. Much of the cluster champion's time would be spent in the field, getting to know companies and government agencies, identifying collaborative projects, and motivating relevant Lincoln and White Pine counties' stake holders. The cluster champion should also establish a forum through which key personnel for companies can come together to learn about industry best practices, and more importantly, to network with each other.

The champion is also the primary link to other clusters that may be identified in Lincoln and White Pine counties. Therefore the second necessary activity for cluster development and maintenance is **networking**. Networking is key for successful cluster development. Networking is the process through which relationships are built, trust is established, and new ideas are generated. A network could be developed by Lincoln and White Pine counties. This network would focus on Lincoln and White Pine counties' competitive clusters and how the proposed pinyon-juniper biomass cluster could interact with clusters not only in Lincoln and White Pine counties but region-wide.

Why Focus on Clusters?

Clusters bring a variety of benefits to firms and the state economy. The benefits of clusters could be best described by the Department of Trade and Industry in the United Kingdom (Carroll and Reid, 2005):

- Clusters increase levels of local expertise. This provides sourcing companies with a greater depth to their supply chain and allows for potential of inter-firm learning and cooperation.
- Clusters give firms the ability to draw together complementary skills in order to bid for large contracts that as individual units they would be unable to successfully complete.
- Clusters allow for potential economies of scale to be realized by further specializing in production within each firm, by joint purchasing of common raw materials to attract bulk discounts or by joint marketing.
- Clusters strengthen social and other informal links, leading to the creation of new ideas and new businesses.
- Clusters improve information flows within industries and government agencies. For example, clusters may enable finance providers to judge who are the good entrepreneurs and business people to find providers of goods and services.
- Clusters allow for the development of an infrastructure of professionals, legal, financial, and other specialist services.

Cluster-based economic development strategy around competitive clusters such as pinyon-juniper biomass cluster would provide an opportunity for Lincoln and White Pine counties to compete for future economic development. For this approach to be successful, it will require a united effort of both public and private support. It will require individual companies within the private sector to establish partnerships and joint ventures with other local businesses. In the public sector, it requires some re-directing of scarce resources towards cluster-based economic development strategies. To develop a successful Lincoln and White Pine counties pinyon-juniper biomass cluster strategy, this may require appointing a cluster champion and developing specific cluster strategy groups to address common issues for future economic development in Lincoln and White Pine counties.

REFERENCES

Carrol, M. and N. Reid. “Implementing Cluster-Based Economic Development,” Presented Paper at the Western Regional Science Association Meetings, San Diego, California, February 2005.

Dillman, D. Mail and Internet Surveys: The Tailored Design Method. John Wiley and Sons, Inc., 2000.

Energy Information Administration. "Energy Overview." Department of Energy, 2005.
.

Energy Information Administration. "Renewable Energy Trends 2004, Highlights." Department of Energy, 2005.

Energy Information Administration, "State Energy Data 2001: Prices and Expenditures" Department of Energy, 2005.

Haq, Z. "Biomass for Electricity Generation." Energy Information Administration, Department of Energy, 2002.

Morris, G. “Biomass Energy Production in California 2002: Update of the California Biomass Database.” National Renewable Energy Laboratory, Golden, CO. Available on-line at http://www.nrel.gov/docs/fy03osti/33111.pdf

Porter, M. The Competitive Advantage of Nations, The Free Press: New York, 1990.

CHAPTER III:

OVERVIEW OF LINCOLN AND WHITE PINE COUNTIES

Introduction

This section will provide a short synopsis of socio-economic trends in Lincoln and White Pine counties. An understanding of these trends provides information as to how development of local pinyon-juniper resources could impact Lincoln and White Pine counties' economic development and diversification activities. Detailed socio-economic data and analysis for Lincoln and White Pine counties are presented in five published University Center technical bulletins (Harris et al., 2004; Fadali et al., 2004; Harris et al., 2004; Harris, 2004; and Harris et al., 2001).

Socio-Economic Data Overview of Lincoln County

Lincoln County is located in the southeastern part of Nevada. Lincoln County is bordered by Nye County to the west, Clark County to the South, White Pine County to the north, and to the east by the Utah counties of Millard, Beaver, Iron, and Washington, and by the Arizona county of Mohave. The community of Pioche is the county seat with three additional population centers of Alamo, Caliente, and Panaca (Figure 10).

Tables 3 through 8 provide socio-economic data and trends for Lincoln County. Table 3 shows trends in population growth for Lincoln County and the Lincoln County communities of Alamo, Caliente, Panaca, and Pioche (Hardcastle, 2004). Beginning in 1996, the Nevada State Demographer initiated detailed community population estimates for the state of Nevada.

From Table 3, the population of Lincoln County declined from 3,983 in 1996 to 3,822 in 2004 or a 4.04% decrease in population over eight years. However, this population decrease was not uniform across the county. The Lincoln County communities of Alamo and Panaca realized population growth from 1996 to 2004. However, the community of Caliente and Pioche and the Rest of Lincoln County realized population decreases from 1996 to 2004.

During the eight year period from 1996 to 2004, population in Lincoln County declined by 4.04 percent. However, during this eight year period, population in the state of Nevada increased from 1,696,405 in 1996 to 2,410,768 in 2004 or a 42.11% increase. State of Nevada population increase primarily occurred in Clark County. Clark County

(Las Vegas) population increased from 1,119,052 in 1996 to 1,715,337 or a 53.28% increase over eight years. Therefore, it can be seen that Lincoln County population growth ran counter to overall state population growth. In order to reverse this population decline, Lincoln County may want to investigate alternative economic development and diversification strategies such as development of local pinyon-juniper resources.

Table 3. Population Estimates by Community for Lincoln County, Nevada, 1996 and 2004

Area	1996	2004	Annual Percentage Change
	(nos.)	(nos.)	(%)
Alamo	359	441	22.84
Caliente	1,121	1,014	-9.55
Panaca	399	552	38.35
Pioche	749	669	-10.60
Rest of Lincoln County	1,355	1,146	-15.42
Lincoln County	3,983	3,822	-4.04

Source: Hardcastle, Jeff. *Nevada County Population Estimates July 1, 1986 to July 1, 2004 Includes Cities and Towns*. The Nevada State Demographer's Office, University of Nevada, Reno, 2004.

Figure 10. Lincoln County, Nevada Cities and Travel Distances

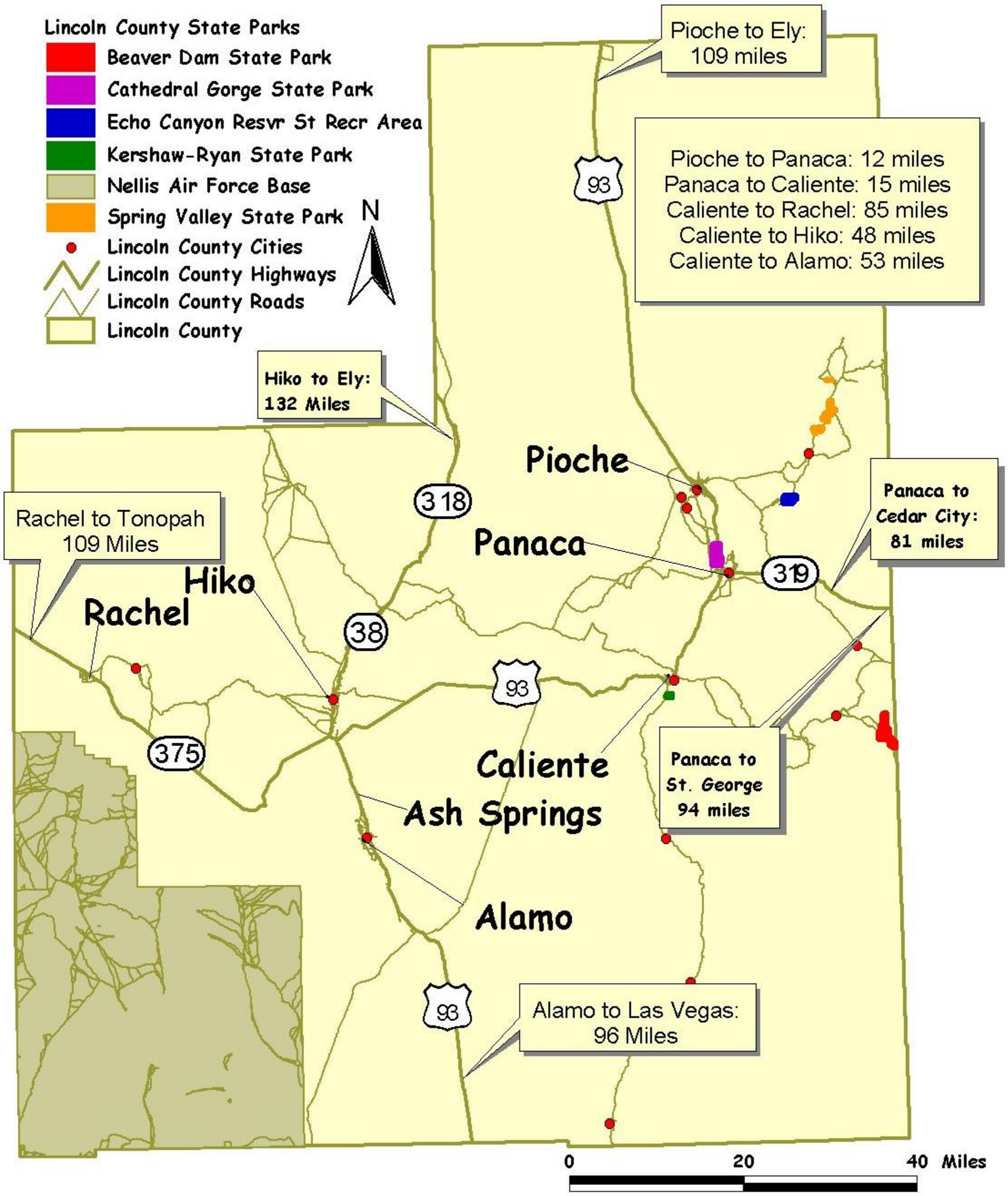


Table 4 uses Census data (U.S. Department of Commerce, 2001) to shed light on the aging of the population in Lincoln County. When analyzing the age grouping in Lincoln County, it should be noted that overall Census population for Lincoln County increased from 3,775 persons in 1990 to 4,165 persons in 2000. For the 20 to 24 years of age group and the 25 to 34 years of age group, their proportion share declined by 4%, and their absolute numbers decreased by 103 persons from 1990 to 2000. For these two age groups, population numbers decreased by 16.67% from 1990 to 2000.

The demographics for Lincoln County are somewhat similar to many rural counties in the nation. Often rural counties lose population in age groups 20 to 24 years and 25 to 34 years because the young people with the best education, health, the most marketable skills and abilities leave the rural areas to realize their potential in metropolitan counties. Lincoln County, like many rural counties from 1990 to 2000, realized a loss in population of persons between the ages of 20 to 35 years of age. Capturing the population age group of persons 20 to 34 years of age, the county area gains future leaders, innovators, and entrepreneurs. Taxes collected in the county to invest in local education will now earn dividends for the people and economies of other counties and states. Developing economic development programs such as pinyon-juniper resources may encourage young people of Lincoln County to remain in the county.

Table 5 shows the trends in labor for Lincoln County from 1999 to 2004. The unemployment rate has been somewhat erratic, decreasing from 5.9% in 1999 to 4.9% in 2002 and increasing to 5.4% in 2004.

The volatility in Lincoln County unemployment rate is also evident in all aspects of the Lincoln County labor market. Number of employed persons who live in Lincoln County increased from 1,048 in 1999 to 1,697 in 2002. However, the labor force in Lincoln County declined from 1,785 in 2002 to 1,564 in 2004 or a 12.38% decrease in labor force over two years. One primary reason for the stabilization in unemployment rate in Lincoln County from 2003 to 2004 is not elevated county economic activity, but the county workforce leaving the county. A pinyon-juniper biomass industry could help stabilize and diversify the Lincoln County economy which may reduce the instability in the Lincoln County workforce.

Table 4. Population by Age and Proportionate Share of Population by Age for Lincoln County, 1990 and 2000.

	1990		**2000**	
Age Group	**Number**	**Proportionate share**	**Number**	**Proportionate share**
		(%)		(%)
Under 5	304	8.05	262	6.29
5 to 9	315	8.34	266	6.39
10 to 14	356	9.43	377	9.05
15 to 19	275	9.11	461	11.07
20 to 24	142	3.76	137	3.29
25 to 34	476	12.61	378	9.08
35 to 44	440	11.66	534	12.82
45 to 54	399	10.57	536	12.87
55 to 59	199	5.27	278	6.67
60 to 64	170	4.50	263	6.31
65 to 74	354	9.38	373	8.96
75 to 84	208	5.51	230	5.52
85 and above	68	1.80	70	1.68
TOTAL	3,775	100.00	4,165	100.00

Source: U.S. Department of Commerce. Table DP-1, Profile of General Demographic Characteristics: 2000." Bureau of Census: Washington D.C. 2001.

Table 5. Annual Labor Data for Lincoln County from 1999 to 2004.

Year	**Employment (nos)**	**Unemployed (nos)**	**Labor Force (nos)**	**Unemployment Rate (%)**
1999	1,048	66	1,114	5.9
2000	1,575	82	1,657	4.9
2001	1,685	95	1,753	5.4
2002	1,697	88	1,785	4.9
2003	1,515	87	1,602	5.4
2004	1,470	95	1,564	5.4

Source: State of Nevada Department of Employment, Training, and Rehabilitation. "County Labor Force Data", Employment Research Division, Carson City, Nevada, Various Issues.

Table 6 shows taxable sales in Lincoln County from 1997 to 2004 (State of Nevada Department of Taxation, Various Issues). Both nominal and real Lincoln County taxable sales are calculated. Real taxable sales are net of inflation so that all real taxable sales are based on 2000 prices. Table 6 shows the cyclical nature of Lincoln County taxable sales that reflect Lincoln County economic activity from 1997 to 2004. Nominal taxable sales for Lincoln County increased from $21,777,163 in 1997 to $24,130,567 in 2004 or a 10.81% increase in nominal taxable sales. However, real taxable sales decreased from $22,873,730 in 1997 to $22,118,046 in 2004 or a 3.30% decrease in real taxable sales in eight years. Also of interest is that real taxable sales for Lincoln County declined by 34.8% in one year from 2003 to 2004.

Table 7 shows sectoral personal income and proportionate shares of personal income for the nation, State of Nevada, and Lincoln County. From Table 7, national per capita income in 2003 was $31,472, which was 1.37% less than the state per capita income value ($31,910) and 52.47% greater than the Lincoln County per capita income value ($20,641). Also from Table 7, the growing influence and impact of the elderly in the national, state, and county economy is indicated by the proportionate share of personal income from dividends, interest, and rents; and transfer payments. These sources are primarily earned by the retired population. For the nation, dividends, interests, and rents and transfer payments make up approximately 31% of total earned personal income, which for the State of Nevada and Lincoln County it is approximately 31% and approximately 42%, respectively.

Table 6 Nominal and Real Taxable Sales for Lincoln County, 1997 to 2004.

Year	Nominal		Real[a]	
	Sales	Annual Percent Change	Sales	Annual Percent Change
		(%)		(%)
1997	$21,777,163		$22,873,730	
1998	$16,663,636	-23.48	$17,313,048	-24.31
1999	$22,421,738	34.55	$22,955,687	32.59
2000	$25,193,612	12.56	$25,193,612	9.75
2001	$22,260,136	-11.64	$21,770,730	-13.59
2002	$22,350,942	0.41	$21,529,796	-1.11
2003	$36,106,365	61.54	$33,964,879	53.56
2004	$24,130,567	-33.17	$22,118,046	-34.88

[a]GDP price deflator where 2000 = 100.00

Source: State of Nevada Department of Taxation. "Sales and Use Taxes", Carson City, Nevada, Various Issues.

Table 7. Personal Income by Economic Sector for the United States, State of Nevada, and Lincoln County, 2003.

	Income			Shares		
Sector	**U.S. ($1,000)**	**Nevada ($1,000)**	**Lincoln County ($1,000)**	**U.S. (%)**	**Nevada (%)**	**Lincoln County (%)**
Farm	45,594,000	98,593	2,089	0.50	0.14	2.37
Forestry & Related	26,962,000	34,889	D	0.29	0.05	D
Mining	56,509,000	765,749	D	0.62	1.07	D
Utilities	73,585,000	536,945	D	0.80	0.75	D
Construction	430,782,000	5,959,452	3,580	4.71	8.33	4.05
Manufacturing	954,525,000	2,598,428	593	10.43	3.63	0.67
Wholesale Trade	365,248,000	2,098,563	D	3.99	2.93	D
Retail Trade	483,598,000	4,257,832	3,640	5.28	5.95	4.12
Transportation & Warehousing	231,926,000	1,718,504	D	2.53	2.40	D
Information	276,104,000	1,122,437	D	3.02	1.57	D
Finance & Income	531,843,000	3,498,071	1,303	5.81	4.89	1.48
Real Estate	175,768,000	1,560,142	256	1.92	2.18	0.29
Professional & Technical Services	647,068,000	3,863,188	D	7.07	5.40	D
Management of Companies & Enterprises	145,304,000	1,177,263	0	1.59	1.65	0
Administrative & Waste Services	254,628,000	2,239,433	603	2.78	3.13	D
Educational Service	93,434,000	164,076	D	1.02	0.23	D
Health Care & Social Assistance	670,247,000	3,943,672	D	7.32	5.51	D
Arts, Entertainment, & Recreation	77,378,000	1,139,554	D	0.85	1.59	D
Accommodations & Food Services	195,271,000	9,095,355	D	2.13	12.71	D
Other Services, exc. Public Administration	213,989,000	1,236,431	D	2.34	1.72	D
Federal Government, Military	109,607,000	791,506	275	1.20	1.73	0.31
Federal Government, Civilian	219,213,000	1,236,431	2,293	2.53	1.11	2.60
State and Local Government	835,168,000	6,113,080	D	9.13	8.55	D
Dividends, Interest, & Rents	1,475,529,000	14,153,526	16,140	16.12	19.78	18.28
Transfer Payments	1,335,323,000	8,109,641	20,558	14.59	11.33	23.28
Total Place of Residence Personal Income	9,151,694,000	68,819,511	88,303			
Per Capita Income	31,472	31,910	20,641			

D stands for non-reported or information suppressed. This is a disclosure problem.
Source: U.S. Department of Commerce. "Regional Economic Information System", Bureau of Economic Analysis: Washington, D.C., 2005.

From Table 7, the county's low per capita income and heavy reliance on dividends, interests, and rents; and transfer payments indicate that alternative economic development strategies are needed for Lincoln County. Development of a local pinyon-juniper industry may contribute to diversification of sources of income for Lincoln County.

A final unique characteristic of Lincoln County is found in Table 8. In terms of landmass, Lincoln County ranks as the third largest county in the state of Nevada with 6,816,597 acres. The federal government administers approximately 98% of the land in Lincoln County, with the Bureau of Land Management managing approximately 83.04% of total Lincoln County acreage.

Also from Table 8, the state government of Nevada administers approximately 18,802 acres or 0.28% of total Lincoln County land mass. A unique feature of Lincoln County as opposed to other Nevada counties is that Lincoln County has five state parks that offer numerous camping, hiking, fishing, and other outdoor recreation opportunities.

Therefore, both federal and state government can play an important role in the successful development and execution of any county strategic economic development plan. The federal government, by the vast acreage it administers in Lincoln County, and the state government, by its five state parks, influences current and future economic development and diversification plans for Lincoln County (Figure 11).

Given the "boom-bust" cycles that have been experienced in Lincoln County from the cyclical natural resource sectors (agriculture and mining) and federal military operations (test site and proposed nuclear waste repository at Yucca Mountain), the industrial utilization of locally derived pinyon-juniper biomass and encouragement of related spin-off industries could become a priority objective for Lincoln County decision makers. Given vast federal government operations and five state parks, commercial development of local pinyon-juniper resources and spin-off industries from local pinyon-juniper resources could potentially establish a rather stable economy given the volatility of natural resource industries and federal military and non-military operations.

Figure 11. Lincoln County Nevada State Parks

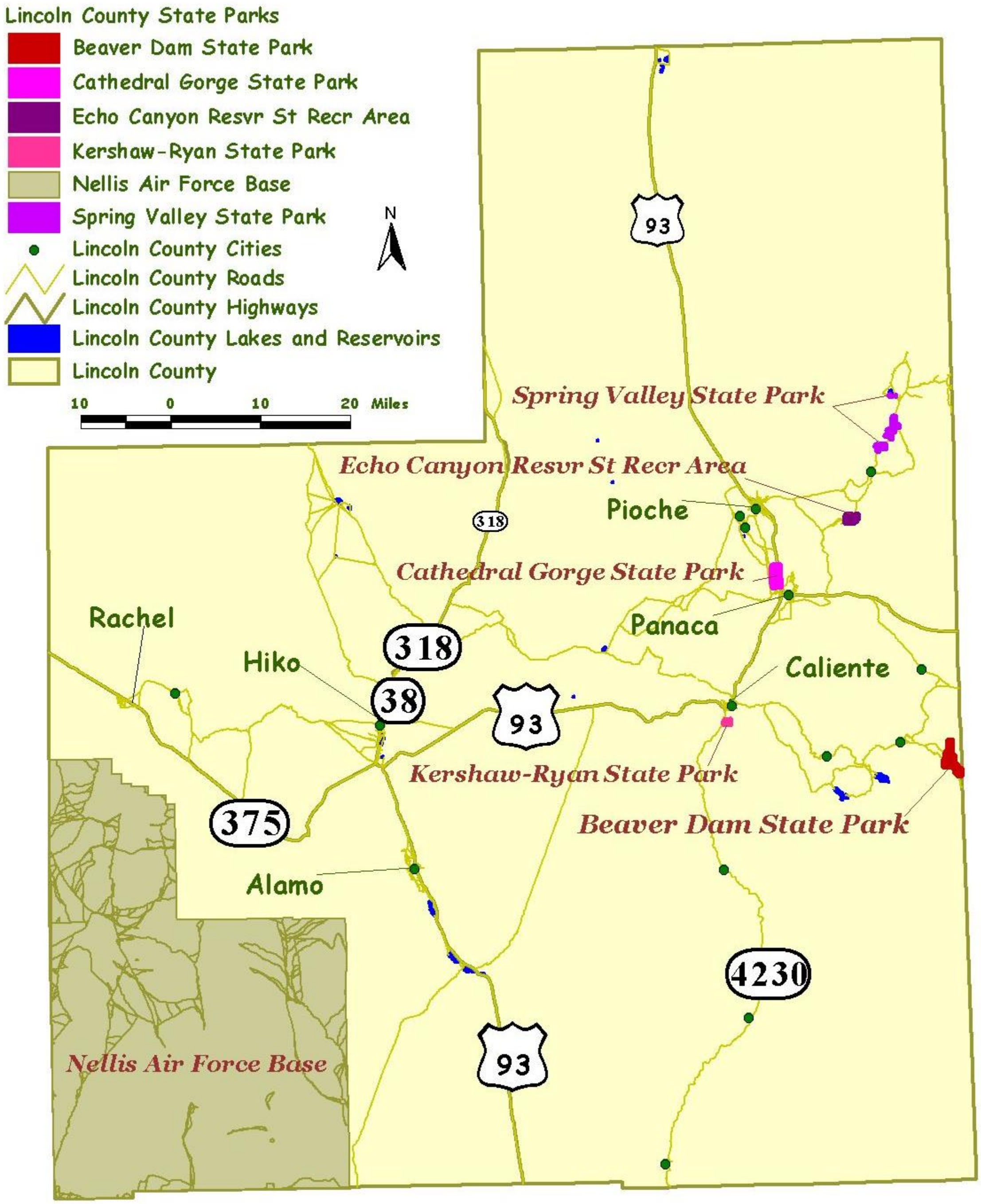


Table 8. Federal, State and Local Government and Private Sector Lands in Lincoln County, 2000.

Categories	**Acreage**	**Share of Total**
	(acres)	**(%)**
Federal Agencies:		
Bureau of Land Management	5,660,396	83.04
Forest Service	30,703	0.45
Other Federal Agencies	1,009,188	14.80
Total Federal Lands	6,700,287	98.20
Native American Reservations	0	0.00
State Government Lands	18,802	0.28
Local Government and Private Sector Lands	97,509	1.43
TOTAL	6,816,597	100.00

Source: Zimmerman, J. and T. Harris. *An Update of Federal and State Land-Based Payments in Nevada*. University of Nevada, Reno: Reno, Nevada, University Center for Economic Development Technical Report UCED 2000/01-06, 2000.

Socio-Economic Data Overview of White Pine

White Pine County is located in the northeastern part of Nevada. The county is bordered by Elko County to the north, Eureka County to the west, and Nye and Lincoln Counties to the south. Its western edge borders Utah's Juab and Miller counties. The community of Ely is the county seat with three additional communities of Lund, McGill, and Ruth (Figure 12).

Tables 9 through 14 provide socio-economic data and trends for White Pine County. Table 9 shows trends in population growth for White Pine County and the White Pine County communities of Ely, McGill, and Ruth (Hardcastle, 2004). Beginning in 1996, the Nevada State Demographer initiated detailed community population estimates for the state of Nevada.

From Table 9, the population for White Pine County declined from 10,134 in 1996 to 8,966 in 2004 or an 11.53% decrease in population over eight years. However, this population decrease was not uniform across the county. White Pine County designated as Rest of White Pine County realized population growth from 1996 to 2004. However, the communities of Ely, Lund, McGill, and Ruth realized population decreases from 1996 to 2004.

During the eight year period from 1996 to 2004, population in White Pine County declined by 11.53%. However, during this eight year period, population in the state of Nevada increased from 1,696,405 in 1996 to 2,410,768 in 2004 or a 42.11% increase. State of Nevada population increase primarily occurred in Clark County. Clark County (Las Vegas) population increased from 1,119,052 in 1996 to 1,715,337 or a 53.28% increase over eight years. Therefore, it can be seen that White Pine County population growth ran counter to overall state population growth. In order to reverse this population decline, White Pine County may want to investigate alternative economic development and diversification strategies such as development of local pinyon-juniper resources.

Table 9. Population Estimates by Community for White Pine County, Nevada, 1996 and 2004

Area	1996	2004	Percentage Change
	(nos.)	(nos.)	(%)
Ely	4,819	2,962	-38.53
Lund	179	147	-17.88
McGill	1,299	1,079	-16.94
Ruth	451	379	-15.96
Rest of White Pine County	3,386	4,399	29.92
White Pine County	10,134	8,966	-11.53

Source: Hardcastle, Jeff. *Nevada County Population Estimates July 1, 1986 to July 1, 2004 Includes Cities and Towns*. The Nevada State Demographer's Office, University of Nevada, Reno, 2004.

Figure 12. White Pine County, Nevada Cities and Travel Distances

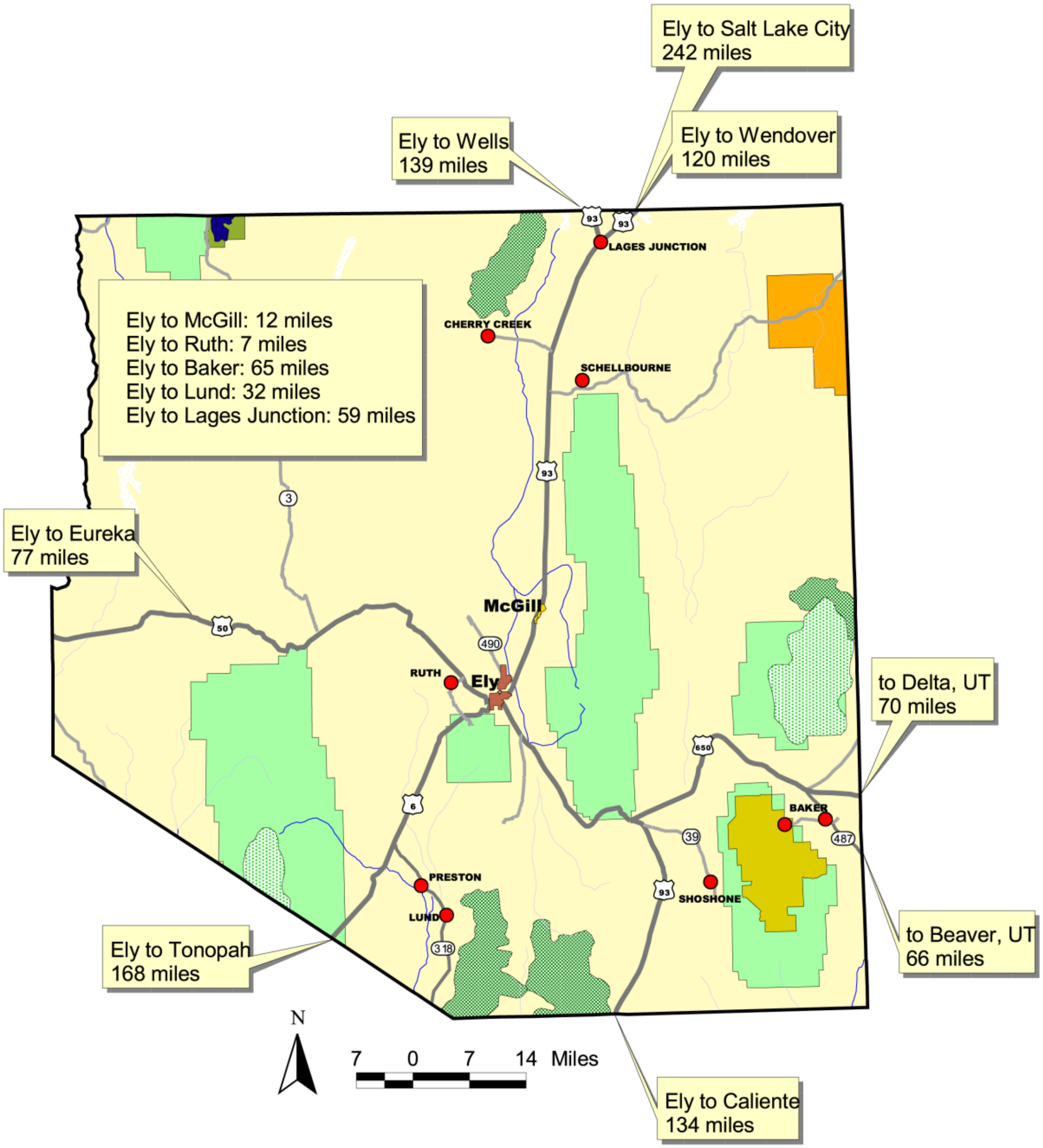


Table 10 uses Census data (U.S. Department of Commerce, 2001) to shed light on the aging of the population in White Pine County. When analyzing the age grouping in White Pine County, it should be noted that overall Census population for White Pine County decreased from 9,264 persons in 1990 to 9,181 persons in 2000. For the 20 to 24 years of age group and the 25 to 34 years of age group, their proportion share declined by three percent, and their absolute numbers decreased by 299 persons from 1990 to 2000. For these two age groups, population numbers decreased by 14.39% from 1990 to 2000.

The demographics for White Pine County are somewhat similar to many rural counties in the nation. Often rural counties lose population in age groups 20 to 24 years and 25 to 34 years because the young people with the best education, health, the most marketable skills and abilities leave the rural areas to realize their potential in metropolitan counties. White Pine County, like many rural counties from 1990 to 2000, realized a loss in population of persons between the ages of 20 to 35 years of age. Capturing the population age group of persons 20 to 34 years of age, the county area gains future leaders, innovators, and entrepreneurs. Taxes collected in the county to invest in local education will now earn dividends for the people and economies of other counties and states. Developing economic development programs such as pinyon-juniper resources may encourage young people of White Pine County to remain in the county.

Table 11 shows the trends in labor for White Pine County from 1999 to 2004. The unemployment rate has been somewhat erratic, increasing from 3.6% in 1999 to 4.6% in 2001 and decreasing to 4.0% in 2004.

The erratic unemployment rate for White Pine County is also evident for White Pine County employment, number of unemployed, and labor force. White Pine County labor force increased from 3,457 in 1999 to 3,772 in 2000, decreased in 2001 to 3,655, increased once again to 3,837 in 2002, decreased once again to 3,710 in 2003, and finally increased to 3,911 in 2004. This volatility in the local labor market is a result of the White Pine County economy being heavily dependent upon natural resource industries. Economic activity of the agricultural and mining sectors are impacted by national and international markets and therefore highly variable. Industrial utilization of pinyon-juniper biomass may help stabilize the White Pine County economy labor market.

Table 10. Population by Age and Proportionate Share of Population by Age for White Pine County, 1990 and 2000.

	1990		2000	
Age Group	**Number**	**Proportionate share**	**Number**	**Proportionate share**
		(%)		(%)
Under 5	731	7.89	550	5.99
5 to 9	748	8.07	604	6.58
10 to 14	728	7.80	662	7.21
15 to 19	567	6.12	590	6.43
20 to 24	544	5.87	509	5.54
25 to 34	1,534	16.56	1,270	13.83
35 to 44	1,429	15.43	1,477	16.09
45 to 54	1,023	11.04	1,371	14.93
55 to 59	456	4.92	481	5.24
60 to 64	421	4.54	428	4.66
65 to 74	678	7.32	682	7.43
75 to 84	332	3.58	436	4.75
85 and above	78	0.84	121	1.32
TOTAL	9,264	100.00	9,181	100.00

Source: U.S. Department of Commerce. Table DP-1, Profile of General Demographic Characteristics: 2000." Bureau of Census: Washington D.C. 2001.

Table 11. Annual Labor Data for White Pine County from 1999 to 2004.

Year	Employment (nos)	Unemployed (nos)	Labor Force (nos)	Unemployment Rate (%)
1999	3,331	126	3,457	3.6
2000	3,615	157	3,772	4.2
2001	3,487	168	3,655	4.6
2002	3,675	162	3,837	4.2
2003	3,551	159	3,710	4.3
2004	3,753	158	3,911	4.0

Source: State of Nevada Department of Employment, Training, and Rehabilitation. "County Labor Force Data", Employment Research Division, Carson City, Nevada, Various Issues.

Table 12 shows taxable sales in White Pine County from 1997 to 2004 (State of Nevada Department of Taxation, Various Issues). Both nominal and real White Pine County taxable sales are calculated. Real taxable sales are net of inflation so that all real taxable sales are based on 2000 prices. Table 12 shows the cyclical nature of White Pine County taxable sales and the impacts of opening and closure of mining operations in White Pine County. Nominal taxable sales for White Pine County decreased from $133,508,480 in 1997 to $80,818,882 in 2004 or a 39.47% decrease in nominal taxable sales. Real taxable sales decreased from $139,925,462 in 1997 to $74,078,481 in 2004 or a 47.06% decrease in real taxable sales.

Table 13 shows sectoral personal income and proportionate shares of personal income for the nation, State of Nevada, and White Pine County. From Table 13, national per capita income in 2003 was $31,472, which was 1.37% less than the state per capita income value ($31,910) and 19.08% greater than the White Pine County per capita income value ($26,429). Also from Table 13, the growing influence and impact of the elderly in a national, state, and county economy is indicated by the proportionate share of personal income from dividends, interest, and rents; and transfer payments. These sources are primarily earned by the retired portion of the population. For the nation, dividends, interests, and rents and transfer payments make up approximately 31% of total earned personal income, which for the State of Nevada and White Pine County is approximately 31% and approximately 31%, respectively.

Table 12. Nominal and Real Taxable Sales for White Pine County, 1997 to 2004.

Year	Nominal		Real[a]	
	Sales	Annual Percent Change	Sales	Annual Percent Change
1997	$133,508,480		$139,925,462	
1998	$117,329,758	-12.12	$121,620,530	-13.08
1999	$109,584,923	-6.60	$111,972,170	-7.93
2000	$75,591,498	-31.02	$75,591,498	-32.49
2001	$65,252,313	-13.68	$63,723,584	-15.70
2002	$68,424,534	4.86	$65,674,733	3.06
2003	$70,689,758	3.31	$66,497,115	1.25
2004	$80,818,882	14.33	$74,078,481	11.40

[a]GDP price deflator where 2000 = 100.00
Source: State of Nevada Department of Taxation. "Sales and Use Taxes", Carson City, Nevada, Various Issues.

Table 13. Personal Income by Economic Sector for the United States, State of Nevada, and White Pine County, 2003.

	Income			Shares		
Sector	**U.S. ($1,000)**	**Nevada ($1,000)**	**White Pine County ($1,000)**	**U.S. (%)**	**Nevada (%)**	**White Pine County (%)**
Farm	45,594,000	98,593	4,015	0.50	0.14	1.78
Forestry & Related	26,962,000	34,889	D	0.29	0.05	D
Mining	56,509,000	765,749	8,096	0.62	1.07	3.58
Utilities	73,585,000	536,945	D	0.80	0.75	D
Construction	430,782,000	5,959,452	5,155	4.71	8.33	2.28
Manufacturing	954,525,000	2,598,428	1,178	10.43	3.63	0.52
Wholesale Trade	365,248,000	2,098,563	1,731	3.99	2.93	0.77
Retail Trade	483,598,000	4,257,832	9,044	5.28	5.95	4.00
Transportation & Warehousing	231,926,000	1,718,504	D	2.53	2.40	D
Information	276,104,000	1,122,437	1,075	3.02	1.57	0.48
Finance & Income	531,843,000	3,498,071	3,633	5.81	4.89	1.61
Real Estate	175,768,000	1,560,142	704	1.92	2.18	0.31
Professional & Technical Services	647,068,000	3,863,188	2,285	7.07	5.40	1.01
Management of Companies & Enterprises	145,304,000	1,177,263	0	1.59	1.65	0
Administrative & Waste Services	254,628,000	2,239,433	1,453	2.78	3.13	0.64
Educational Service	93,434,000	164,076	D	1.02	0.23	D
Health Care & Social Assistance	670,247,000	3,943,672	D	7.32	5.51	D
Arts, Entertainment, & Recreation	77,378,000	1,139,554	1,025	0.85	1.59	0.45
Accommodations & Food Services	195,271,000	9,095,355	6,810	2.13	12.71	3.01
Other Services, exc. Public Administration	213,989,000	1,236,431	4,294	2.34	1.72	1.90
Federal Government, Military	109,607,000	791,506	545	1.20	1.73	0.24
Federal Government, Civilian	219,213,000	1,236,431	11,725	2.53	1.11	5.19
State and Local Government	835,168,000	6,113,080	63,514	9.13	8.55	28.10
Dividends, Interest, & Rents	1,475,529,000	14,153,526	32,443	16.12	19.78	14.35
Transfer Payments	1,335,323,000	8,109,641	38,480	14.59	11.33	17.02
Total Place of Residence Personal Income	9,151,694,000	68,819,511	226,051			
Per Capita Income	31,472	31,910	26,429			

D stands for non-reported or information suppressed. This is a disclosure problem.
Source: U.S. Department of Commerce. "Regional Economic Information System", Bureau of Economic Analysis: Washington, D.C., 2005.

From Table 13, the county's low per capita income indicates that alternative economic development strategies are needed for White Pine County. One economic development and diversification alternative to increase county per capita income would be development of local pinyon-juniper resources.

A final unique characteristic of White Pine County is found in Table 14. In terms of landmass, White Pine County ranks as fifth largest county in the state of Nevada with 5,669,200 acres. The federal government administers approximately 94% of the land in White Pine County, with the Bureau of Land Management managing approximately 78% of total White Pine County acreage. Also from Table 14, the state government of Nevada administers approximately 9,119 acres or 0.16% of total White Pine County land mass.

Therefore, both federal and state government can play an important part in the successful development and execution of any county strategic economic development plan. The federal government, by the vast acreage it administers in White Pine County, can influence current and future economic development and diversification plans for White Pine County (Figure 13).

Given the "boom-bust" cycles that have been experienced in White Pine County from the cyclical natural resource sectors (agriculture and mining), the industrial utilization of locally derived pinyon-juniper biomass and encouragement of related spin-off industries could become a priority objective for White Pine County decision makers. Given vast federal government operations, commercial development of local pinyon-juniper resources and spin-off industries from local pinyon-juniper resources could potentially establish a rather stable economy given the volatility of natural resource industries and federal military and non-military operations. However, investigating past socio-economic trends provides an understanding of the economic base in Lincoln and White Pine Counties.

Figure 13. White Pine County, Nevada National Park and Wildlife Refuge, Wilderness/Wilderness Study Areas and Forest Service Lands

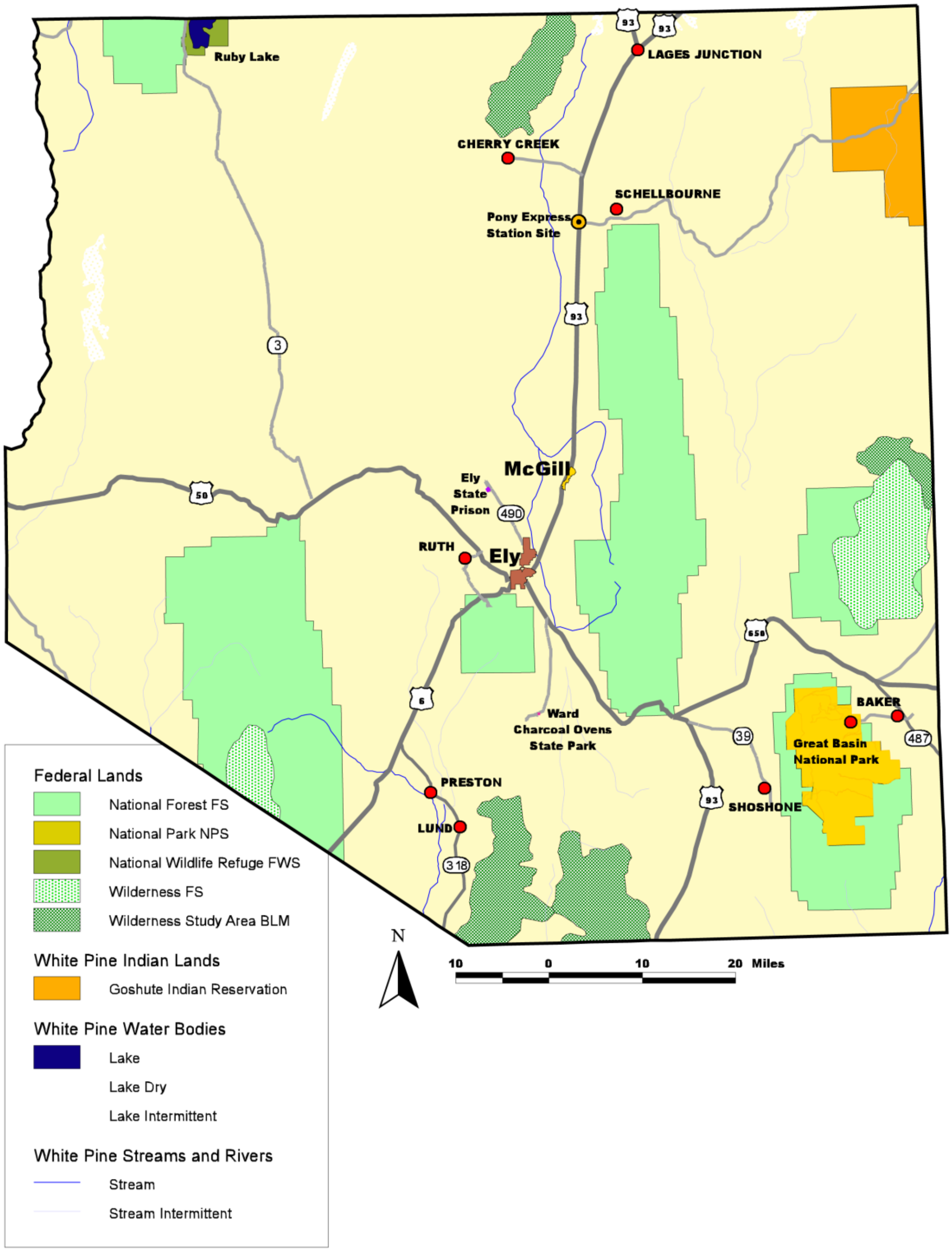


Table 14. Federal, State and Local Government and Private Sector Lands in White Pine County, 2000.

Categories	**Acreage**	**Share of Total**
	(acres)	**(%)**
Federal Agencies:		
Bureau of Land Management	4,416,880	77.50
Forest Service	826,384	14.50
Other Federal Agencies	87,198	1.53
Total Federal Lands	5,330,462	93.53
Native American Reservations	70,670	1.24
State Government Lands	9,119	0.16
Local Government and Private Sector Lands	288,949	5.07
TOTAL	5,669,200	100.00

Source: Zimmerman, J. and T. Harris. *An Update of Federal and State Land-Based Payments in Nevada*. University of Nevada, Reno: Reno, Nevada, University Center for Economic Development Technical Report UCED 2000/01-06, 2000.

Forecasted Population Growth in Lincoln and White Pine Counties

Often a criticism of economic development and diversification analysis by Barkley et al. (1998) was that economic development and diversification plans were based on past economic and/or population growth which might be at the end of its growth phase. Past sectoral employment growth may be a poor predictor of future economic and employment growth as well as pinyon-juniper demands. Therefore for this analysis county projected population employment growth will be incorporated into this analysis.

Population Growth

The Nevada Office of the State Demographer estimates county population growth from 2004 to 2024 (Hardcastle, 2004). Table 15 shows state of Nevada, Lincoln County, White Pine County, and Clark County forecasted population growth from 2005 to 2024. The state of Nevada is forecasted to increase from 2,448,021 in 2005 to 3,625,482 in 2024 or a 48.10% increase in population. Again, Clark County is forecasted to realize most of the state's population growth growing from 1,751,608 in 2005 to 2,751,082 in 2024 or a 57.06% increase in county population.

As for the study area counties of Lincoln and White Pine, forecasted population growth in Lincoln County is less than the state while White Pine County is forecasted to lose population. Lincoln County is forecasted to realize population growth from 3,870 in 2005 to 5,292 in 2004 or a 36.74% increase in population. However the forecasted population increase in Lincoln County may be conservative given the Coyote Springs and Toquop residential developments. These residential developments may greatly increase the population growth in Lincoln County and could increase the commercial and energy demands for local pinyon-juniper resources.

As opposed to state, Clark County, and Lincoln County forecasted population trends, population in White Pine County is forecasted to decline from 8,760 in 2005 to 7,221 in 2024 or a 17.57 percent decline in county population. This forecast was completed before the copper mine resumed operations and other mineral sector activity had risen in Northeastern Nevada. This population projection, like Lincoln County's, may be conservative and could be revised in future population projections. However these conservative population projections indicate a state economy that is expanding as well as the economies of Clark and Lincoln counties. As for White Pine County, the economy may be stagnate or even decrease slightly. However with expansion in the mineral industry and increased economic activity in Lincoln County, White Pine County would also realize increased demands for pinyon-juniper resources for commercial and energy demands.

Table 15. Forecasted Population for the State of Nevada, Lincoln County, White Pine County, and Clark County, 2005 to 2024

YEAR	State of Nevada	Lincoln County	White Pine County	Clark County
2005	2,448,201	3,870	8,760	1,751,608
2010	2,806,940	4,222	8,545	2,058,063
2015	3,125,677	4,619	7,816	2,328,564
2020	3,412,147	5,005	7,445	2,569,960
2025	3,625,482	5,292	7,221	2,751,082

Source: Hardcastle, J. Nevada. *Nevada County Population Projections 2004 to 2024*. The Nevada State Demographer's Office, University of Nevada, Reno, 2004.

REFERENCES

Hardcastle, J. *Nevada County Population Estimates July 1, 1986 to July 1, 2004 Includes Cities and Towns*. The Nevada State Demographer's Office, University of Nevada, Reno, 2004.

Hardcastle, J. Nevada. *Nevada County Population Projections 2004 to 2024*. The Nevada State Demographer's Office, University of Nevada, Reno, 2004.

U.S. Department of Commerce. Table DP-1, Profile of General Demographic Characteristics: 2000." Bureau of Census: Washington D.C. 2001.

State of Nevada Department of Employment, Training, and Rehabilitation. "County Labor Force Data", Employment Research Division, Carson City, Nevada, Various Issues.

State of Nevada Department of Taxation. "Sales and Use Taxes", Carson City, Nevada, Various Issues.

U.S. Department of Commerce. "Regional Economic Information System", Bureau of Economic Analysis: Washington, D.C., 2004.

Zimmerman, J. and T. Harris. *An Update of Federal and State Land-Based Payments in Nevada*. University of Nevada, Reno: Reno, Nevada, University Center for Economic Development Technical Report UCED 2000/01-06, 2000.

CHAPTER IV:

POTENTIAL INDUSTRIAL DEMANDS FOR PINYON-JUNIPER RESOURCES

Potential Industrial Demands for Pinyon-Juniper Resources

This chapter will investigate various potential commercial, industrial, and governmental demands for pinyon-juniper. This analysis will investigate non-energy demands for pinyon and juniper such as landscaping groundcovers and composite materials as well as energy biomass demands for space heating, electric power generation, and public building demands as well as emerging technologies.

Alternative Industrial Demands for Pinyon-Juniper

Below are detailed analyses of alternative demands for pinyon-juniper resources. Information from this section could be used in a detailed feasibility analysis of a specific pinyon-juniper enterprise.

Landscaping Materials, Soil Amendments and Animal Litters

Biomass from pinyon-juniper thinning operations can be chipped for animal litters and bedding, mulches or soil amendments. The national market for these types of products is obviously quite large, but the demand is generally being met by a large number of existing competitors who often can produce them cheaply as by-products of other types of wood industries (Thomas and Schumann, 1993). In addition, Lincoln and White Pine counties face large transportation costs to any sizable market area, which can be exacerbated by rising fuel costs. The most promising avenues for entrepreneurs in White Pine and Lincoln counties may be to either serve local needs for these types of products or to develop a specialized niche market in this type of product. Higher value products typically require increased processing. For example, bark can be separated from the wood or chips can be sorted by size to produce a more consistent looking product or chips can be dyed an attractive color. Bagging wood mulch materials can also add significant value. Bark separation is likely not economically feasible for pinyon-juniper from thinning operations, but sorting, dying and bagging the chips may be[3]. In fact, one company from Cedar City, Utah, using the U.S. Stewardship Program (this program is described in detail later in this section) to assist in covering transportation costs, has reportedly already been able to make use of the pinyon-juniper chips in this way

[3] One Oregon entrepreneur claims to be able to profitably debark small diameter wood on-site (Noble, 2005). However, other experts believe debarking pinyon and juniper is likely to be too costly (Tausch, 2005, Intertech Services, 2005)

(Coombs, 2005). Niche products typically have added value from extra processing, not all of which are possible with pinyon-juniper resources. The added value expands the market place which can feasibly be served because the higher value justifies higher shipping costs.

Using pinyon-juniper woodchips for a landscaping material may be a feasible enterprise. Many types of wood chips are currently being used for landscaping, although no studies on the use of pinyon-juniper wood chips for landscaping could be located.[4] Pine products are routinely used for landscaping purposes, and it is likely that juniper would also be suitable. Aging or composting of the chips is often advised in order to reduce nitrogen deficiency problems when applying the chips to the landscape. Normally, 2 to 4 inches of the material may be applied to the top of the soil around plantings or incorporated into the soil as an amendment. Before widespread use of pinyon-juniper mulch, some testing of the products for any potential toxicity from naturally occurring compounds should first be completed (Johnson, 2005).

Local demands for landscaping mulch were researched for Lincoln and White Pine counties. Only one local retailer of mulching products could be found in the area. The current demand for landscape maintenance use of wood mulching materials in the area was estimated to be a minimum of 1.4 cubic feet per household per year. This would yield a total of approximately 276 cubic yards per year if both counties are assumed to have a similar per household demand. A check of retail prices for wood landscaping materials in Nevada indicated that prices vary from $16 to $61 per cubic yard, depending on sales location, size, aesthetic characteristics and whether or not the material is bagged.[5] There is typically a 35 percent mark-up between wholesale and retail prices for mulch materials (Thomas and Schumann, 1993). Further research could reveal to what extent this existing demand for wood mulch products could be met with pinyon-juniper wood chips and the type of product likely to have the most success. Without any

---

[4]One study discusses the first year result from various depths of pinyon-juniper chip mulch on reseeding efforts in wildland areas and tests mulch effects on perennial grasses and other seeds germination rates in a greenhouse setting. Resource Concepts. "Pinyon-Juniper Biomass Utilization Study for Lincoln County, Nevada." September 2004.

[5] There were also several reports of free mulch material available in White Pine County. Although this is a good practical solution for government agencies that need to dispose of wood wastes in the least expensive manner, as well as beneficial to local residents, the practice may make it difficult for any local enterprise that would attempt to sell the wood chips for landscaping locally.

population growth in the region, however, the magnitude of local demand is likely not to be large enough to justify more research or investment by itself. Mulch might make up one component of an enterprise.

If housing developments such as the Coyote Springs and Toquop projects in Lincoln County were to add large numbers of new homes and businesses to the area, a potentially larger source of local demand for landscaping mulch materials might be realized. For example, a typical single family house could conservatively use as much as three cubic yards of mulching material to cover 500 square feet of landscape at an application rate of 2 inches in depth when the initial landscape is established. Since plans are for as many as 50,000 new residences in the Coyote Springs development and as many as 60,000 people in the Toquop area near Mesquite, potential demand could be quite large (Associated Press, 2005, Rake, 2005). However, plans for the first phase of development are for using solely rock mulching materials for single family residences. Rock is favored over mulch cover because of the area's dry climate. Wood materials are not favored by the first phase developer because of its tendency to dry up and blow off. Some experts, however, assert that wood absorbs less heat and provides cooler mulch that requires less water use. This concern would clearly have to be researched and addressed if Coyote Springs and Toquop are to absorb any large amounts of wood material as a mulch cover for landscaping. The Coyote Springs Investments group did express some interest in using the material as a low-cost soil amendment (Caringer, 2005). The developers of these areas would require cheaper bulk type products, whereas residential consumers might be more willing to buy higher priced bagged materials. Bulk mulch products are considered to be at the low end of the value-added ladder for uses of small diameter woods, however (LeVan and Livingston, 2001).

There is likely very little market locally for bedding material associated with the livestock industry since there are very few confined animal operations in the region. Some small businesses have had some success in filling niche markets in the larger regional market. For example, SBS Shavings of New Mexico produces shavings used for pet or livestock bedding that they ship to five surrounding states. The operation uses 4 to 12 inch diameter wood from fire mitigation work around Ruidoso, New Mexico. The product is high-quality and marketed as especially dust-free and absorbent. The operation employs six people and currently requires approximately 3,900 cords of wood per year. Grants from several different sources were used to help pay for equipment, design and transportation systems. Reliability of supply for the long-term remains an issue for the company. The smaller diameter wood (1 to 5 inches) from the thinning is used by a second near-by business, Sierra Contracting. Sierra Contracting uses a tub grinder to create compost and mulch. The company also charges $3.75 a cubic yard for taking wood waste materials from the City of Ruidoso, providing an alternative to paying tipping fees at a far-away landfill, a major source of revenue. They receive 200 to 400 cubic yards of material per day in total. Compost is sold for $5 per cubic yard and mulch for $3 per cubic yard. Grant money was used for the purchase of a truck and for marketing costs. The company is currently breaking even, largely because of the fees received from the City of Ruidoso for taking wood waste materials (United States Forest Service, 2004).

Composites

By combining ground wood with plastics, ceramics or other materials, lumber substitutes can be made from low quality wood residues. Demand for lumber and lumber substitutes is high and prices are also high. A successful venture for one New Mexico Company, P & M Signs Inc. and P&M Plastics Inc. has been the use of a patented process, Altree™, that uses the whole tree including juniper and pinyon pinecones, berries, bark and needles, in combination with recycled plastics to manufacture signs, pallets, and roofing shingles. The wood residue using portion of the business has benefited from heavy support from the USFS. The company has been in business for 10 years and has a contract with National Forests to replace plywood signs with the new product. The new composite has the advantage of not being attractive to porcupines, a vital attribute in certain national forests. The technology is simple and low-cost. It involves making a “dough” of the recycled melted plastic and finely ground wood waste and pouring it into molds (Knaebe, 2005, USDA Forest Service Forest Products Laboratory, 2003). Making lumber type products is also possible with this composite. Lumber substitute products can sell for several dollars a running foot but require greater expertise and capital outlay to manufacture. Extruders are needed for the more complex lumber type products. Greater value added implies a larger market area since higher shipping costs can be justified by greater profits. For a larger type operation, sustainability of the supply of biomass would likely be an important issue.

Another composite product under development is “ceramicrete”. Gila WoodNet, a nonprofit in New Mexico, is experimenting with the patented material which uses wood chips and a phosphate ceramic mix and can be used like wood (New Mexico Small Business Development Center, 2005). All composite materials may have an additional environmental advantage in that they may be sequestering the carbon thought to be a major cause of global warming while reducing the need for the larger trees normally needed for our lumber supply.

Potential Demands for Biomass Energy in Lincoln and White Pine County

Using wood for biomass energy is considered to be at the bottom of the value added scale. If it is feasible, a much larger value can normally be obtained by using wood for any type of lumber, engineered wood product, wood composite or sometimes even mulch material. The pinyon and juniper wood chips, however, may be difficult to process economically for these uses. Using wood for energy helps meet other goals such as energy independence and decentralization, stability of fuel price and supply, renewable and more diverse source of energy supplies, reduction of harmful emissions that can cause air pollution or global warming and a way to dispose of excess woody materials.

Electric Generation Plants

Electricity demand in the southwestern region is expected to increase. For example, total demand in the Rocky Mountain-Southwestern region that includes southern Nevada is expected to increase by 15 percent from 2005 to 2010. Local increases in demand for electricity in the Las Vegas region including the new Coyote Springs Investments area will likely be even larger. Current average retail prices in the southwest-mountain region ranged from 5.7 cents per kilowatt hour for industrial uses to 9.1 cents per kilo-watt hour for residential uses in August 2005 (see Table 16). Prices for electricity were not expected to increase by 2010, but rather decrease slightly (Energy Information Administration, 2003). However, the projections were based on much lower oil and natural gas prices than the current prices for these commodities.

Table 16. August 2005 and 2010 Projected Average Electricity Prices, Mountain Region

Type of End Use	Average End-Use Price (2003 cents per kilowatt-hour)	
	August 2005	**2010 Projected**
Residential	9.1	8.3
Commercial	7.6	7.1
Industrial	5.7	5.6
Transportation	6.8	7.1
All Sectors Average	7.6	7.3

Sources: Energy Information Administration, Form EIA-826, "Monthly Electric Sales and Revenue Report with State Distributions Report. NewGen Data and Analysis, RDI Consulting/FT Energy (Boulder, CO, August 2000) and EIA, AEO2005 National Energy Modeling System run aeo2005.d102004a.

Currently, very low wholesale electricity costs in the region mean that electric generation from the burning of wood chips may not cost effective, even when "green energy" credits are taken into account. For example, Mt. Wheeler Power cooperative pays less than 2 cents per kilowatt hour for electricity. The cost of producing electricity from wood can range from 6 to 11 cents per kilowatt hour, according to some recent feasibility studies (Haase, 2004, McNeil Technologies Inc., 2000). Costs are variable, depending on many factors, including fuel costs and plant size. A very small plant would likely have higher costs per kilowatt hour.

Estimated plant size for an electric generation plant using solely wood biomass is around 0.4 megawatts if all estimated annual wood thinning produced by White Pine and Lincoln counties BLM thinning operations are devoted to the plant and currently available tonnages remain about the same into the future. Current plans for pinyon and juniper thinning by the BLM imply a maximum supply of perhaps 9,000 tons of green chips per year. If the chips are 25 percent water, bone dry tons available would be 6,750 tons. At least 300 tons a year are contracted to go to the Ely schools for fuels project, leaving 6,450 tons. It is often suggested that plant size be geared to one third or one half of supply believed to be available to order to account for variability in supply. Optimistically, this would mean plant size could be geared to using 3,225 tons of bone dry chips a year. The plant size that can be supported by this amount of wood biomass would likely produce less than one-half megawatt of power, based on a figure of 8,000 bone dry tons of biomass per MW of electricity produced. At 80 percent capacity, a 0.4

megawatt rated plant could theoretically produce enough electricity for somewhere between 170 to 380 homes (Energy Industry Issues Newsletter, 2003). All these estimates should be considered rough and would require a more extensive feasibility study to confirm.

Special Placement for Electric Co-generation Plant

Co-generation that allows for the production of both heat and electricity on-site represents one of the more desirable uses of the pinyon and juniper wood chips for electric generation. Using the heat available from burning the chips increases the efficiency of the system. Because the current cost of electricity in the region is low, electrical energy produced in a small plant of this sort may not be competitively priced. If the wood heat replaces heat produced by natural gas or other high-priced fuel, the heat may be provided at a competitive price. If grant money is available to help build a co-generation plant, than the demand for this type of project will increase.

One element of the cost effectiveness of a pinyon-juniper co-generation strategy is based on the ability to locate the co-generation plants in the most advantageous places on the grid. Typically, these will be in out of the way areas that have small distribution capacities that must carry electricity over long distances. Locating co-generation at the end of these distribution lines greatly reduces the amount of electricity that must be sent down the distribution and can increase reliability (Englin, et al., 1987).

The main suppliers of electrical power in the region are Mt. Wheeler Power and Lincoln County Power District. Both entities have available a large supply of relatively cheap energy.

Mt. Wheeler Power is a member of the Deseret GNP cooperative which gets most of its power from the Bonanza coal-powered plant in Vernal, Utah. The four year average member rate delivered at wholesale was about 3 cents per kilowatt hour. The service area includes most of White Pine County and some surrounding areas. No new lines or line replacements are planned by Mt. Wheeler Power in the next 8 to 10 years, barring major new developments, which mean the utility would experience no additional benefits from being able to delay new lines or line replacement by strategic placement of a small cogeneration plant. New power coming into the cooperative would earn less than 2 cents per kilowatt hour. From the utility's point of view, there would be little interest in a small co-generation unit with the better option for such a plant being an “on-site” plant such as the one at the school in Ely (Murdoch, 2005).

As for Lincoln County, the Lincoln County Power District is organized as a 318 General Improvement District. The LCPD energy is supplied through a Hoover Dam allotment, providing access to inexpensive electric power. A small biomass plant likely could not compete with the price of the energy, even if strategically placed. Once again, from the utility point of view there is little interest in such a plant under current circumstances. The Lincoln County Power District might be willing to hook up to the plant if the energy could be sold elsewhere, possibly using the renewable energy attributes of such a plant. If circumstances changed dramatically with the new Toquop and Coyote Springs developments, such that LCPD used up its Hoover allotment, there might be more interest in such small plants (Lloyd, 2005).

Coyote Springs developers may form their own 318 GID and may not be buying power through the LCPD. They will likely work with Arizona Power or Sierra Pacific Power Company which have higher priced electricity. Coyote Springs developers might be interested in building an electric bio-mass plant in northern Lincoln County. The power generated there could then sold to LCPD at their current price (Caringer, 2005).

An avenue for additional research would be to investigate the desirable and undesirable environmental and security aspects of small biomass cogeneration plants. Biomass plants may have attributes relating to renewable energy, global warming and carbon sequestration, energy independence and security provided by decentralized energy which make its energy more desirable and worth more money per kilowatt hour. Partly because of these attributes, grants may be available to help with start-up costs where desirable attributes relating to these issues are brought to the fore.

Co-firing

Demand for wood wastes for use in co-firing is quite high. Co-firing is the burning of biomass in combination with coal or other fuels. Usually only a small proportion (less than 15 percent) of the total energy inputs in co-firing come from wood waste sources, but for large plants this still produces an enormous demand for biomass. Co-firing is desirable because it can reduce pollutants such as sulfur dioxide and nitrogen oxides. Using a small percentage of wood biomass for co-firing may be an option for the new coal burning power plant being planned in the Ely area. A likely problem for investigation would be whether near-by thinning projects would produce a large enough wood supply over the long-term and whether the equipment being planned can readily accommodate co-firing. Transportation costs of the chips might be reduced if train transport is reinstated locally in connection with the planned power plant. A new power plant is also being planned at the Toquop site. The Toquop site at the far southern end of Lincoln County may not be ideally located for cheap transportation of the wood chips.

Space Heating

Space heating using wood energy is a traditional and viable use for the pinyon and juniper resource. Firewood from pinyon and juniper has been and still is being used locally. A local example of a more modern type of heating use would be the Ely Fuels to Schools program. Space heating projects typically have a better payback period than do electrical generating or co-generation activities (Haase, 2004). This is especially true if wood heat replaces natural gas (or another expensive fuel), which currently costs over $6 per million Btu on average in the southwestern mountain region. Local use of the wood would decrease transportation costs. Increasing the energy density of the wood chips through making pellets or charcoal increases the value of the resource and the distance that the product can economically be shipped. Current wood pellet prices around the country ranged from $120 per ton to $300 per ton. Highest prices are obtained for pellets made from debarked wood since bark contains more impurities.

Potential Demand for Biomass Heating at Public Buildings in Lincoln and White Pine Counties

One possible use for pinyon and juniper wood chips produced by thinning operations on public land is heating of public buildings. The use of woody biomass for school heating has been successful for some eastern states and it is hoped that the program can be expanded into western states. A Fuels for Schools demonstration site has already been established in Ely, Nevada at Norman Elementary School.

The Fuels for Schools program of the United States Forest Service (USFS) promotes the use of woody biomass materials as an energy source for schools and other public buildings. It is hoped that this program and others like it will help to develop commercial uses for biomass that is removed from forests for fire prevention purposes. In Nevada, the Nevada Division of Forestry is working with the USFS on the program. More information about the program, including a pre-feasibility assessment form, is available at http://www.fuelsforschools.org/ or by calling Jason Perock at 775-684-2510.

Fuels for Schools Demonstration Project at Norman Elementary School in Ely, Nevada

The White Pine County School District has successfully converted the Norman Elementary School to a wood heating system with the use of grants from the U.S. Department of Energy and the Fuels for Schools program of the USFS and Nevada Division of Forestry. Grants paid for approximately $600,000 of the $1,000,000 conversion cost. Costs included a biomass boiler with a heating capacity of 3 to 4.2 million Btu/hour, an automatic chip delivery system, a steam to hot water heat exchanger, an electronic control system with diagnostic software, a fire suppression system as well as a new building to house the system. The system is used to provide heat for a 36,000 square foot campus. The system is clean burning and generally does not produce visible emissions. Emissions will be monitored and are expected to be less than those produced with the old oil burning fuel system.

The amount of fuel needed was estimated to be 150 tons per year of wood chips. Assuming a price for fuel oil of $1.30 per gallon and a wood fuel cost that only includes transportation costs; savings in fuel costs were estimated to be about $12,000 a year. Since fuel costs have recently risen to as high as $2.25 per gallon, fuel cost savings are currently significantly better than initially estimated (Johnson, 2005).

In the planning stages, maintenance and operation costs were expected to decrease because the new system reduced the number of boilers that needed to be cleaned and maintained. The decreased maintenance costs were not actualized during the implementation stages, however. Instead, issues that developed relating to chip quality, storage and transportation have created increased maintenance costs. Storage of the wood chips has been difficult for the school district. Outside storage of the fuel has created problems with fuel cleanliness, consistency and moisture levels (Johnson, 2005).

When the school district requested bids for wood chip delivery services, no business submitted a bid. No local business has been interested in providing a wood chip processing, storage and delivery system. A Montana company has been investigating bringing a pellet business to the region but has not yet committed to the project. Paul Johnson, Chief Financial Officer for the White Pine School District, speculates that the reason for this lack of interest may be that no business can make the necessary investments in plant and equipment without better information on the amount of wood chips that will be available over a long term from Bureau of Land Management and other pinyon-juniper thinning operations[6]. Because of these problems the White Pine School District does not anticipate any expansion of the program to other schools at this time (Johnson, 2005). Long term supply guarantees, chip quality, storage and transport are issues that should be carefully examined for any other potential conversion project.

Possibilities for Conversion to Biomass Heating for Public Buildings in Lincoln and White Pine Counties

The cost effectiveness of conversion to biomass heating for a facility depends on many factors. Typically, lower fuel costs for wood or biomass must be weighed against the higher capital costs of modern wood heating systems compared to more traditional fossil fuel heating systems. Some of the most important factors are type of fuel being replaced, cost of fuel being replaced, predictability of future fuel costs, type of existing heating system, whether replacement or addition to existing system is necessary for other reasons, fuel storage space availability and the size of the heat load.

The higher competing fuel costs are in comparison to the biomass fuel costs, the more likely a conversion to biomass heating will be cost effective. Typically electric heat is the most expensive type of heating and therefore larger fuel savings from conversion can be generated. Diesel oil systems with an existing hot water or steam distribution system already in place may be cheaper to convert to a wood burning system, however. Larger facilities with high energy load typically make for a more cost effective conversion than do smaller facilities. If a public building needs to replace the current heating system or install a new system because the heating system is old or because the

[6] The Stewardship Contracts program discussed elsewhere in this document does allow for contracts of up to ten years.

building is new or expanding, conversion will likely be more cost effective than if a new smoothly functioning system is to be replaced. In some cases, the price of wood chips or other biomass may be determined locally and is more stable than world oil or gas prices. The stability of the wood fuel price may be desirable because of its predictability. If grants from state or national sources are available to reduce conversion costs and/or wood fuel costs, the cost effectiveness of a conversion project will naturally increase (Maker, 2004)[7].

Selected Public Buildings

Potential demand for biomass heating in some of the public buildings in Lincoln and White Pine counties was investigated. Included in the survey were the Lincoln and White Pine County court houses, school districts and medical centers and the Nevada State Prison in Ely.

Lincoln County Court House

The courthouse in Lincoln County is a three story building currently heated with diesel fuel. The heating system uses a boiler to produce hot water heat and is reportedly functioning without major problems. Heating fuel oil costs and usage were not readily available and could not be produced in the short time allotted for this brief survey. However, a rough estimate of heating costs for the courthouse was $4,000 per year. Survey results indicated little interest in further exploration of conversion to wood heating at this time.

Grover C. Dils Medical Center

The Grover C. Dils Medical Center is a facility consisting of three buildings: an older building used for administration, a newer building which houses the clinic and the main building with emergency services and 20 beds. The center uses electrical heat and air conditioning and propane for a kitchen stove and back-up generator. A rough estimate of total electricity cost is $6,000 a month with an additional $200 a month spent on the propane. The facility is upgrading heating and air conditioning but it has already been determined that the system will continue to be electric. Facility operators did not consider wood fuel use appropriate for hospital use. Space on the grounds is currently at a

---

[7]This discussion on the economic analysis of conversion to wood heat follows chapter seven in Maker, 2004, "Wood-Chip Heating Systems: A Guide for Institutional and Commercial Biomass Installations" and is available on-line at http://www.biomasscenter.org/pdfs/Wood-Chip-Heating-Guide.pdf

premium and there is no space for storage of wood chips. The facility would not be able to expand in the future unless grant money were available to pay all the costs of expansion (Fackrell, 2005).

Lincoln County School District

The Lincoln County School District facilities cover a wide variety of situations. Types of fuel used for heating the facilities range from diesel oil and propane to geothermal and electric. In Panaca, propane is the fuel used for heating hot water. Panaca is in the planning stages for a new vocational building. In Pioche, the elementary school is only four years old and no expansion of facilities is planned. Limited storage might be available for wood chip storage. The district is interested in learning more about biomass heating. The school district was able to supply detailed energy costs for the schools from fiscal year 2004/2005 (Bradfield, 2005). These costs are enumerated in Table 17 below and ranged between about $3,000/year to over $6,000/year. The elementary school in Pioche uses electric heat and energy costs were not readily available.

White Pine County Courthouse

The county currently uses diesel oil for heating. The road department of the county provided detailed information on fuel usage and costs for the county annex and the road department. Actual fuel use for the 2004/2005 (December to November) year at the annex was 21,381 gallons of diesel which cost $40,497. For the road department annual building fuel use was 4,537 gallons at $9,961. Furnaces were replaced in 2002. The county airport has a 40 year old boiler. The current financial situation in White Pine County means that no expansion or replacement of heating systems can take place unless there is dire necessity or unless outside agencies provide grants that pay the entire cost of the conversion (Blair, 2005).

William B. Ririe Hospital

William B. Ririe Hospital currently uses diesel fuel with a boiler and a propane roof-top heating system. Hot water heat is produced with propane. The facility is currently in the middle of an expansion. To increase heating capacity and add air conditioning, an expansion of the current rooftop heating system has been ongoing. It is unlikely that the facility would want to convert to a new heating system soon and unlikely that they will expand further in the next five years. No space is currently available for storing wood chips. Facility officials were able to provide detailed information on heating fuel use and costs for the previous year. Propane costs were about $17, 870 dollars and diesel costs were $36,935 dollars (Ashcraft, 2005).

Nevada State Prison at Ely

Nevada State Prison officials in Ely started a preliminary investigation of conversion to wood heat, but decided early in the process that wood heat was not feasible for the facility. Conversion costs for the large system were judged to be prohibitive. The facility currently uses diesel fuel oil for heating with three large 5 to 11 million Btu/hour output capacity boilers and a closed loop hot water output system. The prison was built in 1989 and the current system functions very smoothly. There are no plans currently to expand the facility or change the heating system (Saiz, 2005).

Potential Demands Table

Table 17 contains rough estimates of the heating energy demands for selected public buildings in White Pine and Lincoln Counties. The type and/or amount of fuel used in a year was collected by surveying public officials knowledgeable of either heating costs or the actual heating systems or both. Data available in a short time frame ranged from precise monthly billing information to rough guesses at heating costs to complete unavailability. In some cases where only fuel costs were known, fuel usage has been estimated using total heating costs and an assumption about the average cost of fuel, as noted in the table. The data below should be interpreted as a first preliminary estimate that gives an order of magnitude demand for wood chips if a facility were to be converted. A more precise pre-feasibility estimate should be made if consideration of conversion to wood heat is contemplated.

It is assumed that the amount of heat provided by a pound of wood is 6,600 Btu per pound of wood, because this assumption was used in the Norman Elementary School demonstration project (Johnson, 2005). The actual heating value of wood varies depending on its moisture content. For simplicity, the efficiency of heating systems is assumed to be the same for all fuels at a particular facility. Actual heating systems will vary considerably in efficiency depending on price and type of system as well as type of fuel used and other variables.

Estimated demand for wood fuel if a facility were to convert its heating system varied from 16 tons per year to replace diesel oil at Panaca Elementary, which already uses geothermal energy, to the largest demand at the prison facility in Ely of nearly 4,300 tons per year. The latter demand likely exceeds one half the expected supplies of wood chips from BLM chipping operations over the next several years. It is suggested that projects count on only one half to one third of estimated supply, which BLM officials suggested might be around 8,000 tons per year in the next several years. Projects demanding smaller tonnages would be more likely to have a sustainable supply, if projects were coordinated. However, smaller projects would also likely pay more per Btu for the initial capital costs of conversion.

Table 17. Potential Wood Heating Energy Demand in Selected Public Facilities in White Pine and Lincoln Counties.

Facility	Fuel Type	Annual Fuel Use	Annual Fuel Cost	Btu Equivalent (Billions/Yr)	Equivalent Wood Chips (Tons/Yr)
Norman Elementary	Wood Chips	150 tons	$5250 to $6750	1.98	150
State Prison at Ely	Diesel Oil	405,000 gal. (rough estimate)	$810,000 (assuming $2/gal.)	56.7	4,296
White Pine County Annex	Diesel Oil	21,381 gal.	$40,497 (avg. $1.90/gal.)	3.0	227
White Pine County Roads Department	Diesel Oil	4,537 gal.	$9,961 (average $2.20/gal.)	0.64	48
William B. Ririe Hospital	Diesel Oil, Propane	11,573 gal.(propane), 14,824 gal. (diesel)	$17,869 (propane, avg. $1.54/gal.) $36,935 (diesel, avg. 2.49/gal.)	3.2	237
Lincoln County Courthouse	Diesel Oil	2000 gal. (assuming $2/gal.)	$4000 (rough estimate)	0.28	21
Grover C. Dils Medical Center	Electric Heat, Propane	960,000 KwH (assuming 7.5 cents per KwH, Elec. Only)	$74,400 (all electric costs including non-heat and propane)	3.3	248
Panaca Elementary	Geothermal, Diesel Oil	1,522 gal. (assuming $2/gal.)	$3,044 (diesel only)	0.21	16
Meadow Valley Middle School	Diesel Oil	1,625 gal. (assuming $2/gal.)	$3,250	0.23	17
Lincoln County High	Diesel Oil	1825 gal. (assuming $2/gal.)	$3,649	0.26	19
Caliente Elementary	Diesel Oil, Electricity	3224 gal. (assuming $2/gal.)	$6,448	0.45	34
Pahranagat Valley Elementary	Propane	3117 gal. (assuming $1.90/gal.)	$5,923	0.28	22
Pioche Elementary	Electricity				
Pahranagat Valley High School	Diesel Oil	3446 gal. (assuming $2/gal.)	$3,446	0.48	37

Emerging Technologies

Below is a discussion of ongoing research at university and governmental laboratories on biomass products and uses. Some of the emerging technologies may find use of pinyon-juniper biomass and could in the future initiate a new industry in Lincoln or White Pine counties.

Water Filters

Experimental research at the Forest Product Laboratories in Wisconsin indicates that low grade juniper wood-fiber is especially good at absorbing heavy metals and other contaminants. The bark of the juniper is actually especially desirable since it contains more of the extractives that absorb pollutants, so all of the wood can be used. They have created filters to use for land reclamation and other cleanup of pollution. The filtration business world wide is a multi-billion dollar business and growth industry. If the filters could be shown to be useful at nearby mining operations, a potential regional niche for the product would exist. The technology needed for this type of product is fairly simple. The main piece of equipment needed would be a hammer mill (Forest Products Journal, 2003, Knaebe, 2005, USDA Forest Service Forest Products Laboratory, 2003).

Wood Ethanol

Because ethanol can be used as a substitute for a large percentage of the gasoline burned in vehicles, demand and prices for the product are high. Currently the terminal market price of ethanol is about $2.30 per gallon (Oxy-fuel News Price Report, 2005). The recently passed energy bill provides tax incentives and tax breaks to be used to increase ethanol production.

Efficient and competitive production of ethanol from wood wastes is still under development, although there have been several promising breakthroughs recently. Wood feedstock costs are low but capital and operating costs are higher than costs for grain ethanol. Production of ethanol from wood wastes is possible, with 50 to 80 gallons per ton of wood waste the potential yield. Some barriers to using the juniper and pinyon thinning for ethanol use, in addition to the usual transportation costs barrier, would be that, for most ethanol processes, debarked wood is a superior feedstock, larger size plants are more efficient and waste products may be difficult to handle. Technical expertise or the desire to learn the technical expertise is a prerequisite for this type of project (Zerbe, 1991, Knaebe, 2005).

Ethanol from Wood and Municipal Solid Wastes

Bio-ethanol made from municipal solid wastes and other carbon based materials such as pinyon-juniper waste wood is being made in pilot plants. BRI Energy, the company backing one effort, claims that it can produce 75 gallons of ethanol from a ton of waste materials. No commercial plant has been built as of November 2005 according to the BRI website (Voyles, 2005). The Lincoln County Crestline landfill has recently been purchased by NorCal Waste, a company based in California. The company has been exploring with the county the possibility of bringing in several trainloads a week of municipal waste from the Los Angeles area. The site is advantageously placed east of Panaca near railroad lines which help reduce transport costs (Keaton, 2005).

Mobile Bio-power Plants

One of the most difficult aspects of developing an economic use for pinyon and juniper wood chips is the expense of hauling the low-value chips. One potentially promising technology for pinyon and juniper chips might be the portable bio-power plant in development by the University of North Dakota, Energy and Environmental Research Center. This technology is currently being tested. The Flex micro-turbine is trailer mounted and can be taken to the site of the wood wastes where it can convert the wood chips into gas. The ability to go on-site improves the economics of the gasification process (Energy and Environmental Resource Center, 2005). The technology is not available commercially, but commercial testing is scheduled. Conversion processes for wood wastes are fairly technical and would require several individuals who are knowledgeable about or very interested in these processes to work closely with the project. The unit may not be portable on very rough terrain.

Stewardship Contracts Program

The Bureau of Land Management (BLM) and United States Forest Service (USFS) are using stewardship contracts to link land management goals of the Healthy Forests Initiative to economic development and other local needs in surrounding communities. The contracts generally allow a private company, non-profit or local government entity to keep the forest products produced in exchange for services such as thinning, processing or removing excess fuels produced by forest health projects. Authority for contracts as long as ten years can be granted, in recognition that investment in plant and equipment requires a reliable resource for extended periods. There is a special encouragement of non-profit and local government participation in stewardship contracts. Contracts are awarded on a so-called “best value basis” and should meet dual goals of increasing forest health and meeting local community needs. The contracts do not need to be based solely on revenue generation. If any excess revenues are generated they may be used for additional forest health projects within the state (Bureau of Land Management, 2004).

Local examples of stewardship contracting include the Ely Fuels to Schools project and the removal of pinyon-juniper chips from the Mt. Wilson thinning project to Cedar City, Utah to a company that dyed the chips for use as a landscaping material. Private companies are also contracting with the BLM for carrying out pinyon-juniper thinning in the region. Forest products produced must be given fair market value. In the case of the BLM pinyon-juniper wood chips the current fair market value being used is $25 per delivered green ton. Removal and transportation of the chips may be considered one of the services rendered in exchange for the chips. Extensive guidance on stewardship contracting is provided by the BLM on-line at http://www.blm.gov/nhp/spotlight/forest_initiative/stewardship_contracting/ . The local contact for the stewardship contracting is Cody Coombs, Fire Management Specialist/Fuels Program Manager Bureau of Land Management Ely Field Office (Coombs, 2005).

REFERENCES

Ashcraft, M. Accounts Payable, William B. Ririe Hospital, "Informal phone discussion of possible wood fuel use and faxed materials", Ely, Nevada, December 19 and 22, 2005.

Associated Press. BLM land sale, development boom may reshape Lincoln. Mesquite, NV., 2005.

Blair, H. Supervisor, "Informal phone discussion of possible wood fuel use and faxed materials". White Pine Public Works Department, Ely, Nevada, December 15, 2005.

Bradfield, D. "Informal phone discussion of possible wood fuel use and faxed materials". Lincoln County School District, December, 22, 2005.

Bureau of Land Management . BLM Stewardship Contracting: Q's and A's. Washington, D.C., 2004.

Caringer, D. Coyote Springs Investments, "Informal phone discussion of uses for pinyon- and juniper wood chips.", November 7,2005.

Carlton, M. Wood Chips, Sierra Pacific Industries, "Informal phone discussion of prices for wood chips", November 8, 2005.

Coombs, C. Fire Management Specialist/Fuels Program, Manager Bureau of Land Management, Ely Field Office, "Informal phone discussions and e-mails concerning pinyon-juniper uses and supplies", Ely, Nevada, November 16, 2005.

Energy and Environmental Resource Center. "FlexEnergy Small Modular BioPower Project", University of North Dakota., 2005.

Energy Industry Issues Newsletter. What is a Megawatt?, ed. Alexander's Gas and Oil Connections. "Understanding How Many Houses can be Served by a Megawatt of Power". 2003.

Energy Information Administration ."Annual Energy Outlook 2005 with Projections to 2025, Regional and Other Detailed Tables". Washington, D.C., 2003.

Englin, J., et al. "Load Management Alternatives to Construction: Toledo-Wren Case Study." Pacific Northwest Laboratories, Department of Energy, Bonneville Power Administration. 1987.

Fackrell, S. Controller, "Informal phone discussion of possible wood fuel use.", Grover C. Dils Medical Center, December 19, 2005.

Ffolliott, P. F., and W. P. Clary. "Pinyon-Juniper Woodlands in the Southwest." University of Arizona, School of Renewable Natural Resources. 1986.

Forest Products Journal. "Techno News: Water Filters Made From Wood Fiber." *Forest Products Journal* 53, no. 1(2003): 1.

Haase, S. "Lessons Learned from Forest Biomass Feasibility Studies". Lakewood, CO, McNeil Technologies, Inc.,2004.

Intertech Services Corporation. "Industrial Utilization of Pinyon-Juniper Biomass Resulting From Thinning Treatments in White Pine and Lincoln Counties, Nevada: Business Considerations, Preliminary Draft." Carson City, Nevada, 2005.

Johnson, P. "Informal phone and e-mail discussion of Biomass Heating Pilot Project", Chief Financial Officer, White Pine School District, December 14, 2005.

Johnson, P. "White Pine County, NV Public School System Biomass Conversion Heating Project." White Pine School District, Department of Energy.

Johnson, W. Extension Specialist, PAT, IPM, Horticulture and Urban Forestry, "Informal e-mail correspondence concerning pinyon-juniper wood mulch materials", October 25, 2005.

Keaton, H. Lincoln County Commissioner, "Informal phone discussion of solid waste importation plans.", November 16, 2005.

Knaebe, M. Small Diameter Woods, USDA Forest Service Forest Products Laboratory, "Informal phone and e-mail discussion of economic uses for Pinyon and Juniper Thinnings", November 4, 2005.

LeVan-Green, S. and J. Livingston. "Exploring the Uses for Small-Diameter Trees." Journal of Forest Products. Volume 51, No. 9, September 2001.

Lloyd, M. Manager, Lincoln County Power District, "Informal phone discussion of pinyon-juniper use for electrical power generation.", October 21, 2005.

McNeil Technologies Inc. "Final Report: Development of a Green Power Program Using Biomass from the Lake Tahoe Basin." Nevada Tahoe Conservation District, Western Regional Biomass Energy Program. 2000.

Maker, T. M. "Wood-Chip Heating Systems: A Guide for Institutional and Commercial Biomass Installations." Biomass Energy Resource Center. 2004.

Murdoch, J. Engineer, Mt. Wheeler Power, "Informal phone discussion of pinyon-juniper use for production of electrical energy", September 9, 2005.

New Mexico Small Business Development Center." Success Story: Mountainair - A Best-in-Class Provider of Signage", 2005. Success Story: Santa Clara - Gila WoodNet: an ecological forest products company. Santa Fe, New Mexico, New Mexico Small Business Development Center.

Noble, Bob. "Informal discussion of Pinyon-Juniper contracting work in Lincoln and White Pine County." Advanced Grinding Services. December 28, 2005.

Oxy-fuel News Price Report." Fuel Ethanol Terminal Market Price - 18 Month History", Hart Publications, 2005.

Rake, L. "Water for New Town Flows to Lobbyist", Weekend Edition. Las Vegas, 2005.

Resource Concepts. "Pinyon-Juniper Biomass Utilization Study for Lincoln County, Nevada." September 2004.

Saiz, D. "Informal discussion of biomass heating possibilities.". Facility Supervisor, Ely Nevada State Prison, December 16, 2005.

Tausch, R. "Informal discussion of characteristics of and uses for Pinyon Juniper." Supervisory Ranch Scientist, United States Forest Service. November 14, 2005.

Thomas, M. G., and D. R. Schumann. "Income Opportunities in Special Forest Products: Self-Help Suggestions for Rural Entrepreneurs." Agriculture Information Bulletin, AIB-666, United State Department of Agriculture. Washington, D.C. 1993

United States Forest Service." Numerous Businesses and Communities within the Forest: Region 3 Success Stories", 2004. http://www.fs.fed.us/r3/asnf/news/2004/r3_success_stories.shtml

USDA Forest Service Forest Products Laboratory. "Conserving Our Forests since 1910". Madison, Wisc., 2003.

Voyles, S. "New Technology Turns Waste into Fuel, but Will It Ever Get Out of the Lab?" Reno Gazette Journal. Reno, Nevada, 2005.

Zerbe, J. I. "Liquid Fuels from Wood-Ethanol, Methanol, Diesel. ." Forest Products Laboratory. 1991.

CHAPTER V:

ESTIMATES OF AVAILABLE PINYON-JUNIPER HARVEST

Estimates of the Available Pinyon-Juniper Harvest

Previous estimates of the total area of pinyon-juniper forests in all of Nevada set the value at about 9 million acres (Intertech, 2005; Ffolloit, et al., 1999). Estimates of available supplies in White Pine and Lincoln counties range from 10.8 million acres to 3.6 million acres (Intertech, 2005). Most professionals, however, appear to believe that the Nevada Gap Analysis Project (GAP) figures greatly underestimate the actual supply of pinyon-juniper available in these two counties.

The value of 9 million quoted by Ffolloit, et al (1999) come from Born, Tymco and Casey (1992) and includes values for pinyon-juniper woodlands that are in private hands. It also includes non-pinyon-juniper species (mostly mountain mahogany, but that is only about 2% of the total) (Born, et al., 1992). The more appropriate estimate for Nevada would be about 8.24 million acres. The Nevada GAP project, however, estimates about 7.11 million acres of total pinyon-juniper for the state. It is not known if this figure includes private land or not. Born, et al. (1992), exclude areas of limited or prohibited access (Death Valley National Monument, Lake Mead National Recreation Area, the Nevada Test Site and the Desert National Wildlife Refuge) and list pinyon-juniper amounts for the Great Basin National Park in a separate category. Again, it is not known if the GAP project also excluded theses areas.

The data from which Born, et al. (1992) drew their figures comes a sample-based inventory using map data, aerial photo interpretation and field samples. Map and aerial data were samples using 1,000 m^2 plots (Born, et al., 1992). The data from the GAP Project used a resolution of 30 m^2. Because of the higher resolution, it is believed that the GAP Project provides better data.

The GAP Project split pinyon-juniper woodlands into six sub-categories based on predominant species and the amount of canopy cover. These categories are listed in Table 18. In this analysis, all six categories were combined to arrive at the 7.11 million figure quoted above. Of that amount, pinyon and pinyon-juniper forests covering 30 to 60% (Pinyon 2 and Pinyon-Juniper 2) comprised almost 90% of the total acreage.

Table 18. GAP Classification Categories

Classification	Description
Juniper 1	Predominant species is Utah juniper with canopy cover less than 30%
Juniper 2	Predominant species is Utah juniper with canopy cover from 30 to 60%
Pinyon 1	Predominant species is single leaf pinyon with canopy cover less than 30%
Pinyon 2	Predominant species is single leaf pinyon with canopy cover from 30 to 60%
Pinyon-juniper 1	Co-dominant species are single leaf pinyon and Utah juniper with canopy cover less than 30%
Pinyon-juniper 2	Co-dominant species are single leaf pinyon and Utah juniper with canopy cover from 30 to 60%

The amounts estimated for pinyon-juniper in Lincoln and White Pine Counties also appear to be overestimated. Born, et al. (1992) estimates 1.939 million acres of pinyon-juniper in White Pine County and 1.738 million acres in Lincoln County. This totals to 3.678 million acres for both counties. It is suspected that Morris (Intertech, 2005) made this estimate based on the Born et al. (1992) data. The GAP Project, however, estimates that White Pine has a total of 1.237 million acres and Lincoln has 0.849 million acres for a total of 2.087 million acres (Table 19). This estimate is approximately two-thirds of the Born et al. (1992) estimate.

The data from Born, et al. predates 1992. The data supplied by the Nevada Gap Project came from the Utah Cooperative Fish and Wildlife Research Unit (1996). Therefore the data does not represent changes that have affected the pinyon-juniper woodlands in the past nine years. How much additional growth that has occurred is unknown. However, Born, et al. (1992) in their survey estimated that annual growth for pinyon-juniper woodlands was about 1%. Pinyon was increasing twice as fast as juniper.

In addition, Nye County has about one million acres of pinyon-juniper. However, it was not determined how much of the coverage was in the eastern part of the county.

Available Volume

Ffolloit, Gottfried and Kruse (1999) state that the average yield of pinyon-juniper woodlands in Nevada is about 6.5 cords per acre. This yields about 464 ft^3 (17.2 yd^3) per acre in volume (Ffolliott, et al., p 254). The weight of a cord of wood is 1.2 short tons (2400 lbs). On average, each acre of pinyon-juniper forest contains 7.8 tons of biomass material (Intertech, p 4).

The above is total biomass per acre available. However, the actual amount will be less since the forests are to be thinned, not clear cut. Two factors will affect the amount of biomass that is available for harvesting. One will be the rate of growth of the P-J woodlands over the past 9 years. The other will be the rate at which the woodlands are thinned. Table 20 lists the volume available cross-tabulating the thinning rate with the growth rate. Thinning rates are analyzed at 10%, 20%, 25%, 30%, 40% and 50% and growth rates from 0 %to 5% (with 10% and 20% rates also included). The analysis uses the GAP Project data. Table 21 does the same cross-tabulation by volume.

Table 19. Pinyon-Juniper Coverage in Lincoln and White Pine Counties

County	Total Area (acres)	P-J Coverage (acres)	% Coverage
Lincoln	6,808,697	849,172	12.47%
White Pine	5,694,155	1,237,624	21.74%
Total	12,502,852	2,086,796	16.69%

Table 20. Estimates by Volume

Cubic Yards of Biomass (000) Available						
Growth Rate	Clearance Rate					
	10	20	25	30	40	50
0	3,589	7,179	8,973	10,768	14,357	17,946
1	3,926	7,851	9,814	11,777	15,702	19,628
2	4,290	8,579	10,724	12,868	17,158	21,448
3	4,683	9,366	11,708	14,049	18,733	23,416
4	5,109	10,217	12,771	15,326	20,435	25,543
5	5,568	11,136	13,920	16,704	22,273	27,841
10	8,463	16,926	21,158	25,390	33,853	42,316
20	18,520	37,040	46,300	55,560	74,080	92,600

Table 21. Estimates by Weight

Tons of Biomass (000) Available						
Growth Rate (%)	Clearance Rate (%)					
	10	20	25	30	40	50
0	4,307	8,614	10,768	12,921	17,229	21,536
1	4,711	9,421	11,777	14,132	18,843	23,553
2	5,147	10,295	12,869	15,442	20,590	25,737
3	5,620	11,240	14,049	16,860	22,479	28,099
4	6,130	12,261	15,326	18,391	24,522	30,652
5	6,682	13,364	16,704	20,045	26,727	33,409
10	10,156	20,312	25,390	30,468	40,624	50,780
20	22,224	44,448	55,560	66,672	88,896	111,120

At a thinning rate of 50%, the expected volume available will be about 20 to 30 million yds^3 or 25 to 35 million tons of biomass. The rate of growth that Born, et al. (1992) estimated may actually be greater. There seems to be a consensus that the amount of pinyon-juniper is growing fairly rapidly. However, there are no estimates available except for those provided by Born, et al. (1992).

Further Considerations

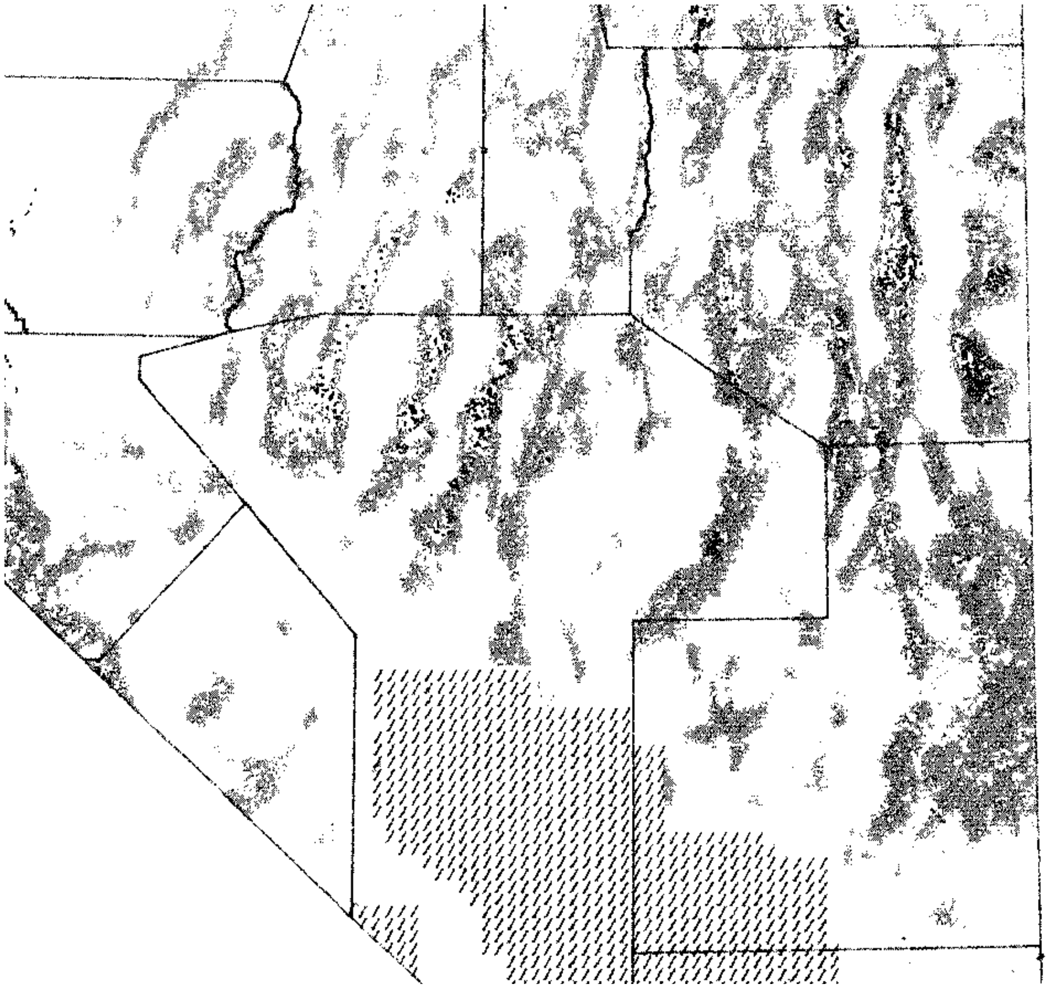
The data available is relatively old. Additional data is required for improved estimates of the actual amount of pinyon-juniper available. Conversion values for the volume and weight of chipped pinyon-juniper need to be validated. There is a possibility that the weight is overstated. The actual amount removed in thinning operations needs to be pinpointed. Additional data would decrease the variability of estimates of the potential pinyon-juniper harvest.

Another consideration is the possibility of expanding the source area into Nye County. The GAP Project estimates slightly more than 1 million acres of pinyon-juniper in Nye County but the location and distribution is not known. Born, et al. (1992)) estimate about 1.55 million acres of pinyon-juniper in Nye County. As seen in Figure 14, much of this appears to be located in the eastern portion of the county although actual acreage amounts are not given (Born, et al., 1992).

An additional consideration that is not addressed here is to include parts of Western Utah as a potential source of pinyon-juniper biomass. The vegetation landscape for Eastern Nevada and Western Utah are similar. O'Brien and Woudenberg (1999) discuss the abundance of pinyon-juniper in Utah. Mitchell and Roberts (1999) employed maps of the pinyon-juniper forests in Utah. They use two different mapping surveys to estimate area from both surveys. However, the distributions of pinyon-juniper are different for each survey. Both studies seem to indicate larger areas of pinyon-juniper in southwestern Utah, particularly in Beaver, Iron and Washington counties.

In summation, the actual amount of biomass available maybe smaller and will depend on how much of the acreage is actually thinned. Most of the thinning will be done by the Bureau of Land Management (BLM). Currently, projections by the BLM in Ely are to thin 5,800 acres over the next five years. At an estimated yield of

Figure 14. Woodland Available in Eastern Nevada



Grey = Woodland

Black = Timberland

Crosshatch= Restricted/Prohibited Areas

Source: Born, et al, p 9.

approximately seven tons (7 tons) of biomass per acre, this would mean that 40 to 45 thousand tons will be available over the five year span or an average of 8 to 9 thousand tons will be available per year. However, these averages are highly variable due to uncertainties of future federal budget funding for the BLM and potential legal actions by environmental and/or other groups. Without legal problems and given enough federal budgetary support, it is expected that the amount of biomass available will increase in the future (Coombs, 2005).

A supply of approximately 9,000 tons per year would not necessarily be available for start-up enterprises in Lincoln County or White Pine County. Current thinning projects have had no surplus output because private contractors have absorbed the surplus amount. One contractor is reprocessing the chips in Cedar City, Utah and reselling the pinyon-juniper biomass as mulch. A second contractor is supplying biomass to the "Fuels for School" program in Ely. Interest in future output has appeared from an Oregon company and a company in Susanville, California that produces biomass power (Coombs, 2005). Therefore, there would be a great amount of competition for a relatively limited supply. Currently, Honey Lake Power is operating at one-third of its capacity due to the lack of biomass supply (Lassen County, 2005).

If feasibility studies of potential uses of pinyon-juniper resources in Lincoln and White Pine Counties are initiated, a detailed study of potential pinyon-juniper supplies in Lincoln and White Pine counties needs to be completed. Also, the probability of a stable supply of pinyon-juniper for a number of years needs to be estimated for a multi-year feasibility study.

REFERENCES

Born, J.D., R.P. Tymco and O.E.Casey, *Nevada Forest Resources*, United States Department of Agriculture, Intermountain Research Station, Resource Bulletin INT-76, 1992.

Coombs, C. Phone conversation and e-mail communications. Fire Management Specialist/Fuels Program in the BLM Field Office, 2005.

Ffolliott, P.F., G.J.Gottfried and W.H.Kruse. "Past, Present and Potential Utilization of Pinyon-Juniper Species", in S.B. Monsen and R. Stevens, compilers, *Proceedings, ecology and management of Pinyon-juniper communities within the interior West*, Proceedings RMRS: P9, pp 146-154, 1999.

Intertech Services Corporation. *Industrial Utilization of Pinyon-Juniper Biomass Resulting From Thinning Treatments in White Pine and Lincoln Counties, Nevada: Business Considerations*, Carson City, NV, 2005.

Lassen County Board of Supervisors. Lassen County Board of Supervisors Regular Session, February 8, 2005.

Mitchell, J. E. and T. C. Roberts. "Distribution of Pinyon-Juniper in the Western United States", in S.B. Monsen and R. Stevens, compilers, *Proceedings, ecology and management of Pinyon-juniper communities within the interior West*, Proceedings RMRS: P9, pp 146-154, 1999.

Nevada GAP Project, www.brrc.unr.edu/mtn/html/ref/gapref.html

O'Brien, R.A. and S.W. Woudenberg. "Description of Pinyon-Juniper and Juniper Woodlands in Utah and Nevada from an Inventory Perspective", in S.B. Monsen and R. Stevens, compilers, *Proceedings, ecology and management of Pinyon-juniper communities within the interior West,* Proceedings RMRS: P9, pp 146-154, 1999.

CHAPTER VI:

SUMMARY AND SUGGESTED ACTIONS

Summary and Suggested Actions

The University Center for Economic Development conducted a study estimating potential industrial demands for pinyon-juniper resources in Lincoln and White Pine Counties of Nevada. This study was sponsored by the Lincoln County Regional Development Authority through funding provided by the Nevada Commission on Economic Development through U.S. Forest Service Grant 02-26-12-NFP-03 and the U.S. Economic Development Administration through its University Center Program. This publication is divided into four sections:

Chapter I provides a general introduction,

Chapter II gives an overview of socio-economic data and trends of Lincoln County,

Chapter III estimates the potential industrial demands for pinyon-juniper resources, and

Chapter IV provides an overview of available pinyon-juniper resources in Lincoln and White Pine Counties.

General Introduction, Survey Results, and Procedures to Form a Pinyon-Juniper Economic Cluster

- Counties and communities are searching for new and alternative economic development and diversification strategies to promote local economic activity and stability. One potential strategy for economic activity and stability in Lincoln and White Pine Counties of Nevada is the industrial development of local pinyon-juniper resources.
- A biomass industrial cluster could be formed in Lincoln and White Pine Counties which focuses on industrial uses of local pinyon-juniper resources.
- To form an efficient and effective pinyon-juniper industrial cluster, industrial pinyon-juniper supplying and demanding sectors must be identified in Lincoln and White Pine Counties and counties adjacent these two Nevada counties.
- Biomass energy may be used for electric power generation, space heating, cogeneration of heat and electricity, or for ethanol and other liquid bio-fuels. In 2004, the amount of biomass energy used in the United States was 2,845 trillion Btus or approximately 2.9% of total energy consumption in the United States. Of

the 2,845 trillion Btus, about 2,000 trillion Btus were supplied by wood energy. Close to 60% of energy supplied by wood biomass was used in pulp and paper industry operations for cogeneration in 2003. Although biomass energy represented only a small proportion of the current total energy consumption in the United States, biomass energy represented almost half of the total *renewable* energy supply.

- Over the period from 1949 to 2004 total U.S. energy consumption has risen 212% from 32.0 to 99.7 quadrillion Btu. Over the same period U.S. energy production has risen by 122% from 31.7 to 70.4 quadrillion Btu. The excess of consumption over production is accounted for by net imports. Total renewable energy production includes hydroelectric, geothermal, solar, wind, wood and biomass and is equal to renewable energy consumption. Renewable energy has risen by 106% over the same period from 3.0 to 6.1 quadrillion Btu.
- In 1949, biomass energy including wood and waste materials made up almost 5% of total U.S. energy production. This decreased to a low in 1971 and 1972 of 2.3% of total energy production. After two oil shocks in the 1970s and changes in energy regulations, biomass energy production increased to 4.4% of total energy production in 1983. Since 1983 biomass energy production has fluctuated between 4.4% to 3.7% of total energy production.
- When comparing nominal direct price for a million Btu of energy for different fuel sources from 1970 to 2001 wood competes with coal as a cheap source of energy, particularly for electrical generation and industrial or commercial use. Coal is abundant and more energy dense than wood. Wood is abundant also, but typically harvested over a larger acreage than is coal. These factors tend to increase the cost of harvesting and transporting wood fuels in relation to mining and transporting coal. In addition, generating plants for producing electrical energy with fossil fuels are usually less costly in terms of initial capital costs and operation and maintenance. However, wood residues leftover from primary production may be available at very low or even negative prices since there may be a cost to dispose of the wood residues. Paper and lumber mills may use the energy on the same site that is being using to process the lumber or paper for both

electrical energy and heat. This type of wood energy use typically has already been exploited and represents the largest proportion of wood energy use in the United States today. In a similar manner, wood residues may also be available at lower cost when collection and transportation of the wood residue serves other socially desirable goals such as the reduction of fire risks or increase in forest health, as may be the case in Lincoln and White Pine counties in Nevada. In this case, government entities such as the Bureau of Land Management and the U.S. Forest Service may produce wood fuels as a byproduct of these other goals. An additional market in which wood may successfully compete is as a fuel to replace current and future expensive natural gas or other expensive fuels for space heating.

- The environmental benefits of using biomass wastes may mean increased use in the future. Because coal as a competing energy source will often be a lower cost option than wood, demand for wood energy may be driven more by environmental considerations than by such factors as higher prices for oil. In addition to being a renewable energy source, environmental benefits of biomass energy include lower sulfur dioxide, nitrogen oxide and carbon dioxide emissions when compared to coal.
- Any regulations adopted that increase renewable energy portfolio requirements for electricity generation will very likely increase the demand for wood energy and the prices paid for wood fuels. Nevada currently has a renewable energy portfolio law that requires that 20% of all electricity sales be derived from renewables by the year 2015. These energy portfolio requirements may increase future demands for pinyon-juniper resources in Lincoln and White Pine counties.
- Energy production is projected by 2025 to rise by about 0.7% a year to 82.7 quadrillion Btu with the shortfall in energy needs met by rising imports. Renewable energy consumption, which is assumed to be equal to renewable energy production, is forecast to rise about 1.5% per year at a slightly higher rate than consumption is predicted to rise. Total renewable production in 2025 is predicted to be 8.1 quadrillion Btu.

- In the summer of 2005 and using survey procedures outlined by Dillman (2000), businesses in Lincoln and White Pine Counties were surveyed as to their understanding of wildfire hazards with pinyon-juniper and potential use of pinyon-juniper as an energy resource.
- Approximately 42% of the respondents replied that they were not familiar with wildfire issues of pinyon-juniper. However approximately 17% were very familiar of the wildfire issue and pinyon-juniper. If one of the premises for pinyon-juniper harvesting is to reduce combustible sources for rangeland fires, there seems to be a need for more education. With sufficient education on the need for pinyon-juniper harvesting to reduce wildfires, there may be potential to increase commercial and energy demand for pinyon-juniper resources.
- Questionnaire results also showed that only 12.5% of respondents would consider use of pinyon-juniper to produce their own electricity. However with current energy price increases, the response to alternative fuels such as pinyon-juniper biomass as an energy source may increase.
- As an economic development alternative, pinyon-juniper harvesting falls within the definition of industrial cluster economic development. Biomass industrial development is an industrial cluster because pinyon-juniper biomass potentially has numerous interlinked local economic sectors, such as housing, electric power plants, industrial parks, and etc.
- Clusters are geographic concentrations of interconnected companies that work closely with each other, local suppliers, infrastructure providers, educational institutions, government agencies, and other relevant business groups. Cluster-development is based on the premise that a company (and their regions) can realize higher levels of competitiveness when it looks beyond its own limited capacity and strategically partners with other companies to support institutions to address challenges and solve problems that it is unable to solve when operating in isolation. It is a strategy that encourages companies who compete to come together and identify ways in which they can cooperate to their mutual benefit.
- Having identified a competitive cluster, how does a cluster development get organized and supported? Support for a cluster can be provided in many ways.

First, a **cluster champion** must be identified. This person would be a conduit for cluster activity. The champion must have knowledge of the industry. The champion is also the primary link to other clusters that may be identified in Lincoln and White Pine counties. Therefore the second necessary activity for cluster development and maintenance is **networking**. Networking is key for successful cluster development. Networking is the process through which relationships are built, trust is established, and new ideas are generated.

Overview of Lincoln and White Pine Counties

- From Table 3, the population for Lincoln County declined from 3,983 in 1996 to 3,822 in 2004 or a 4.04% decrease in population over eight years. However, this population decrease was not uniform across the county. The Lincoln County communities of Alamo and Panaca realized population growth from 1996 to 2004. However, the community of Caliente and Pioche and the Rest of Lincoln County realized population decreases from 1996 to 2004.
- The decrease in population growth in Lincoln County did not follow overall state of Nevada population growth which grew by 42.11% over the same eight years. Therefore Lincoln County needs to explore alternative economic development and diversification strategies to reverse this population decline. One strategy may be the industrial development of local pinyon-juniper resources.
- The decrease in unemployment in 2004 hides the true dynamics within the Lincoln County labor market. Number of employed persons who live in Lincoln County increased from 1,048 in 1999 to 1,697 in 2002. However, the labor force in Lincoln County declined from 1,785 in 2002 to 1,564 in 2004 or a 12.38% decrease in labor force over two years. One primary reason for the stabilization in unemployment rate in Lincoln County from 2003 to 2004 is not elevated county economic activity, but the county workforce leaving the county.
- National per capita income in 2003 was $31,472, which was 1.37% less than the state per capita income value ($31,910) and 52.47% greater than the Lincoln County per capita income value ($20,641). Also the growing influence and impact of elderly in a national, state, and county economy is indicated by the proportionate share of personal income from dividends, interest, and rents; and

transfer payments. These sources are primarily earned by the retired portion of a nation's, state's, and/or county's population. For the nation, dividends, interests, and rents; and transfer payments make up approximately 31% of total earned personal income, which for the state of Nevada and Lincoln County is approximately 31% and 42%, respectively.

- Lincoln County's low per capita income and heavy reliance on dividends, interests, and rents; and transfer payments indicate that alternative economic development strategies are needed for Lincoln County. One economic development and diversification alternative would be development of local pinyon-juniper resources.
- A final unique characteristic of Lincoln County is the amount of county acreage administered by the federal and state governments. The federal government administers approximately 98% of the land in Lincoln County, with the Bureau of Land Management managing approximately 83.04% of total Lincoln County acreage. The state government of Nevada administers approximately 18,802 acres or 0.28% of total Lincoln County land mass. A unique feature of Lincoln County as opposed to other Nevada counties is that Lincoln County has five state parks. Therefore, both federal and state governments can play an important part in the successful development and execution of any Lincoln County strategic economic development plan through their administration of federal and state lands.
- From Table 8, the population for White Pine County declined from 10,134 in 1996 to 8,966 in 2004 or an 11.53% decrease in population over eight years. However, this population decrease was not uniform across the county. The Lincoln County communities of Ely, Lund, McGill, and Ruth realized population declines from 1996 to 2004. However, the Rest of White Pine County realized population increases from 1996 to 2004.
- However the decrease in population growth in White Pine County did not follow overall state of Nevada population growth which grew by 42.11 percent over the same eight years. Therefore White Pine County needs to explore alternative economic development and diversification strategies to reverse this population

decline. One strategy may be the industrial development of local pinyon-juniper resources.

- The erratic unemployment rate for White Pine County is also evident in other White Pine County labor statistics. White Pine County labor force increased from 3,457 in 1999 to 3,772 in 2000, decreased in 2001 to 3,655, increased once again to 3,837 in 2002, decreased once again to 3,710 in 2001, and finally increased to 3,911 in 2004. This volatility in the labor force is a result of the White Pine County economy being heavily dependent upon the natural industries (agriculture and mining).
- National per capita income in 2003 was $31,472, which was 1.37% less than the state per capita income value ($31,910) and 19.08% greater than the White Pine County per capita income value ($26,429). Also the growing influence and impact of elderly in a national, state, and county economy is indicated by the proportionate share of personal income from dividends, interest, and rents; and transfer payments. These sources are primarily earned by the retired portion of a nation's, state's, and/or county's population. For the nation, dividends, interests, and rents and transfer payments make up approximately 31% of total earned personal income, which for the state of Nevada and White Pine County is approximately 31% and 31%, respectively.
- White Pine County's low per capita income and heavy reliance on natural resource industries indicate that alternative economic development strategies are needed for Lincoln County. One economic development and diversification alternative would be development of local pinyon-juniper resources.
- A final unique characteristic of White Pine County is the amount of county acreage administered by the federal and state governments. The federal government administers approximately 94 percent of the land in White Pine County, with the Bureau of Land Management managing approximately 77.50% of total Lincoln County acreage. The state government of Nevada administers approximately 9,119 acres or 0.16% of total White Pine County Therefore, both federal and state governments can play an important part in the successful

development and execution of any White Pine County strategic economic development plan through their public land management policies.

Potential Industrial Demands for Pinyon-Juniper Resources

- The following are a list of potential industrial uses and demands for pinyon-juniper resources. These results would provide input into any detailed feasibility analysis of a pinyon-juniper industrial application.
- The most promising avenues for entrepreneurs in White Pine and Lincoln Counties may be to either serve local needs for landscape types of products or to develop a specialized niche market in this type of product. Higher value products typically require increased processing. For example, bark can be separated from the wood to produce a more consistent looking product, chips can be sorted by size or chips can be dyed an attractive color. Bagging wood mulch materials can also add significant value. Bark separation is likely not economically feasible for pinyon-juniper from thinning operations, but bagging, sorting and dying the chips may be. In fact, one company from Cedar City, Utah using the U.S. Stewardship Program to assist in covering transportation costs has reportedly already been able to make use of the pinyon-juniper chips in this way. Niche products typically have added value from extra processing, not all of which are possible with the pinyon-juniper resources. The added value makes the marketplace that can feasibly be served much larger because the higher value can justify higher shipping costs. **If a feasibility analysis is completed analyzing opportunities for pinyon-juniper chips, the U.S. Stewardship Program needs to be explored thoroughly. This federal program could make such a business endeavor feasible.**
- Local demands for landscaping mulch are currently limited. **However a potential feasibility study of a local landscaping mulch industry would need to incorporate the future demands of the Coyote Springs and Toquop housing developments**. The county could work with these housing developers to encourage use of local landscaping mulch used in the Coyote Springs and Toquop housing developments.
- Space heating using wood energy is a traditional and viable use for the pinyon-juniper resource. A local example of this type of use would be the Ely Fuels to

Schools program. Space heating projects typically have a better payback period than do electrical generating or co-generation activities. Increasing the energy density of the wood chips through making pellets or charcoal increases the value of the resource and the distance that the product can economically be shipped. Current wood pellet prices around the country ranged from $120 per ton to $300 per ton. **A feasibility study of potential uses of pinyon-juniper for space heating would also require investigation of the U.S. Stewardship Program which could assist in reducing transportation costs.**

- Even with forecasted population growth in Southern Nevada, using wood for biomass energy is considered to be at the bottom of the value added scale for uses of small diameter wood. If it is feasible, a much larger value can normally be obtained by using wood for any type of lumber, engineered wood product, wood composite or sometimes even mulch material. Pinyon-juniper wood wastes, however, may be difficult to process economically for these uses. Currently, very low electricity costs in the region mean that electric generation from the burning of wood chips may not be cost effective, even when "green energy" credits are taken into account. A feasibility study for electric power generation would quantify these suggested problems.
- Demand for wood wastes for use in co-firing is quite high. Co-firing is the burning of biomass in combination with coal or other fuels. Usually only a small proportion (less than 15 percent) of the total energy inputs in co-firing come from wood waste sources, but for large plants this still produces an enormous demand for biomass. Co-firing is desirable because it can reduce pollutants such as sulfur dioxide and nitrogen oxides. Using a small percentage of wood biomass for co-firing may be an option for the new coal burning power plant being planned in the Ely area. Also, a new power plant is also being planned at the Toquop site. The Toquop site at the far southern end of Lincoln County may not be ideally located for cheap transportation of the wood chips**. A feasibility analysis of the potential of co-firing uses of pinyon-juniper would need to incorporate the U.S. Stewardship Program and how this program could reduce transportation costs for this industrial venture**.

- Special placement for electric co-generation plant that allows for the production of both heat and electricity on-site represents one of the more desirable uses of the pinyon-juniper wood chips for electrical energy generation. Locating co-generation at the end of distribution lines greatly reduces the amount of electricity that must be sent down the distribution and can increase reliability. Given the forecasted growth in Southern Nevada and the potential growth from the housing developments of Coyote Springs and Toquop, special placements for electric co-generation plants might be a viable alternative. Biomass plants also may have attributes relating to renewable energy, global warming and carbon sequestration, energy independence and security provided by decentralized energy which make its energy more desirable and worth more money per kilowatt hour. Partly because of these attributes, grants may be available to help with start-up costs. **Additionally, the Chair in the Department of Resource Economics at the University of Nevada, Reno headed the Toledo-Wren Case Study for Bonneville Power Administration that investigated the feasibility of special placement of electric co-generation plants. Dr. Englin's expertise in the feasibility of special placement for electric co-generation plants may be an avenue of discussion for the Lincoln County Regional Development Authority.**
- One possible use for pinyon and juniper wood chips produced by thinning operations on public land is heating of public buildings in Lincoln and White Pine counties. The Fuels for Schools demonstration site has already been established in Ely, Nevada at Norman Elementary School. Grants paid for approximately $600,000 of the $1,000,000 conversion cost. Costs included a biomass boiler with a heating capacity of 3 to 4.2 million Btu/hour, an automatic chip delivery system, a steam to hot water heat exchanger, an electronic control system with diagnostic software, a fire suppression system as well as a new building to house the system. A pellet business has not committed to either Lincoln County or White Pine County. Speculation as to the absence of a pellet business investment is that their exists a lack of information as to long-term pinyon-juniper chip supply. Long

term supply guarantees, chip quality, storage and transport are issues that should be carefully examined for any other potential conversion project.

- Potential demand for biomass heating in some of the public buildings in Lincoln and White Pine counties was investigated. Included in the survey were the Lincoln and White Pine County court houses, school districts and medical centers and the Nevada State Prison in Ely. Survey results indicated a somewhat limited interest in conversion. A detailed feasibility study might provide information as to possible barriers to conversion and potential governmental grants or loans that might provide financial incentive to convert to pinyon-juniper biomass energy source.
- Other areas for suggested feasibility analysis for potential uses of the local pinyon-juniper resource are composites, water filters, wood ethanol, ethanol from wood and solid wastes, and mobile bio-power plants.
- Lastly for any feasibility analysis of potential industrial endeavors using local pinyon-juniper resources, **a detailed analysis of the Bureau of Land Management and United States Forest Service using stewardship contracts to link land management goals of the Healthy Forests Initiative to economic development and other local needs in surrounding communities needs to be investigated.** The contracts generally allow a private company, non-profit or local government entity to keep the forest products produced in exchange for services such as thinning, processing or removing excess fuels produced by forest health projects. These contracts have been used to pay the transportation cost of removal of pinyon-juniper chips. **There is a special encouragement of non-profit and local government participation in these stewardship contracts.** Contracts are awarded on a so-called "best value basis" and should meet dual goals of increasing forest health and meeting local community needs. The contracts do not need to be based solely on revenue generation. **Local examples of stewardship contracting include the Ely Fuels to Schools Project and the removal of pinyon-juniper chips from the Mt. Wilson thinning project to a Cedar City, Utah company that dyes the chips for use as a landscaping**

material. Private companies are also contracting with the BLM for carrying out pinyon-juniper thinning in the region.

Estimates of the Available Pinyon-Juniper Harvest

- For any feasibility analysis of potential pinyon-juniper ventures in Lincoln County, an accurate estimation of current and future stream flows of pinyon-juniper supplies needs to be conducted. Potentially the actual amount of biomass available will depend on how much of the acreage is actually thinned. Most of the thinning will be done by the BLM.
- Currently, projections by the BLM in Ely are to thin 5,800 acres over the next five years. At an estimated yield of approximately seven tons (7 tons) of biomass per acre, this would yield between 40 to 45 thousand tons over the five year span or an average of 8 to 9 thousand tons annually. However, these averages are highly variable due to uncertainties due to future federal budget funding for the BLM and potential legal actions by environmental and/or other groups. Without legal problems and given enough federal budgetary support, it is expected that the amount of biomass available will increase in the future. The Lincoln County Regional Development Authority might investigate how it can claim some of this future supply for potential pinyon-juniper biomass ventures.

APPENDIX A:

PINYON-JUNIPER BUSINESS SURVEY

1. Which of the following industries best describes that of your company/business? *(check one)*

- ☐ Agriculture
- ☐ Mining
- ☐ Manufacturing
- ☐ Construction
- ☐ Transportation
- ☐ Commercial
- ☐ Utilities
- ☐ Trade
- ☐ Finance
- ☐ Insurance
- ☐ Real Estate
- ☐ Services
- ☐ Governmental
- ☐ Other: (please specify) ___________________________

2. What ownership type is currently used? *(check one)*

- ☐ Sole Proprietor
- ☐ Partnership
- ☐ S-Corporation
- ☐ C-Corporation
- ☐ LLC
- ☐ Other: (please specify) ___________________________

3. What is your position in this company? *(check one)*

- ☐ Owner
- ☐ Manager
- ☐ Accounting
- ☐ Marketing
- ☐ Other: (please specify) ____________________________

4. Are you the decision maker for gas/electricity purchases? *(check one)*

- ☐ Yes (go to 6)
- ☐ No

5. If you answered "no" to the previous question, how is the decision made?

6. Who is your gas/electricity provider? *(check one)*

- ☐ Lincoln County Power District
- ☐ Mt. Wheeler Power
- ☐ Other: (please specify) _____________________________

7. On a scale of 1-10, please rank how familiar are you with the Pinyon-Juniper woodland's wildfire issue, with the value of 1 as "very familiar" and the value of 10 as "not familiar at all".

1 2 3 4 5 6 7 8 9 10

8. In the following table, on a scale of 1-5, please rank how familiar you are with Pinyon-Juniper biomass applications, with the value of 1 as "very familiar" and the value of 5 as "not familiar at all", by circling the appropriate number.

Application	Very Familiar	Somewhat Familiar	Not Sure	Not Very Familiar	Not Familiar At All
1. Electric generation application	1	2	3	4	5
2. Co-firing application	1	2	3	4	5
3. Space and process heating application	1	2	3	4	5
4. Chemical and fuel applications	1	2	3	4	5
5. Densification	1	2	3	4	5
6. Other uses: _____________________	1	2	3	4	5

9. To your knowledge, does your gas/electricity provider use Pinyon-Juniper biomass as an alternative energy source? *(check one)*

- ☐ Yes
- ☐ No

10. Please list any issues you see in using Pinyon-Juniper biomass as an alternative gas/electricity source:

1.
2.
3.
4.
5.
6.

11. What corrective actions would you suggest be taken to solve these issues:

Issue	Corrective Action
1.	
2.	
3.	
4.	
5.	
6.	

12. Would you be willing to purchase gas/electricity if the provider uses Pinyon-Juniper biomass as an alternative energy source in the future? *(check one)*

- ☐ Yes
- ☐ No, why: ____

13. In your company, what is the average monthly electricity bill? *(check one)*

- ☐ $_________/month
- ☐ Prefer not to answer

14. How many KWHs does you company consume monthly? *(check one)*

- ☐ _________KWHs
- ☐ Prefer not to answer

15. In the following table you will be given eight bids which represent the electricity charge in cents per KWH should your electricity provider use Pinyon-Juniper biomass for partial electricity generation. Assume you currently pay .060 cents/KWH. For each bid amount specify if you would definitely not be willing (1), probably not be willing (2), not sure (3), probably be willing (4), or definitely be willing (5) to pay the electricity charge (bid), by circling the appropriate number (1-5).

Bid Amount	**Definitely No**	**Probably No**	**Not sure**	**Probably Yes**	**Definitely Yes**
1. .075/KWH	1	2	3	4	5
2. .120/KWH	1	2	3	4	5
3. .060/KWH	1	2	3	4	5
4. .080/KWH	1	2	3	4	5
5. .065/KWH	1	2	3	4	5
6. .100/KWH	1	2	3	4	5
7. .070/KWH	1	2	3	4	5
8. .090/KWH	1	2	3	4	5

16. Would your company consider using Pinyon-Juniper biomass to produce its own electricity? *(check one)*
- ☐ Yes
- ☐ No, why: ____

17. Would you company consider using Pinyon-Juniper biomass for other uses? *(check all that apply)*
- ☐ Chips for landscaping
- ☐
- ☐ Other: _____________________

18. How many full-time employees does your company hire? *(check one)*

_____________ (number)

19. How many part-time employees does your company hire? *(check one)*

_____________ (number)

20. What are your company's average net earnings per year? *(check one)*
- ☐ $___________
- ☐ Prefer not to answer