RESOURCE ASSESSMENT AND FEASIBILITY REPORT

Task 1 and 2 – Renewable Energy Resource Assessments and Feasibility Study Report

Incorporating:

Renewable Power Transmission Assessment – S&B Christ Consulting, LLC.
Pinyon-Juniper Biomass Assessment – Resource Concepts, Inc.
Concentrating Solar Power Resource Assessment – Millennium Energy, LLC.
Renewable Energy Feasibility Study and Resource Assessment: Geothermal Component– Nevada Bureau of Mines and Geology, University of Nevada, Reno
Pumped Storage Hydroelectric - Millennium Energy, LLC.
Solar Photovoltaic – Millennium Energy, LLC.
Wind Power - Millennium Energy, LLC.
Resource Maps: Land Status and Transmission, Biomass, Concentrating Solar Power, Potential Geothermal, Photovoltaic Solar, Microhydro Resource, and Wind Power – Terraspectra Geomatics
Financial Analysis and Incorporation of Risk in Clean Energy Projects – University of Nevada, Reno
Economic Impact Assessment – University of Nevada Cooperative Extension

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Author	**Document**
S&B Christ Consulting, LLC.	Renewable Power Transmission Assessment
Resource Concepts, Inc.	Pinyon-Juniper Biomass Assessment
Joe Bourg, President, Millennium Energy, LLC.	Concentrating Solar, Pumped Storage Hydroelectric, Solar Photovoltaic, and Wind Power Assessments
Terra Spectra Geomatics	Resource Maps: Land Status and Transmission, Biomass, Concentrating Solar Power, Potential Geothermal, Photovoltaic Solar, Microhydro Resource, and Wind Power
Dr. James Faulds, Nevada Bureau of Mines and Geology, University of Nevada, Reno	Renewable Energy Feasibility Study and Resource Assessment: Geothermal Component
Dr Thomas Harris, Professor in the Department of Economics and Director of the University Center for Economic Development, College of Business at the University of Nevada, Reno	Financial Analysis and Incorporation of Risk in Clean Energy Projects for White Pine County
Buddy Borden, Area Extension Specialist in Community and Economic Development, University of Nevada Cooperative Extension	Economic Impact Assessment

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ACRONYMS

AB	Assembly Bill
ARRA	American Recovery and Reinvestment Act
BIA	US Bureau of Indian Affairs
BLM	US Bureau of Land Management
Cd-Te	Cadmium-Tellurium
CIGS	Copper-Indium Gallium-Diselenide
CREBS	Clean Renewable Energy Bonds
C-Si	Crystalline Silicon
DC	Direct Current
DNI	Direct Normal Irradiance
DOE	US Department of Energy
DSM	Demand Side Management
EID	Environmental Impact Datasheet
EPC	Engineering/Procurement/Construction
GHI	Global Horizontal Irradiance
GTI	Global Tilted Irradiance
IRP	Integrated Resource Plan
IRR	Internal Rate of Return
IRS	US Internal Revenue Service
ITC	Investment Tax Credit
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
LLC	Limited Liability Company
MACRS	Modified Accelerated Cost Recovery System
MW	Megawatt
MWh	Megawatt Hour
NMTC	New Markets Tax Credit
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
O & M	Operations and Maintenance
PC	Portfolio Energy Credit
PPA	Power Purchase Agreement
PUC	Public Utilities Commission
PURPA	Public Utilities Regulatory Policies Act
PV	Photovoltaic
QF	Qualifying Facility

REAP	Rural Energy Assistance Program
REC	Renewable Energy Credit
RFP	Request for Proposal
RPS	Renewable Portfolio Standard
SB	Senate Bill
SGIP	Standard Small Generator Interconnection Procedures
T & D	Transmission and Distribution
TERA	Tribal Energy Resource Agreements
TWh	Terawatt Hour
USDA	US Department of Agriculture
VAR	Voltage-ampere Reactive

1 PURPOSE

The White Pine County Renewable Energy Resource Assessments and Feasibility Study (Feasibility Study) was prepared to help community leaders and developers to understand and capitalize on the area's renewable energy resources. The purpose of the hypothetical feasibility analysis was to provide an initial understanding of potential financial considerations for actual clean energy investments. For actual clean energy projects, a detailed feasibility analysis would require the input of specific financial and physical information as to the proposed project. This Feasibility Study was prepared with the understanding that the County's long-term goal is to strengthen and diversify its economy, generate jobs and business opportunities for its residents, and to provide sufficient tax revenue to meet the needs of its citizens.

Background

White Pine County is located in east, central Nevada at the crossroads of US Highways 93 and 50. The County is sparsely populated, with the majority of its land base being public land administered by federal agencies. Its economy is based on mining, agriculture, and tourism. The County's long-term goal is to strengthen and diversify its economy, generate jobs and business opportunities for its residents, and provide sufficient tax revenue to meet the needs of its citizens.

The County's history of energy development dates back to 1978. Faced with the closure of the Kennecott Copper Mine, its primary employer, one of the County's first economic diversification efforts was a partnership with the Los Angeles Department of Water and Power (LADWP) to develop the White Pine Power Project, a 1,500 megawatt coal fired power plant. The development phase of the White Pine Power Project extended from 1978 to 1997 when the project was closed by LADWP.

During the period LADWP was active in White Pine County, the Idaho Power Company initiated the development phase of the Southwest Intertie Project (SWIP) to establish a transmission corridor from Twin Falls, Idaho through eastern Nevada to Las Vegas, Nevada, to enable transfer of power north and south during periods of peak demand. Although, neither the White Pine Power Project nor the Idaho Power transmission line was built, they provided the County with a strong basis for future energy development efforts. Development of the White Pine Power Project provided the County with 25,000 acre feet of water rights permitted for power generation, a library of studies for the Environmental Impact Statement and air quality permit applications, and community awareness of permitting processes and energy development issues. Through the SWIP project a permitted transmission corridor was established which would eventually house the One Nevada (ON-Line) Transmission Line from the Thirty-Mile substation near Ely south to Las Vegas. The opportunity for the construction of additional north and south transmission lines exists in this corridor.

During the period from 2000 to 2008, the County worked with several developers responding to energy shortages in California and volatile natural gas prices by exploring the potential of updating the permits for the White Pine Power Project and using the County's water rights and infrastructure to support coal fired power plants. Two Environmental Impact Statements and air quality permit processes were initiated, one by LS Power for the White Pine Energy Station and the other by NV Energy for the Ely Energy Center. A Record of Decision was issued for the

White Pine Energy Station, but as the nation's priorities had shifted to renewable energy, both the LS Power and NV Energy coal fired plants were put on hold. Attention focused on the use of the SWIP corridor for construction of the One Nevada (On-Line) Transmission Line and development of the County's resources for renewable energy. White Pine County worked closely with its Congressional Delegation and their staffs to facilitate development of the One Nevada (On-Line) Transmission Line and associated energy projects.

The Ely District Office of the Bureau of Land Management worked with seventeen proposed wind energy projects in varying stages of the application process. Wind energy developers accessed the thirty-year old wind data collected for the White Pine Power Project air quality permit application, and found the historic data supported their wind data collection processes. In August 2012, the Spring Valley Wind Project, located thirty miles east of Ely, went into operation as Nevada's first utility scale wind energy project.

1.1 Project Description

To strengthen their position to assist renewable energy developers and to prepare the community for the opportunities the potential projects offered, County leadership wanted to have a better understanding of the area's renewable energy resources and the economic feasibility and impact of renewable energy projects.

In 2009 the County worked with the Department of Energy's Golden Colorado Office to complete a grant application for $500,000 from the Renewable Energy Research and Development Grant program (CFDA 81.087) administered by the Energy Efficiency and Renewable Energy Program (EERE). The grant funds were supplemented with local matching funds and in-kind contributions for a total project amount of $747,500. The grant was awarded to White Pine County and the grant's Statement of Project Objectives and the project scope were subsequently expanded to include wind, solar, geothermal, and hydro-electric potential.

The grant project objectives were to:

- Maximize the County's opportunities to host renewable energy generation, increase services to support maintenance and operation of renewable energy generation, and develop manufacturing components required for renewable energy projects.
- Establish the County as a center for training and research in natural resource management, renewable energy, and green construction.
- Maximize use of renewable energy and green construction methods throughout the County.

The scope of work for the White Pine County Grant was designed to:

- Provide data and evaluate the potential for development of renewable energy resources in White Pine County.
- Analyze the economic feasibility of each type of renewable energy project that has potential for development in the County.

Project Approach

Each segment of the White Pine County Renewable Energy Resource Assessments and Feasibility Study (Feasibility Study) was conducted by contractors with expertise in the renewable energy markets, resources, and development needs. The Feasibility Study provides the following analyses:

- White Pine County's cultural and business environment as well as the opportunities for businesses and their employees.
- Existing and anticipated markets for renewable energy.
- Resources available for transmission and distribution of renewable energy.
- Resources available in White Pine County and the economic feasibility of renewable energy projects in White Pine County including:
    - Pinyon-juniper woody biomass resources from fuels reduction and landscape restoration projects on public lands.
    - Solar energy resources for Concentrating Solar Hybrid and Photovoltaic Solar projects.
    - Resources available for Pumped Hydroelectric Storage projects.
    - Wind energy resources.
    - Geothermal resources.
    - Transmission and Distribution of Renewable Energy.
- Cost of operations of renewable energy projects.
- Socio-economic impacts to White Pine County due to development of renewable energy resources.
- Resource maps showing renewable energy resources in conjunction with land status, water resources, transportation, and availability and ownership of transmission capacity.

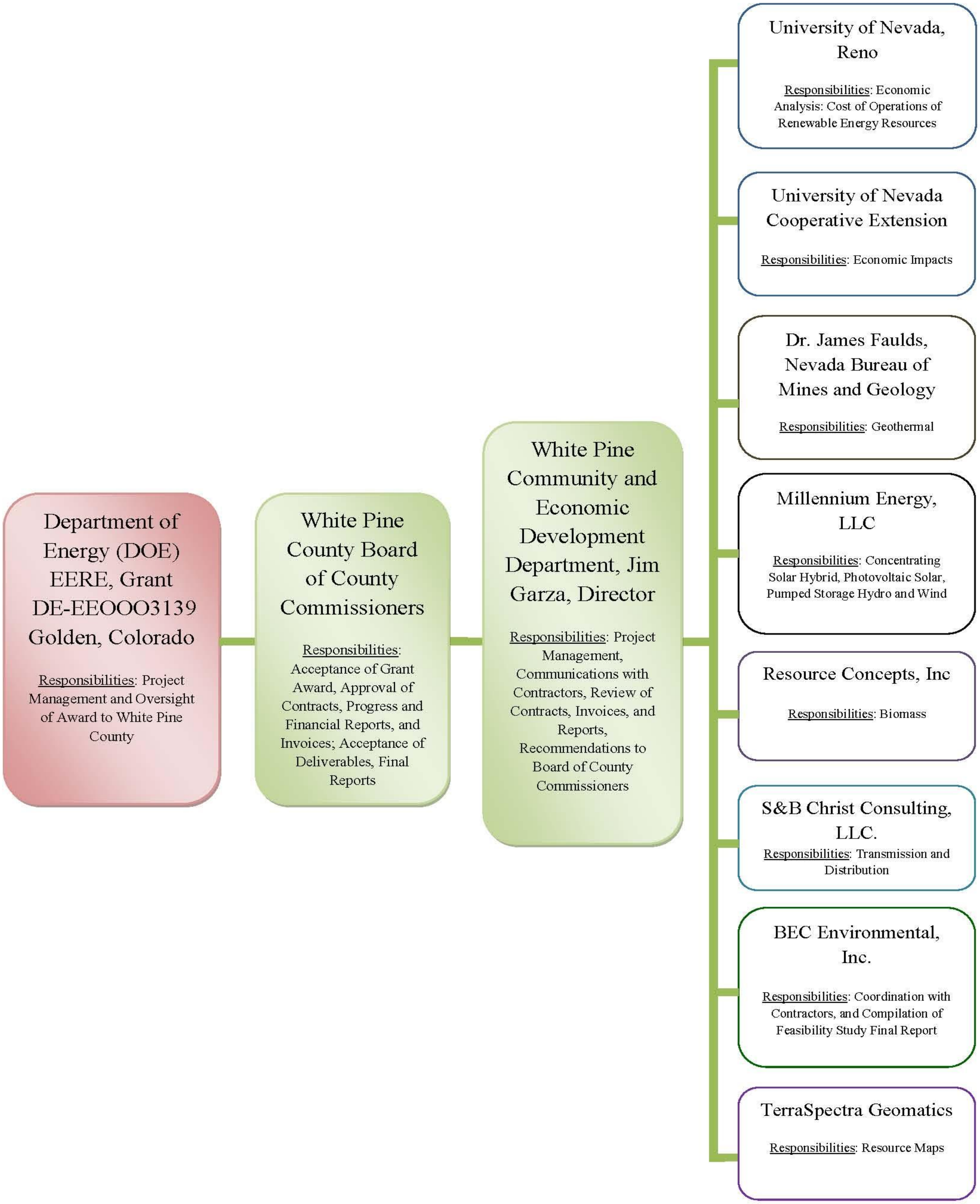

Figure 1.1 Team Chart

The Feasibility Study compiled results of the analyses for each type of renewable energy resource. The study identifies opportunities, issues, potential barriers to development, and available incentives. The report concludes with an outline of potential marketing strategies and next steps for community leaders, educators, and developers. It should be noted this report is dependent upon the detailed information provided in its appendices, therefore the document is intended to be read in its entirety.

1.2 Community Assessment: Business, Culture, and Opportunities

White Pine County, Nevada provides basic services and facilities to support renewable energy projects and meet the needs of their employees. It is centrally located in the Inter-Mountain West accessible to the urban centers of Reno, Las Vegas, and Salt Lake City. The community offers businesses and their employees a unique combination of quality educational, medical, and local business services partnered with specialized services and programs available throughout the inter-mountain west. Residents enjoy beautiful mountain scenery, high desert climate, unparalleled outdoor recreation, and a small town way of life. The County traces its origins to the days of the Pony Express, the gold and silver mining camps in the mid1800's, and the advent of copper mining in the early 1900's. The County remains proud of its history and cultural heritage; while it works progressively to develop new industries including renewable energy and technology (White Pine County, 2006).

1.2.1 Services to Business and Industry

Business Environment

The County's economy is based on three primary market sectors: gold and copper mining, alfalfa production and ranching, and tourism. Its growing tourism industry attracts visitors year-round to participate in a variety of special events, visit Great Basin National Park, ride the historic Nevada Northern railroad, experience the old west, and enjoy the wide open spaces. The County houses the state's maximum security prison and serves as a regional hub for federal and state agencies.

County businesses provide materials, equipment, and repair and maintenance services. Local contractors are licensed for excavation, general construction, electrical, and plumbing work. Attorneys, accountants, insurance agents, real estate brokers, computer specialists, engineers, and surveyors are available locally to assist companies. The community supports three banks that are branches of statewide and regional banks and offer residential and commercial lending services. Area industries can also call upon the surrounding urban areas in Las Vegas, Reno, Sacramento, Salt Lake City, and San Francisco for more specialized products and services. Industrial activity is encouraged in manufacturing zones and industrial sites are concentrated in the County owned and administered full service industrial park located three miles north of Ely on US Highway 93. The White Pine County Industrial Park has up to 40 semi-improved acres available for sale upon proper Notice to the General Public processing and Commission approval to develop renewable energy related facilities. Interested parties should contact the Community and Economic Development Office to request the County consider starting the competitive bid process for sales of 40 acre or less parcels (Garza, 2014). The Ely Shoshone Tribe owns 660 acres designated for economic development that are located 24 miles north of Ely adjacent to US Highway 93 (Ely Tribe Conservation District , 2013).

Population and Workforce

White Pine County's population of 10,030 (2010 Census) is concentrated in the communities of Ely, Ruth, and McGill with 60 percent of the total population living in the three communities. The remaining 40 percent resides in the outlying communities of Baker, Lund, Preston, and Cherry Creek and on ranches and mining property throughout the County. The population density for the County is 1.1 persons per square mile. For more information about the County's demographic profile visit http://quickfacts.census.gov/qfd/states/32/32033.html or http://factfinder2.census.gov and enter White Pine County, Nevada.

Nevada's Department of Employment, Training, and Rehabilitation (DETR) reported the total labor force in White Pine County in 2013 was 5,548 with an unemployment rate of 6.9 percent representing 380 unemployed and 5,167 employed in the County. The average weekly wage of $928 was higher than the statewide average of $829 due to the high percentage of the workforce in mining. One-fifth of the County's workforce was employed in the mining sector with an average weekly wage of $1,534 while other employment sectors were equal to or below the statewide averages (Nevada Department of Employment, Training, and Rehabilitation).

The County's largest employers include the Robison Nevada Copper Mine and Nevada State Department of Corrections. Area employees are skilled in heavy equipment operation, transportation services, law enforcement and corrections, and technical fields. Training opportunities are available through Nevada's JobConnect programs (Nevada Department of Employment, Training, and Rehabilitation). For more information on White Pine County's workforce characteristics and employment patterns visit www.nevadaworkforce.com.

Land Ownership and Use

White Pine County covers 8,900 square miles, an area equivalent to the size of Massachusetts. Ninety-five percent of the land base in the County is in public ownership. Four federal agencies administer 93 percent of the land in the County (Bureau of Land Management, Forest Service, National Park Service, and Fish and Wildlife Service). Land administered by the State of Nevada includes Cave Lake and Ward Charcoal Ovens State Parks, Ely State Prison and Ely Conservation Camp, Steptoe Valley Wildlife Management Area, and the Ely Campus of Great Basin College. Local Governments, including White Pine County, the City of Ely, and the White Pine County School District own approximately 0.03 percent of the land in the County for public facilities. Tribal lands include the Ely Shoshone Tribe with 3,526 acres and a small portion of the Ibapah Reservation in the northeastern corner of the County. Private land accounts for five percent of the County's land base and uses include residential and commercial areas in urban centers, private industrial and mining operations, and agricultural land (White Pine County, 2012).

Photo: Charcoal Ovens Panorama
Photo courtesy of White Pine County Tourism and Recreation Board, Bristlecone Convention Center

Local Government

There are two units of local government in White Pine County: the County and the City of Ely. Their elected boards serve specific needs in the County. The White Pine County School Board, the White Pine County Hospital District Board, the Boards for the Baker and McGill Ruth Water and Sewer General Improvement Districts, and the White Pine and Baker TV Districts. All are able to levy fees, incur long-term debt, and operate independently of County government. The Tourism and Recreation Board oversees the expenditure of Lodging Tax revenue for operation of the Convention Center, promotion of the County, funding for special events, and projects that enhance recreation and tourism activities. The Ely Shoshone Tribal Council governs activities on Tribal lands.

White Pine County is governed by a five member Board of County Commissioners (BOCC). The County provides law enforcement, emergency services, property assessment, tax collection, emergency aid to indigents, district and justice courts, community and economic development, and amenities including the airport, senior citizens programs, and the County library. The County cooperates with the State of Nevada to provide the Ely Cooperative Extension and Public Health offices. The County's Public Works Department oversees maintenance and improvement of County roads and facilities. The City of Ely operates under a Mayor-Council form of government and is responsible for the City's water and sewer services, fire protection, emergency medical services, city parks and facilities, and streets. The outlying communities in the County are governed by the BOCC and are served by appointed Town Councils and Citizen Advisory Boards. Through cooperative agreements, the White Pine County Sheriff's Office provides law enforcement, centralized dispatch services, patrol, and the jail for both the City and the County; the County and City coordinate emergency medical services (EMS) and fire protection; and the City operates the Regional Landfill and cemetery for all County residents. The Regional Transportation Commission is a combined effort of City and County to disburse a portion of motor fuels revenue for repair and improvements to City and County roads. Both the City and the County maintain Planning Commissions to review planning documents, zoning ordinances, and proposed land use actions (White Pine County, 2012).

Emergency Services

White Pine County's strong heritage of volunteerism is a hallmark of its emergency services. Dedicated volunteer firefighters and emergency medical technicians devote hundreds of hours to training, maintaining equipment and facilities, and answering emergency calls to help neighbors and travelers in every community in the County. White Pine County and the City of Ely coordinate emergency medical services (EMS), fire protection, and law enforcement services through an inter-local agreement. Both the County and city provide staffed EMS and Fire Departments supplemented with volunteer EMS services and Fire Departments. Ambulance crews provide the initial response and transport to William Bee Ririe Hospital where critically ill or injured patients are stabilized and can be air-lifted to urban hospitals for specialized services. Through membership in the Inter-Agency Fire Management Program, the Ely District Bureau of Land Management (BLM), Forest Service, Nevada Division of Forestry, the Ely Shoshone Tribe, and local fire departments coordinate response to wildland fires throughout the County. The County Office of Emergency Management works with area emergency services, law enforcement, local industries, and public media to coordinate disaster planning, training, and hazardous materials programs.

Taxes

Businesses locating in White Pine County enjoy Nevada's favorable tax climate and incentives and renewable energy projects are eligible for the state's renewable energy tax abatements. White Pine County draws its primary tax revenues for on-going operations from property tax, the County's portion of sales tax, and Payment in Lieu of Taxes (PILT), based on the amount of federal land in the County. The City of Ely's primary tax revenues come from the City's portion of the Consolidated Tax (sales tax, excise taxes on cigarettes and liquor, general services tax, and real property transfer tax) (White Pine County, 2012).

Nevada state law limits the total property tax rate to $3.66 per $100 of assessed value. Property taxes are assessed on 35 percent of the property value and the value is depreciated by 0.25 percent every year for twenty years. The sales tax rate in White Pine County is 7.725 percent which includes a one eighth cent allocation for new school construction and one-fourth cent for operation of the swimming pool (Nevada Department of Taxation, 2013).

Utilities

Water and sewer services within the City of Ely and areas adjacent to the corporate boundaries are managed by the City's Municipal Utilities System. Water and sewer rates are established by the Utilities Board and approved by the City Council. Water and sewer services for the communities of Ruth and McGill are provided by the McGill Ruth Consolidated Water and Sewer General Improvement District and the water and sewer services for the town of Baker are provided by the Baker Water and Sewer General Improvement District. A small, private water company provides water to the residents of Cherry Creek and all other areas in the County use private wells and septic systems. The City of Ely and communities throughout the County have sufficient water resources, sewage capacity, and landfill capacity to support growth (White Pine County, 2012).

Electrical power is provided by Mt. Wheeler Power, a rural electric cooperative which serves 5,422 customers in White Pine County. Seventy-eight percent are residential customers. The company has no generation of its own but has an all user requirements contract that should meet current and future demand for power. Deseret Power Electric Cooperative (Utah) is the primary electrical power supplier and power is generated by hydroelectric and coal fired power plants (Mt. Wheeler Power, 2013). Approximately one-third of the housing units in White Pine County are heated with propane. There is no natural gas service in White Pine County (White Pine County, 2012).

Transportation

The City of Ely and White Pine County are located at the crossroads of U.S. Highways 50 and 93. U.S. Highway 93 provides a north-south route with access to the Pacific Northwest and connection to Interstate 80 at Wells, Nevada and Las Vegas to the south and U.S. Highway 50 provides an east-west route with connections to Denver to the east and Reno, Sacramento, and San Francisco to the west. In addition, State Route 318 (south of Ely) is maintained at federal highway standards, it reduces the travel distance to Las Vegas by 50 miles, and it minimizes travel over mountain passes. Six carriers provide one- and two-day motor freight service to and from Salt Lake City, Las Vegas, and Reno via regional and local trucking firms. Small parcel delivery service is provided by FedEx, UPS, and the US Postal Service. White Pine County does not currently have scheduled commercial air service. Its airport, Yelland Field, provides two lighted runways and the Fixed Base Operator provides fuel and rental cars (for detailed information about airport facilities and services visit the Ely Airport website, http://elyairport.org) (Ely Airport, 2013). Regional air service through SkyWest Airlines is available at Elko, Nevada and national and international flights are available via the Las Vegas, Reno, and Salt Lake City airports. Local bus service is available within Ely and between Ely, Ruth, and McGill and shuttle service is available to the airport. There is one car rental service in Ely.

The Nevada Department of Transportation maintains state and federal highways, the City of Ely's Street Department maintains city streets, and the County Road Department maintains over 2,000 miles of roads. County roads vary from paved streets in towns to gravel roads and unmaintained dirt roads throughout the County. The County Code requires entities using County roads for heavy equipment or unusually high traffic to enter into a road agreement with the County to provide funds or in-kind service to maintain and repair roads subject to unusual wear due to their use (White Pine County, 2012).

1.2.2 Services to Employees and Their Families

Education

White Pine County elementary schools in Ely, McGill, Lund, and Baker and the Learning Bridge Charter School in Ely provide smaller scale learning environments to help young students develop academic skills as well as leadership and an appreciation for community service. The White Pine Middle School and High School have been recognized for their innovative and award-winning programs. High School students have the opportunity to pursue academic programs and earn college credit through dual credit courses at Great Basin College. The Career and Technical Education programs range from agriculture, auto mechanics, and basic cabinetry/woodworking and welding skills to culinary programs, health sciences, and mechanical technology. Students enjoy a full range of athletic, drama, arts, and extra-curricular activities. The Ely campus of the state's Great Basin College is linked to the statewide system of higher education through distance learning equipment and offers several Bachelor degree programs, Associate of Arts degrees, and certificated programs in vocational skills. The college works directly with area employers to provide customized training to meet their needs. White Pine School District and Great Basin College, in partnership with Pattern Energy (a Spring Valley wind developer), are developing science and engineering education opportunities for students interested in careers in energy development. For more information visit the White Pine County School District website http://www.whitepine.k12.nv.us (White Pine County School District, 2013), the Learning Bridge Charter School website, http://elylearningbridge.org (Learning Bridge Charter School, 2013); and the Great Basin College website, http://www.gbcnv.edu (Great Basin College).

Photo: Great Basin College
Photo courtesy of Great Basin College

Medical Services

The County's William Bee Ririe Hospital and Clinic provides a primary care facility with specialized programs including surgery, obstetrics, and physical and respiratory therapy. Its local staff is supplemented with visiting physicians in a wide variety of specialties. The medical staff works in partnership with regional medical centers including Primary Children's Center and the Huntsman Center, both in Salt Lake City. (For detailed information on services and staff visit the William Bee Ririe Hospital web site, http://www.wbrhely.org (William Bee Ririe Hospital, 2013). There are three dentists and one optometrist in Ely and they work with orthodontists, oral surgeons, and ophthalmologists in the region.

Photo: William Bee Ririe Hospital in Ely, Nevada
Photo courtesy of William Bee Ririe Hospital

Housing

According to the 2010 Census, White Pine County had 4,498 housing units with 3,707 units occupied and 791 units vacant for a vacancy rate of 17.6 percent (U.S. Census Bureau, 2013). According to the White Pine County Housing Needs Assessment (White Pine County Community and Economic Development, 2012), the median price of a home in Ely for the period 2006-2010 was $157,800 (White Pine County). The County's housing stock covers the full range of housing options from apartments and affordable housing to higher end homes on acreage. Area real estate brokers are available to assist home buyers to locate homes, for purchase or rent, to fit their needs and budgets. There are numerous 2.5 and 5 acre building lots available in the areas surrounding Ely and McGill for those who prefer a rural lifestyle and local contractors can assist with construction of custom built homes or installation of manufactured housing. Low interest loans are available for low and moderate income households through U.S. Department of Agriculture, Rural Development programs and the Nevada Rural Housing Authority. Down payment assistance is available through the Rural Nevada Development Corporation for first time home buyers. For further information see the Housing Gap Analysis for White Pine County, UCED Technical Report 08/09-03, http://www.unr.edu/Documents/business/uced/technical-reports/white-pine/08-09-03housing-gap-analysis-for-white-pine-co7-10-2008.pdf. White Pine County's four hotels and seventeen motels are available to house visiting staff consultants, and specialists as well as construction workforce. The County's eleven RV Parks provide full service spaces for employees who prefer to bring travel trailers and mobile homes during construction assignments (White Pine County Tourism and Recreation Board, 2013).

Climate

White Pine County is typical of the Basin and Range topography of alternating north south mountain ranges and long, narrow valleys. The city of Ely is located in Steptoe Valley at an elevation of 6,300 feet and is surrounded by mountain ranges of 8,000 to 10,000 feet in elevation. The area's semi-arid high desert climate is characterized by clear, sunny days; temperatures averaging 23.9 in January and 65.5 in August; and an annual average of 9 inches of rainfall and 49.1 inches of snowfall.

Photo: Duck Creek Basin
Photo courtesy of BEC Environmental, Inc.

Community

Ely's business community provides a small town friendly atmosphere and stores offer a wide range of products from groceries and hardware to unique crafts and works by local artists. Downtown Ely serves as the focal point for tourist activity and local social events, housing, hotel and motel facilities, restaurants, two casinos, the Ely First National bank, and shops. The Garnet Mercantile Department Store is a community-owned corporation formed in response to the closure of the JC Penney store in 2003. The Board of Directors is comprised of County residents and the staff coordinates with similar stores in the west to increase its buying power. The local retail sector is supplemented by shopping and entertainment available in the surrounding urban areas.

White Pine County supports churches of several denominations and community activities include several civic groups and youth activities. Community parks, the Little League field, and the softball complex are busy spring through fall with youth baseball, softball, and soccer and adult softball leagues. The McGill swimming pool is a unique, warm springs fed pond and the County's new aquatics center is under construction and will offer an indoor pool available for all age groups. Volunteer activities and special events are available to meet every interest, from the Nevada Northern Railroad Foundation promoting the area's mining and railroad history to the Ely Renaissance Society dedicated to public arts and preserving the area's cultural heritage. Special events include the home town 4th of July and Christmas Parades, the County Fair, the Fire and Ice winter celebration, and the Silver State Classic open road race.

Photo: 4th of July Parade in Ely, Nevada
Photo courtesy of White Pine County Tourism and Recreation Board, Bristlecone Convention Center

Photo: Fire and Ice Winter Celebration
Photo courtesy of White Pine County Tourism and Recreation Board, Bristlecone Convention Center

Recreation

Outdoor enthusiasts enjoy year round outdoor recreation activities just a few minutes' drive from Ely. Residents and visitors enjoy camping and hiking in the Great Basin National Park near Baker, fishing at Cave Lake State Park, 4-wheeling on back country roads, and exploring the County's 500,000 acres of wilderness areas. The County offers site-seeing and wildlife viewing from 10,000 foot alpine meadows to desert playas. It is home to some of the state's best trophy hunting for elk, mule deer, and antelope. Fall brings aspen turning gold on the surrounding hillsides, berry picking, and gathering pine nuts. In winter, clear, sunny days offer ice fishing, snow shoeing, snowmobiling, and cross country skiing (White Pine County Tourism and Recreation Board, 2013).

Photo: Spring Valley, Cleve Creek
Photo courtesy of BEC Environmental, Inc.

Photo: Lehman Caves
Photo courtesy of White Pine County Tourism and Recreation Board, Bristlecone Convention Center

Get Connected

White Pine County welcomes new business and industry by offering assistance through its Community and Economic Development Department as well as its Chamber of Commerce. Full service industrial sites, a variety of low interest loan programs, relocation assistance, and assistance with permitting processes are available to help new companies and their employees.

New business developers are encouraged to contact Jim Garza, Director, White Pine County Community and Economic Development Department at 775-293-6592 or Wayne Cameron, Director, White Pine County Chamber of Commerce at 775-289-8877. More information about White Pine County and its services is available on the White Pine County website, www.whitepineCounty.net (White Pine County) and the Chamber of Commerce website, www.whitepinechamber.com (White Pine Chamber of Commerce, 2012).

2 MARKET OPPORTUNITIES

The basis of the information provided in this Market Opportunities section is from preliminary research done in September 2013 by Millennium Energy, LLC, in support of BEC Environmental, Inc.'s Battle Mountain Renewable Energy Park Project.

2.1 Market Assessment

The identification of a market for power produced by renewable energy resources is a fundamental step in evaluating the feasibility of such a project. Several significant barriers and opportunities that arise relate to market identification for potential renewable energy projects in White Pine County. Markets, in turn, are greatly influenced by public policy. Federal and state energy policies influence the relatively new renewable energy market and influence every stage of decision making, determining:

- Who will buy renewable generation?
- How will they buy it?
- How much will they buy?
- Where and what kind of renewable resource will they buy?
- How much will they pay?

According to the 2010 U.S. Census, Nevada was experiencing the most rapid growth in population of any state. This period of rapid population and economic expansion also increased electricity consumption in the state and resulted in Nevada utilities spending more than $115,700,000 on coal, natural gas, and other fuel in 2011 (U.S. Energy Information Administration). Natural gas, the predominant fuel source for Nevada electric utilities, supplied nearly two-thirds of Nevada's net electricity generation. According to a report by the U.S. Energy Information Administration, three in ten Nevada households depend upon electricity to heat their home. Nevada's industrial sector leads consumption in the state and accounts for more than one-third of the total power consumption of the state. Nevada was hard hit by the recent recession, but infrastructure remains and expectations are high for the Silver State's recovery. Nevada imports most of its energy from out of state resources. The population is concentrated in the state's two population centers, Clark County and Las Vegas in the south, and Reno in the north. Energy consumption exceeds production in the state which receives it electricity via several high-voltage transmission lines. Upgrades to these lines and several new high-voltage transmission facilities are planned and may enhance the state's power supply, although capacity for delivery into Nevada will be limited by out-of-state transmission service subscribers. New generation planned by the State's Investor Owned Utility (IOU), NV Energy, would be fueled either by natural gas or renewable sources.

The State of Nevada's Renewable Portfolio Standard (RPS) requires IOUs maintain a minimum portfolio of 25 percent renewable energy (calculated as a percentage of sales) by the year 2025 (State of Nevada Legislative Code, 2013). Additionally, during the 2013 Nevada Legislative session, Nevada passed Senate Bill (SB) 123 (Atkinson, 2013) which mandated the State's only IOU, NV Energy (formerly Sierra Pacific Power Company and Nevada Power Company), purchase an additional 300 MW from renewable resources, although regulations have not yet been written and the interpretation of this new law is being debated in an Investigatory and Rule Making Public Utilities Commission (PUC) Docket (State of Nevada Public Utilities Commission , 2013). A National Renewable Energy Laboratory (NREL) report stated, "Historical trends in population, GDP, and per-unit electricity consumption suggest that retail sales (in Nevada) could rise 23 percent from 2011 to 2025, reaching a projected total of 43.6 TWh, taking into account energy efficiency improvement consistent with state requirements… suggests the demand for renewable energy related to the RPS will most likely be between 5.6 TWh and 6.6 TWh in 2025... and 2.1 TWh to 3.1 TWh will still be needed by 2025 to meet RPS requirements" (Hurlbut, 2013, pp. 55 - 58).

Nearly half of Nevada's renewable energy comes from geothermal resources. The vast majority of the rest of Nevada's in-service renewable energy comes from the Western Area Power Authority Hoover Dam hydroelectric plant which also supplies electricity to Arizona and California. Solar, wind, and biomass make up the balance of Nevada's renewable portfolio. An NREL report advised Nevada had the country's largest untapped geothermal resources, and estimated Nevada rural areas were capable of producing 8,614,454 Gigawatt hours (GWh) of electricity from photovoltaic resources. This same report stated Nevada had potential wind resources along ridgelines across the state (Anthony Lopez, 2012). See Section 3 for more information about the renewable resources specific to White Pine County.

Eighty-seven percent of lands in Nevada are federally managed. Included in these lands are identified environmentally sensitive areas like Areas of Critical Environmental Concern (ACEC), protected wilderness, designated wild and scenic rivers, and critical wildlife conservation areas closely protected by the responsible federal agencies. Permitting a project in one of these areas could be highly controversial, limited by law, or even prohibited.

The Natural Resources Defense Council maintains an interactive mapping tool on the Google Earth platform to enable renewable energy developers to identify areas where renewable energy sources may conflict with preserving wildlife and wildlands in the western U.S (Natural Resources Defense Council, 2009).

In 2010, the Department of Energy awarded a $3 Million grant to western state wildlife agencies to launch a regional pilot project to improve coordination across political jurisdiction, inventory data, improve data development and management, and increase data sharing to enable identification of crucial habitat and corridors across the West. The Western Governors' Association Wildlife Council subsequently created and launched the Western Wildlife Crucial Habitat Assessment Tool (CHAT) for public release in December 2013 (Western Governors' Association Wildlife Council, 2013). According to the CHAT Website, "While not intended for project-level approval, CHAT is designed to reduce conflicts and surprises while ensuring wildlife values are better incorporated into land use decision-making, as well as large-scale conservation projects." Local government and developers alike, may find CHAT a useful screening tool.

Characteristic of western states, Nevada is a place where there are basically four markets for renewable generation:

1. Renewable generation purposefully procured (through investment in a capital project or a long-term power contract) for the resident utility's resource portfolio.
2. Renewable generation purchased by a utility as required by federal law (Public Utilities Regulatory Policy Act - PURPA) from non-utility merchant generators at Qualifying Facility (QF) avoided-cost rates.
3. Renewable generation sold and delivered to a remote utility, including an out-of-state utility, to meet its solar portfolio needs.
4. Renewable generation developed through a third party agreement or by the customer, for use directly on-site, according to regulated utility guidelines, usually including net metering and sometimes including a sale of renewable energy credits (in Nevada, called Portfolio Credits, or PCs).

2.1.1 Option 1: PPA with Resident Utility

For much of White Pine County, the resident utility is Mt. Wheeler Power (Ely, Nevada), a rural electric cooperative. Under Nevada Statute, rural electric cooperatives are not subject to the requirements of the state's RPS and therefore they have not been compelled to procure premium priced renewable energy for their members (NRS 704.7808(3)(b) (State of Nevada Legislative Code, 2013). Mt. Wheeler Power is comprised of nine Districts, serving 4,600 member accounts disbursed over a 16,000 square mile territory in four Nevada counties and three Utah counties (Mt. Wheeler Power, 2013). The utility maintains more than 200 miles of transmission line and over 1,800 distribution lines. Mt. Wheeler Power procures its wholesale electricity from Deseret Power in Utah, a regional generation and transmission cooperative. Leading the fleet of power plants owned by Deseret Power is the Bonanza Power Plant, which Deseret Power claims is, "consistently ranked in the top environmentally clean coal fired plants in the U.S" (Deseret Power Electric Cooperative, 2012). Deseret also has long-term hydroelectric contracts with the Western Area Power Administration. The Mt. Wheeler Power Annual Report for 2012 referred to a future challenge for the coop: "the uncertainty of national political forces – especially those who want coal to be removed from our baseload generation resources." The coop assured its members they would, "engage wherever we can to promote new technology and common sense as we transition to solutions that produce cleaner electric power at an affordable cost" (Mt. Wheeler Power, 2012).

2.1.2 Option 2: PPA with IOU at QF Avoided-cost Rate

The State of Nevada's investor owned utility maintains a system of high-voltage transmission facilities which pass through White Pine County. This makes it possible for renewable energy generated by non-utility merchant generators at Qualifying Facilities (QF) in White Pine County to be purchased by the utility as required by federal law (Public Utilities Regulatory Policy Act - PURPA) at avoided-cost rates. NREL explains, "Utility Avoided costs are complex. The issue at hand is how to calculate what utilities pay qualifying facilities (including renewable generators). Under the PURPA, QFs can be paid no more than the utility's avoided cost, or the incremental cost of alternative energy (National Renewable Energy Laboratory, 2011)." State regulators have the authority to set prices paid to QFs. This marketing scenario is supported by a 1978 law called the Public Utilities Regulatory Policy Act (PURPA) (Federal Energy Regulatory Commission, 2010).

2.1.3 Option 3: PPA with Remote Utility to Comply with RPS

The option to sell electricity to a remote utility is a relevant discussion. As stated earlier, the resident utility owns transmission and distribution facilities including interconnecting facilities with Deseret Power in Utah. Deseret Power is not currently subject to an RPS, but if Federal policies mandate a reduction in coal generation, Deseret Power may become a possible market for clean power produced in White Pine County. If Deseret's coal plants were retooled, there is also the possibility for cogeneration with Nevada produced biomass. Other more distant markets are probably not feasible due to the transaction costs for wheeling power from White Pine County through the Sierra Pacific Power Company (SPPC d/b/a NV Energy) transmission grid and associated line loss of power, rendering electricity produced in the County non-competitive in those markets.

SPPC (d/b/a/ NV Energy), the wholesale and distribution/retail utility serving customers in northern Nevada, and Nevada Power (d/b/a NV Energy) serving customers in southern Nevada, are subject to Nevada's RPS and constitute a potential market for renewable resources located in White Pine County. In September 2013, the shareholders of NV Energy approved a previously announced merger agreement for the acquisition of NV Energy by MidAmerican Energy Holdings Company (MidAmerican). The Federal Energy Regulatory Commission (FERC) authorized the internal corporate reorganization which merged Sierra Pacific Power Company with Nevada Power Company on November 26, 2013 (Federal Energy Regulatory Commission, 2013). The Nevada PUC approved the acquisition of NV Energy by Midamerican on December 15, 2013. That acquisition adds MidAmerican as another possible wholesale buyer—essentially as a bigger entity in place of NV Energy. MidAmerican could feasibly be motivated to meet an out-of-state subsidiary's needs for renewable energy credits (RECs); however, most of the states served by MidAmerican do not have significant renewable portfolio requirements. Therefore, MidAmerican/NV Energy likely will remain focused on meeting instate renewable needs for the time being.

2.1.4 Option 4: Development to Meet Onsite Demand

By statute, Nevada IOUs must reach a goal of 25 percent renewables and efficiency/load management by 2025. Solar must constitute five percent of the annual requirement of PCs every year through 2015 (totaling 1.2 percent of retail sales in 2015) and six percent for the 2016-2025 period (1.5 percent of retail sales in 2025). In addition, large energy intensive mining operations in Nevada must meet a similar standard. This is relevant because White Pine County is home to the White Pine Mining District and 320 current gold, silver, copper, and other precious metals and mineral mining claims. KGHM International Ltd. operates the Robinson Mine approximately eight miles west of Ely in White Pine County, and produces and ships copper concentrate (KGHM International, Ltd., 2013). In January 2014, Midway Gold Corp. (Denver) broke ground on a new gold mine in White Pine County. “The Pan Mine, located at the northern end of the Pancake Mountains about 50 miles west of Ely,…will feature two primary open pits,, three satellite pits, one heap leach pad, three rock disposal areas and a transmission line. According to the BLM, total surface disturbance will be about 3,300 acres” (Associated Press, 2014). Robinson and/or the Pan Mine could be potential electricity offtakers for a White Pine County renewable project, subject to eligibility and certain restrictions. Supplementing onsite production of electricity with biomass co-generation may also be of interest to mining operations.

2.2 Energy Policy and Regulations

As suggested earlier, renewable portfolio standard (RPS) policies drive renewable energy development in the United States by creating upward market pressure (demand). In addition, federal and state financial incentives have historically enabled costlier renewable resources to compete with conventional, fossil fuel resources. For example, NRS 701A.360 gave authority to the Director of the Office of Energy to grant partial abatement of certain taxes to facilities generating electricity from renewable energy (State of Nevada Legislative Code, 2013). Assembly Bill 239 (2013) amended the statute by strengthening the authority of county government with respect to approval of tax abatements for eligible facilities within their jurisdiction (Assembly Bill, 2013). State regulations may require some utilities to acquire RECs, each REC representing the renewable energy attributes of one Megawatt Hour (MWh) of renewable energy generation. In Nevada, the RPS has been more broadly defined to include energy efficiency (although this is being phased out) and Demand Side Management (DSM) as well as renewables. The Nevada credit, called a Portfolio Energy Credit (PEC, or simply PC), represents one kilowatt-hour (kWh) of electricity generated from renewables, with the exception of PV, for which 2.4 PCs are credited for each kWh generated. Customer-maintained distributed (meaning small scale) renewable energy systems receive a 0.05 adder for each kWh. For example, a customer-maintained distributed PV system would be credited 2.45 PCs for each kWh generated. Energy efficiency resources receive a multiplier of 1.05 or a multiplier of 2.0 if they save electricity during periods of peak utility load. The utility may accumulate credits from projects it owns or has under contract, as well as from customer-sited PV.

According to PUC filings, NV Energy has surpassed its RPS targets for several years (NV Energy, 2013). It is also notable, while each subsidiary of NV Energy (Nevada Power and Sierra Pacific) tracks compliance separately, they have legally pooled PCs in each category (energy efficiency/DSM, solar, or other renewables), and so if one subsidiary was short in a given year, it took excess credits from the other. This virtual sharing increased NV Energy’s confidence in its ability to reach future RPS targets statewide. When the One Nevada Line went into service in December of 2013, NV Energy’s grid was united and the need for virtual sharing of PCs was eliminated.

In the NV Energy Portfolio Standard Annual report for Compliance Year 2012, NV Energy reported, “The RPS outlook for both of the utilities is favorable, based on current assumptions and current law, with both Nevada Power and Sierra on target to meet the RPS compliance requirements for several years” (NV Energy, 2013, p. 11). NV Energy has stated it expects to meet the next RPS milestone without adding significant new renewables. Yet, it has expressed concerns for possibly changing conditions, such as:

- Possible retail solar market changes that could affect the growth of its distributed energy (net metered, facility based) solar program. This included assessing the impacts of a new law, Assembly Bill (AB) 428, which streamlined how solar incentives are paid, putting more emphasis on low income customers, and directing work toward cost-based rate changes that could impact solar customers. A dramatic increase or decrease in activity in this program could impact wholesale solar acquisitions.
- The possibility that companies under contract to complete solar projects and/or to deliver solar MWH might not all perform as promised. In past years, renewable energy projects had a high failure rate. Although NV Energy's Integrated Resource Plan filings currently place confidence in the completion of most of the projects underway at 85 percent or above, it recognizes some projects still fail (Nevada Power Company, 2012, p. 53). The failure of a currently anticipated solar project could increase new solar acquisitions.
- The possible erosion of federal solar tax credit incentives after 2016 is a considerable risk to future RPS compliance. If those incentives were significantly reduced or eliminated, the impact on the solar industry would be devastating, and drive prices up. In its Integrated Resource Plan for Sierra Pacific, NV Energy suggested a hedging strategy to be sure new incentivized solar projects are in the pipeline before the end of 2016.
- New, 2013 Nevada state legislation related to the RPS is being discussed in PUC Dockets. Legislation includes the following:
    - SB 123: the NVision Plan, or Emissions Reduction and Capacity Replacement Plan, which would displace as much as 350 MW of coal-fired generation in Nevada with renewable resources and require 300 MW of new renewable energy be added to the NV Energy resource portfolio.
    - SB 252: Clean Energy Project Bill revises the Renewable Portfolio Standard and puts more emphasis on renewables in general, due to the ramping-down of the energy efficiency resource requirement from 25 percent to zero percent by 2025, and encourages utilities to sell off excess PCs instead of banking them for future compliance. Yet, this legislation could constrain solar development somewhat due to elimination of the solar credit multiplier. The net effect of these and other provisions is hard to predict.
- State policies promoting economic development through solar industry growth, which already have put NV Energy on record in support of some additional solar development, such as a large solar project with Apple, Inc., near Reno.
- Federal laws and regulations, including fast-tracking of Right-of way applications to use public land managed by the Bureau of Land Management (BLM) for large solar development in Nevada and encouragement from the government to engage Tribal entities could put additional pressure on the utility to accept more solar projects.

The "pooling" provision for RPS compliance, noted above means policies aimed primarily at the more populated southern Nevada Power region could affect the SPPC region as well. This was underscored by the completion the Nevada One Line (On-line) transmission line that finally electrically connected both regions in December of 2013. Yet because of the stronger solar resource and more cost-effective solar development in the south, this new transmission path could detract from solar development in northern areas like White Pine County as readily as it could help.

The recent (December 2013) approval by the PUC of the acquisition of NV Energy by MidAmerican Holding Company adds to the likelihood that no new renewable resource procurement will be forthcoming until possibly mid to late-2014. However, due to concerns about the looming decline of federal solar incentives, impacts of AB 252 that revise the RPS, and other concerns, it seems likely that NV Energy could ask the PUC to approve a new solar request for proposals (RFP) in the mid-2014 to mid 2015 timeframe. It is important to note drivers for solar procurement other than the RPS may drive more solar acquisition in Nevada within the next two to five years.

Policy developments more likely to help speed progress toward a White Pine County renewable energy sector pertain to changes to the RPS that will end the long practice of banking excessive numbers of PCs for RPS compliance. If NV Energy is encouraged to sell off old credits (presumably to the voluntary market), then it will be seeking new PCs sooner. Also, the demand for renewable energy PCs would increase by ten percent in the next few years and then by 20 percent by 2020, due to a declining demand for energy efficiency PCs. In particular, the combination of NV Energy's stated concerns about the decline of federal solar tax credits after 2016 coupled with the stepping down of energy efficiency as a means of achieving RPS compliance underscores the likelihood of a solar procurement statewide.

3 RESOURCE AND ECONOMIC ASSESSMENT REPORTS

3.1 Resource Assessment Reports

Full reports produced by subject matter specialists referenced in this section are appended to this study. The following comprise the executive summaries of each of the appended reports.

3.1.1 TRANSMISSION AND DISTRIBUTION ASSESSMENT FOR WHITE PINE COUNTY, NEVADA

Prepared by S&B Christ Consulting, LLC.

This report has been prepared for White Pine County (WPC) by the S&B Christ Consulting, LLC (SBCC) project team--consisting of SBCC providing civil engineering and environmental engineering consulting, and Professional Design Associates, Inc. (PDA) providing electrical engineering input--to provide an assessment regarding the location and capacity of existing and proposed electrical transmission, distribution and interconnection facilities in WPC utilizing readily accessible and publically available existing information, in order to inform an economic analysis of renewable resources available for renewable energy generation facility feasibility purposes.

White Pine County is positioned at a power transmission grid crossroads between existing east-west aligned transmission lines and future north-south aligned transmission lines. Opportunities for renewable power generation within WPC have been identified by others; however, generating facilities will need to be situated in close proximity (generally 25 miles or less) to existing power transmission lines, with shorter distances being least cost intensive, in order to reduce the applicable capital costs related to construction of new dedicated energy transmission lines and voltage transforming substations.

A large portion of land in White Pine County is Federal, and is managed by the various associated Federal agencies. Permitting for renewable energy generation and transmission facilities across federal lands will require detailed environmental studies and clearances prior to such development and such costs and associated preparation and review schedules will need to be incorporated into project pro-forma information for those facilities located on or crossing Federal lands.

Renewable energy generation is not created equal, with various renewable sources having differing annualized generation capacities and production costs, which translates to a wide range of energy production and transmission related capital and tariff costs and fees that will be specific to the type of renewable power generation implemented.

Potential customer markets for renewable energy generated in White Pine County include local markets (in particular Mt. Wheeler Power), in-state markets located at the northern and southern Nevada population centers (NV Energy), and out-of-state markets, particularly California to the west. Other markets, including those in Utah and other Nevada rural power cooperatives, may prove to be suitable for renewably generated power from the County in the near- to mid-term. Power Purchase Agreements (PPAs), transmission agreements, applicable transmission tariffs, and other project fiscal factors will need to be carefully explored and considered for each specific proposed renewable energy generating facility, target customer(s), and transmission intertie project.

SBCC's detailed transmission and distribution assessment is appended as Appendix A.

3.1.2 PINYON-JUNIPER BIOMASS ASSESSMENT FOR WHITE PINE COUNTY, NEVADA

Prepared by Resource Concepts, Inc.

For the purpose of managing natural resources in a healthy and sustainable condition, the Resource Management Plan (RMP) for the Bureau of Land Management (BLM) Ely District provided for the treatment and removal of 674,000 acres of Pinyon-Juniper (PJ) found to be encroaching into sagebrush ecological sites. In addition, the RMP identified the need to treat 2.7 million acres of 'over mature PJ woodlands' (BLM, 2008). While the Ely District includes White Pine, Lincoln, and a portion of Nye County, much of the necessary PJ treatment would be located within White Pine County. A significant portion of the Ely Ranger District of the Humboldt-Toiyabe National Forest is also located in White Pine County, and lands under this Forest Service jurisdiction are also in need of PJ treatment. If the woody biomass resulting from these vegetation treatments can be developed into a viable and economically feasible product, then the economics associated with commercial utilization has the potential to assist in offsetting agency costs for large-acreage treatment of PJ. Such planned vegetation treatments will also result in the restoration of wildlife habitat (i.e. critical Sage-grouse habitat), improved watershed and woodland health, increased plant diversity and range condition, and reduced hazardous fuels loads. All of these ecological functions also have a positive economic affect to White Pine County and the multiple uses and associated industries that rely upon public lands.

The focus of this report was to define the available PJ biomass resources near Ely, Nevada and identify a potential energy development scenario and associated infrastructure requirements that in turn could lead to the evaluation of PJ utilization for energy production in White Pine County. The County's Community and Economic Development Office directed Resource Concepts, Inc. (RCI) to focus its analysis on the potential development of a 10 Megawatt Combined Heat and Power (CHP) Plant as its potential development scenario. Such a project would generate electrical power that could be sold for renewable energy credits, and also generate steam and heat that could be used by a nearby large existing facility (i.e. Nevada State Prison or Great Basin College) or a future industrial facility. This development scenario is based upon an expressed desire of several companies to develop such a project in the area, and relies upon a proven biomass utilization technology. However, there are a multitude of existing and emerging biomass utilization technologies and industries that may also have applicability in terms of future development in White Pine County.

Earlier assessments have reviewed alternative uses and products from PJ biomass and have determined, due to the isolated and remote nature of this resource and high costs for bulk transport, PJ does not represent a competitive wood fiber based on the biomass that is commercially available in other regions. There are PJ products that have a value and potential in the local market area; however, the local demand for these wood products does not nearly approach the utilization levels needed to support the landscape restoration goals established in White Pine County by the BLM and Forest Service.

Ely was selected as the PJ biomass utilization hub for this analysis because it is located near the center of White Pine County, at the cross-road for the two major highways, near primary transmission power lines and central to the PJ biomass resources identified for restoration. Further, Ely represents the largest city and commercial hub in the County and has a skilled labor force. The City also represents the area within White Pine County where heat and steam generated by a CHP Plant may be utilized, which would further help to improve the economic feasibility of such a facility.

Based on existing satellite vegetation mapping, a PJ distribution map was compiled for White Pine County. This mapping indicated approximately 1,421,000 acres of PJ within a 50 mile radius of Ely. Further analysis concluded that there are approximately 750,000 acres of PJ within 50 miles of Ely that fall in areas that would allow mechanical harvest methods. Based on a conservative yield rate of five bone dry tons of biomass per acre of PJ treated it was determined that this identified area could support a sustainable harvest of 13,400 acres per year, or the amount of biomass that would be required to supply a 10 megawatt biomass energy generation plant.

Both the BLM Ely District and the Forest Service Ely Ranger District have implemented priority programs to plan and develop watershed management or project plans. Products from this agency planning involve the development of project restoration plans and National Environmental Policy Act (NEPA) compliance documents. Currently completed restoration plans in the planning area have identified over 100,000 acres in eastern Nevada with the potential for mechanical PJ harvest. Resource planning under this initiative continues with nearly 1.6 million acres identified for agency planning and evaluation in 2014-2015.

Based on these preliminary estimates, it is the conclusion of this analysis that there exists a potential for PJ biomass utilization to occur within White Pine County based on restoration needs and potential available biomass. The economic feasibility for a power generation plant fed by PJ biomass falls outside the scope of this analysis but should be evaluated through further analysis. It should also be noted that a majority of the biomass within the planning area is located on public lands resulting in long-term feedstock availability, location and quantities that are subject to restoration planning progress, federal land management agency budgets and the NEPA process.

The detailed biomass report is appended as Attachment B.

3.1.3 CONCENTRATING SOLAR POWER RESOURCE ASSESSMENT FOR WHITE PINE COUNTY

Prepared by Joe Bourg
Millennium Energy, LLC.

White Pine County (County) is home to an abundant solar resource that provides potential opportunities for development of concentrating solar power (CSP) plants, and associated economic development. For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for CSP energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they are unregulated and not subject to state RPS regulations and sales outside of Nevada would likely be uncompetitive due to additional transmission service costs.
- **Anticipated market prices for energy sales:** Based on historical sales prices to NV Energy and current solar plant costs, CSP-based energy sales prices were estimated to be in the eight to nine cent per kilowatt-hour (kWh) range, with a mid-point price of 8.5 cents per KWh. This is the same range as solar photovoltaic resources as they are competing within the same market.
- **Solar resource data and expected annual energy generation potential:** Based upon modeling of a 10 MW CSP plant utilizing the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM), it was estimated that the annual energy generation would be 25,386 MegaWatt-hours (MWh).
- **CSP construction and operations and maintenance (O&M) costs:** Utilizing the NREL Jobs and Economic Development Impact (JEDI) and SAM models, the CSP construction cost was estimated to be $71.5 Million with total annual O&M costs of ~$1,080,000.
- **Financing parameters and tax incentives:** Project financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a

30% Federal Income Tax Credit, five-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.

- **Economic development potential:** Utilizing the NREL JEDI model, it was estimated that 79 construction and 21 O&M full-time jobs would be supported by a 10 MW CSP project.
- **Project Locations:** Potential project locations were limited to areas within a five-mile radius of the NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines, and within the southern portion of the County due to the better solar resource. It should be noted that projects of larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection.

The detailed concentrated solar resource report is appended as Attachment C.

3.1.4 WHITE PINE COUNTY RENEWABLE ENERGY FEASIBILTY STUDY AND RESOURCES ASSESSMENT: GEOTHERMAL COMPONENT

Prepared by Nicholas Hinz, Mark Coolbaugh, and James Faulds
Nevada Bureau of Mines and Geology, University of Nevada, Reno

Geothermal resources can potentially contribute toward the renewable energy portfolio of White Pine County (County) in two ways: first through the direct conversion of heat energy into electricity, and second by way of direct use applications in which thermal energy is used as a source of heat for buildings, greenhouses, and related structures. Several known geothermal areas within the County lie proximal to the Southwest Intertie power line currently under construction.

A potential source of electricity could come from conventional geothermal systems associated with young faults and regions of active crustal deformation. These systems have a total installed capacity in the Great Basin region of nearly 1,000 Megawatts – electricity (MWe). The County hosts several geothermal systems of this type, but none are currently producing electricity. The County has relatively low rates of crustal deformation (e.g., faulting accommodating crustal extension). However, based on a review of the geology in the region, we conclude that sustained and reasonable exploration efforts could result in the discovery and development of one or more electricity-grade geothermal systems, with potential generation capacity at each system in the range of 1-20 MWe.

In addition, a new type of potential geothermal resource termed “deep stratigraphic reservoirs” or “hot sedimentary aquifers” has recently been recognized in the western United States. The County, and in particular, the northern Steptoe Valley, has some of the most promising potential for electricity generation from this type of reservoir in the U.S. Preliminary calculations suggest that as much as 500 MWe of baseload electricity in the northern Steptoe Valley could be produced from this type of reservoir using wells reaching depths of 1.25 to 2.5 miles (2-4 km). The economic feasibility remains unproven, but initial estimates are encouraging.

Based on observed surface temperatures and flow rate of springs, several geothermal systems in the County also have the potential for direct use, including the heating of buildings or greenhouses. Such uses could reduce the consumption of electricity generated from fossil fuels and could lead to economic expansion by extending the growing season for certain agricultural products and reducing utility costs.

The detailed geothermal report is appended as attachment D.

3.1.5 PUMPED STORAGE HYDROELECTRIC RESOURCE ASSESSMENT FOR WHITE PINE COUNTY

Prepared by Joe Bourg
Millennium Energy, LLC.

Pumped Storage Hydroelectric plants are a unique renewable energy resource. While they are overall net consumers of energy, they also provide the best form of energy storage in the market today. The plants operate by pumping water uphill into an upper storage reservoir when electricity prices are low, and generate electricity by releasing water when electricity prices are high from the upper reservoir through a penstock to a turbine located at a lower elevation. The water is then stored in a lower reservoir. Pumped storage hydro plants recover about 70-80% of the energy used to operate them.

Pumped hydro plants require very unique and specific land characteristics. They require a sufficient elevation gain between the lower and upper reservoirs, with flat areas located near the lower and upper bounds of the elevation gain to support the development of reservoirs. There are a number areas in White Pine County (County) with these land characteristics, but none that met the minimum screening criteria for the size of the project considered for this study (50 Megawatts). The 50 MegaWatt (MW) size was selected because it meets the criteria for “small hydroelectric” classification. However, if the size of the potential project were expanded along with the screening criteria, it is likely that potential projects would be identified in the County. This is evidenced by the fact that a 300 MW pumped storage hydroelectric project in the County has received initial approval from the Federal Energy Regulatory Commission.

For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they purchase power from Deseret Generation and Transmission Cooperative (Deseret), and Deseret manages the generation and transmission needs of the local utility.
- **Anticipated market prices for energy sales:** Since wholesale power price data for utilities is considered proprietary, Millennium had to estimate what the net energy sales price would be based on limited information. For this study, it was estimated that the price differential between off-peak and on-peak energy was five cents per kilowatt-hour

(kWh). For the purposes of this study, it was assumed that 100% of the energy required to pump water to the upper reservoir would be purchased at the off-peak energy rate, and 80% of that energy would be recovered by the generation turbines and sold at the on-peak rate with a five cent per kWh price differential.

- **Hydroelectric resource data and expected annual energy generation potential:** The expected annual energy generation potential was estimated based on a 300 MW plant. This value was derived from a linear scaling of the energy output of the 300 MW plant proposed within the County, based on publicly available information on the project. Based on this assessment, it was estimated that a 50 MW plant would produce 153,300 MWh per year.
- **Pumped storage hydroelectric construction and operations and maintenance (O&M) costs:** Utilizing a database developed for hydroelectric resources by Oak Ridge National Laboratories (ORNL), a 50 MW pumped storage hydroelectric plant's construction costs were estimated to be $139 Million with total annual O&M costs of $3.1 Million.
- **Financing parameters and tax incentives:** Projecting financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, seven-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the ORNL database, it was estimated that 736 construction and 6.5 O&M full-time jobs would be supported by a 50 MW pumped storage hydroelectric project.
- **Project Locations:** No potential project sites were identified that met the two critical land requirements contained in the screening criteria, and that were also located in areas within a five-mile radius of the NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines. However, projects of a larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection.

The detailed pumped storage report is appended as Attachment E.

3.1.6 SOLAR PHOTOVOLTAIC RESOURCE ASSESSMENT FOR WHITE PINE COUNTY

Prepared by Joe Bourg
Millennium Energy, LLC.

White Pine County (County) is home to an abundant solar resource that provides opportunities for development of solar photovoltaic (PV) power plants, and associated economic development. For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they are unregulated and not subject to state RPS regulations and sales outside of Nevada would likely be uncompetitive due to additional transmission service costs.
- **Anticipated market prices for energy sales:** Based on historical sales prices to NV Energy and current PV plant costs, PV-based energy sales prices were estimated to be in the eight to nine cent per kilowatt-hour (kWh) range, with a mid-point price of 8.5 cents per KWh.
- **Solar resource data and expected annual energy generation potential:** Based upon modeling of a 10 MW PV plant utilizing the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM), it was estimated that the first year's annual energy generation would be 20,075 MegaWatt-hours (MWh), and would decline 0.5% per year due to PV panel degradation.
- **PV construction and operations and maintenance (O&M) costs:** Utilizing the NREL Jobs and Economic Development Impact (JEDI) and SAM models, the PV construction cost was estimated to be $26.7 Million with annual O&M costs of $230,000.
- **Financing parameters and tax incentives:** Project financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, five-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the NREL JEDI model, it was estimated that 35 construction and one O&M full-time jobs would be supported by a 10 MW PV project.
- **Project Locations:** Potential project locations were limited to areas within a five-mile radius of NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines, and within the southern portion of the County due to the better solar resource. It should be noted that projects of larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection.

The detailed solar photovoltaic report is appended as Attachment F.

3.1.7 WIND POWER RESOURCE ASSESSMENT FOR WHITE PINE COUNTY

Prepared by Joe Bourg
Millennium Energy, LLC.

White Pine County's (County) wind resource is widely varied, ranging from Class 2 (Fair) to Class 7 (Superb). Most the best areas (Class 5-7) are located on mountain ridge tops which are difficult and costly to develop, and in many cases are in excluded areas for development. However, there are some lands with Class 3to 5 resources (Fair to Excellent) that may provide opportunities for development of wind power plants, and associated economic development. For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they are unregulated and not subject to state RPS regulations, and sales outside of Nevada would likely be uncompetitive due to additional transmission service costs.
- **Anticipated market prices for energy sales:** Based on historical sales prices to NV Energy, and recent sales prices in the west, wind-based energy sales prices were estimated to be in the 8.4 to 9.5 cent per kilowatt-hour (kWh) range, with the current median price estimated at 8.7 cents per KWh.
- **Wind resource data and expected annual energy generation potential:** Based upon modeling of a 10 MW wind plant located in Spring Valley utilizing the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM), it was estimated that the annual energy generation would be 25,967 MegaWatt-hours (MWh).
- **Wind power construction and operations and maintenance (O&M) costs:** Utilizing the NREL Jobs and Economic Development Impact (JEDI) and SAM models, the wind power plant construction cost was estimated to be $21.3 Million with annual O&M costs of $230,000.
- **Financing parameters and tax incentives:** Project financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, five-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the NREL JEDI model, it was estimated that 29 construction and one O&M full-time jobs would be supported by a 10 MW wind project.
- **Project Locations:** Potential project locations were limited to areas within a five-mile radius of the NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines, and within areas of Class 3 to5 wind resource potential. It should be noted that projects of larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection. Based on these screening criteria, the sites that were identified as having development potential are in areas adjacent to the 151 MW Spring Valley Wind Farm and the substation that was built to support that project.

The Ely District office of the Bureau of Land Management worked with seventeen proposed wind energy projects in varying states of the application process. Wind energy developers assessed the thirty-year old wind data collected for the White Pine Power Project air quality permit application and found the historic data supported their wind data collection processes. In August 2012, the Spring Valley Wind Project, located thirty miles east of Ely, went into operation as Nevada's fist utility scale wind energy project.

The detailed wind report is appended as Attachment G.

3.2 Economic Analyses Reports – Executive Summaries

Resource assessment reports were provided to economists from the Department of Economics, College of Business at the University of Nevada, Reno, and from the University of Nevada Cooperative Extension in Reno. The economists used the resource assessments to prepare financial analyses and economic impact assessments, respectively, that are provided in the executive summaries, below.

3.2.1 *FINANCIAL ANALYSIS AND INCORPORATION OF RISK IN CLEAN ENERGY PROJECTS FOR WHITE PINE COUNTY*

Prepared by Thomas Harris
Professor in the Department of Economics and Director of the University Center for Economic Development, College of Business at the University of Nevada, Reno

The University Center for Economic development completed a feasibility analysis for five hypothetical clean energy projects in White Pine County, Nevada. These alternative energy projects are biomass, concentrated solar-hybrid, micro hydro, photovoltaic solar and wind. The results of these hypothetical clean energy studies can provide educational background to White Pine County decision makers as to financial considerations for actual clean energy projects. Also actual clean energy studies may have different assumptions that need to be considered that may not be addressed in these hypothetical studies.

The following information is provided from the report in addition to the above executive summary:

For this paper, feasibility analysis will be completed for five hypothetical alternative energy projects. These alternative energy projects are biomass, concentrated solar-hybrid, micro hydro, photovoltaic solar and wind. The purpose of the hypothetical feasibility analysis is to provide an initial understanding of potential financial considerations for actual clean energy investments. For actual clean energy projects, detailed feasibility analysis would require specific financial and physical information as to the proposed project. Also for this analysis, deterministic and stochastic feasibility analysis will be completed given price data availability. Stochastic or Monte Carlo simulation offers business analyst and investors an economical means of conducting risk-based economic feasibility studies of new investments such as alternative energy projects in White Pine County. Results of this study are outlined below:

- For the **biomass power plant system**, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does not meet the investor's required rate of return of between 10% to 15% for the deterministic analysis with output price remaining constant at $0.095/kWh over 30 years. Since there were no output price ranges given for the biomass power plant project, a stochastic simulation was not attempted.
- For the **concentrating solar with hybrid cooling system**, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does not meet the investor's required rate of return of between 10% to 15% for the deterministic analysis where output price remained constant at

$0.085/kWh for 30 years and the stochastic prices ranged between $0.08/kWh and $0.09/kWh for 30 years.

- For the **pumped storage hydroelectric plant system**, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does not meet the investor's required rate of return of between 10% to 15% for the deterministic analysis with output price remaining constant at $0.05/kWh over 30 years. Since there were no output price ranges given for the pumped storage hydroelectric plant power project, a stochastic simulation was not attempted.
- For the **solar photovoltaic power system**, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project met the investor's required rate of return of between 10% to 15% for the deterministic analysis where output price remained constant at $0.085/kWh for 30 years and the stochastic prices ranged between $0.08/kWh and $0.09/kWh for 30 years.
- For the **wind power system**, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does meet the investor's required rate of return of between 10% to 15% for the deterministic analysis with output price remaining constant at $0.0866/kWh over 30 years. Since there were no output price ranges given for the wind power project, a stochastic simulation was not attempted.

It should be noted that these five hypothetical feasibility analyses are only for demonstration of financial possibilities of clean energy projects in White Pine County. Actual clean energy projects may differ as to fuel costs, investments, and etc., and these should be considered in an actual feasibility analysis.

The detailed financial analysis is appended as Attachment I.

3.2.2 ECONOMIC IMPACT ASSESSMENT

Prepared by Buddy Borden
Area Extension specialist in Community and Economic Development, University of Nevada Cooperative Extension, University of Nevada, Reno

and

Tom Harris
Professor in the Department of Economics and Director of the University Center for Economic Development, College of Business at the University of Nevada, Reno

White Pine County, Nevada is currently focusing its economic development efforts on exploring innovative industries that achieve economic diversification that provide job stability and the ability to grow community services. Renewable energy initiatives at the national and state levels have increased the interest of White Pine County to further study alternative renewable energy technologies, economic feasibility, and economic impacts on constructing a facility to generate and sell renewable power as a viable economic development strategy.

This study only considers the economic impacts of alternative renewable energy facility construction and annual facility operations for photovoltaic solar (PVSP), concentrated solar (CSP), wind, pumped storage hydroelectric and biomass. In addition, economic impacts are estimated for the construction of five miles of transmission lines to support 10 Megawatt (MW) and 50MW facilities.

This study has three main objectives:

1. Provide a basic demographic, social and economic profile for White Pine County.
2. Measure economic impacts of the construction of alternative renewable energy facilities on White Pine County and State of Nevada.
3. Measure the economic impacts of the annual operations of alternative renewable energy facilities on White Pine County and State of Nevada.

Economic impacts for renewable energy development were estimated using a White Pine County and State of Nevada IMPLAN economic impact model. The IMPLAN model is an input-output based model that describes the inter-industry relationship between industries and commodity purchases within a local economy. Economic impacts are measured as total expenditures, personal income and employment. This includes direct impacts, indirect impacts (industry purchases), induced impacts (household purchases) and total impacts (direct + indirect + induced).

Demographic, social and economic characteristics of a community are one of the first steps in understanding the overall dynamics and development opportunities. Key characteristics for White Pine County include:

- Population is estimated at 10,300 residents (56% male and 44% female).
- Approximately 44.5% of population is 45 years and older with a median age of 41.
- High percentage of population is institutionalized because of state prison (121.3%).
- Nearly 37% of residents have graduated from high school and 33.4% have some college of AA degree.
- Government employment accounts for nearly 29% of total employed 16 years and older.
- Household income less than $35,000 accounts for nearly 40% of total households.
- Households income $75,000 and greater account for approximately 25% of total households.
- Over one-third of household income is derived through social security.
- 30% of households are collecting retirement income.
- Approximately 21% of total jobs are in agriculture, forestry, fishing & hunting and mining industries.

Phase one of alternative renewable energy development includes the construction of a power facility. Construction is considered as short-term and temporary increases in economic activity, personal income, and employment (12-15 months).

Table 3.1 Estimated Total Construction Impacts on White Pine County

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW	10MW	10MW	50MW	10MW
Economic Activity*	$1,041	$3,321	$342	$9,069	$6,726
Personal Income*	$393	$1,172	$129	$3,683	$1,665
Employment	5	13.6	1.7	90.3	29

*Thousands

Table 3.2 Estimated Total Transmission Lines Construction Impacts on White Pine County

	10WM Transmission	50MW Transmission
Size	5 Miles	5 Miles
Economic Activity*	$1,690	$2,304
Personal Income*	$892	$1,181
Employment	12.5	16.5

*Thousands

Table 3.3 Estimated Total Construction Impacts on State of Nevada

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW		10MW	50MW	10MW
Economic Activity*	$16,505	$39,417	$10,461	$151,322	$17,306
Personal Income*	$5,784	$16,134	$4,016	$54,069	$4,880
Employment	85.2	208.3	55.2	1,200.7	81.9

*Thousands

Table 3.4 Estimated Total Transmission Lines Construction Impacts on State of Nevada

	10WM Transmission	50MW Transmission
Size	5 Miles	5 Miles
Economic Activity*	$10,302	$13,834
Personal Income*	$3,495	$4,644
Employment	53.6	71.3

*Thousands

Phase two of alternative renewable energy development includes the annual operations of a power facility. Annual operations are considered as levels of long-term sustainable or reoccurring economic activity, personal income and employment.

Table 3.5 Estimated Total Annual Operations Impacts on White Pine County

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW	10MW	10MW	50MW	10MW
Economic Activity*	$149	$1,215	$153	$850	$6,537
Personal Income*	$104	$962	$91	$613	$977
Employment	1.4	23.6	1.3	8.2	15.6

*Thousands

Table 3.6 Estimated Total Annual Operations Impacts on State of Nevada

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW	10MW	10MW	50MW	10MW
Economic Activity*	$208	$1,278	$208	$2,778	$12,881
Personal Income*	$108	$1,150	$110	$777	$1,424
Employment	1.6	27.2	1.7	11.3	23.8

*Thousands

This study provides the basic framework for White Pine County to evaluate the economic impacts of alternative renewable energy facility construction and annual operations. This is just one component that White Pine County needs to consider when deciding if one or more of the renewable energy resources makes sense for full scale facility development.

The detailed economic impact assessment is appended as Attachment J.

3.3 Compiled Renewable Energy Study Conclusions

Resource assessments demonstrated all resources studied were present and in sufficient quantity and quality to warrant consideration for development.

Pinyon-Juniper biomass was found to be able to provide feedstock fuel for a 10 MW electricity generating facility for 50 to 60 years from materials that could be mechanically harvested on public lands within 50 miles of the County's population and industry center. The financial analysis indicated the estimated internal rate of return for investor's cash flow benefit to be less than the hypothetical required rate of return used for the analysis.

Concentrating Solar resources were of a high quality such that a 10 MW facility could produce an estimated 25,386 MWh annually at an average cost of $0.085/KWh. However, the financial studies indicated this technology may have a lower estimated cash flow benefit rate of return lower than the hypothetical required rate of return used in the analysis.

Geothermal resources were abundant and were expected to be able to support one or more one to 20 MW electricity generating facilities. The presence of surface springs suggested a facility located onsite could utilize the heat to reduce consumption of fossil fuels for agricultural uses or to extend the growing season. Unlike other renewable resources, geothermal plants operate at 95 percent or higher capacity. A 10 MW geothermal plant could generate 78,892 MWh annually. The current wholesale rate for geothermal energy has been reported to be about $0.06/KWh. (SMU Geothermal Laboratory, 2013) It should be noted the transmission costs and opportunities will be different for a resource having 95 percent capacity.

Photovoltaic Solar resources, particularly those located in the southern part of the County were sufficient to produce 20,075 MWh from a 10 MW generation facility at a cost of $0.085/KWh, although panel degradation was expected to reduce power output by a half percent per year over the life of the project. They financial analysis also viewed the photovoltaics to have an estimated internal return for investor's cash flow benefit greater than the hypothetical investor required rate of return used in the analyses.

Wind power resources were variable and location specific; however, project sites were identified where the resource was sufficient. A 10 MW generating facility could expect to produce 25,967 MWh annually at a cost of $0.087/KWh. The financial analysis indicated the estimated internal rate of return for investor's cash flow was greater than the hypothetical required rate.

Transmission options in the County were identified among existing infrastructure owned and operated by NV Energy, the most likely utility to purchase power generated in White Pine County. Transmission interconnection costs were estimated based upon a 10 MW capacity facility interconnecting within a short distance of an existing substation. For projects of larger size, interconnecting directly with existing transmission would provide even more project siting options.

Utilizing data provided by the resource subject matter specialists, State of Nevada economists modeled economic impacts and financial viability.

After considering the demographic, social, and economic characteristics of the County, economic models demonstrated development of 10 or 50 MW renewable energy facilities in the County would have minimal impact on these characteristics while providing modest levels of sustainable employment. Pumped storage hydroelectric was expected to have the greatest construction related economic impact to the County of the five renewable resources studied, generating over nine million dollars and supporting more than 90 jobs. Potential for long term sustainable impacts was greatest for biomass operations generating an estimated $6.5 million and supporting 15.6 permanent jobs.

When economists applied deterministic and stochastic modeling to the project scenarios identified by the renewable energy resource subject matter specialists for biomass, photovoltaic and concentrating solar, pumped storage hydroelectric, and wind projects, results indicated photovoltaic solar and wind demonstrated the 10 to 15 percent return on investment required by developers. However, actual clean energy projects may differ as to fuel costs, investments, etc., and these should be considered in an actual feasibility analysis conducted by a prospective resource developer.

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APPENDICES

Appendix A: Renewable Power Transmission Assessment for White Pine County, Nevada – S&B Chris Consulting, LLC.

S&B Christ Consulting, LLC
Ops Research & Civil/Env Engineering
8(a), Woman, Service Disabled Veteran Owned Small Business

SBCC Project No. 303-13-001

December 31, 2013

Mr. Jim Garza
White Pine County
Community and Economic Development
957 Campton Street
Ely, NV 89301

**Re: RENEWABLE POWER TRANSMISSION ASSESSMENT
WHITE PINE COUNTY, NEVADA**

Dear Mr. Garza:

Please find enclosed the "Renewable Power Transmission Assessment" report prepared by S&B Christ Consulting and Professional Design Associates, Inc. under contract to White Pine County (WPC), under Department of Energy Award Number DE-EE0003139. The enclosed report includes an overview and evaluation of current power transmission infrastructure located within White Pine County, Nevada.

Review of existing and planned transmission facilities located in WPC reveal the following implications regarding the locating of renewable power generating facilities within the County:

- WPC is positioned at a power transmission grid crossroads between existing east-west aligned transmission lines and future north-south aligned transmission lines.
- To lower transmission intertie costs, generating facilities should be situated in close proximity (generally 25 miles or less) to existing power transmission lines, with shorter distances being more desirable.
- A large portion of land in White Pine County is Federal, and is managed by the various associated Federal agencies;
  - Permitting for renewable energy generation and transmission facilities across federal lands will require detailed environmental studies and clearances prior to such development;
  - Land use fees will be applicable for utilized federal lands.
- Renewable energy generation types are not created equal, with various renewable sources having differing annualized generation capacities and production costs;
  - Energy source variability translates to a wide range of energy production and transmission related capital and tariff costs and fees that will be specific to the type of renewable power generation implemented;
  - Renewable power sources with greater capacity factors and controllability are generally more desirable.

- Identified potential customer markets for renewable energy generated in White Pine County include the following:
  - The markets with the greatest potential includes in-state markets located at the northern and southern Nevada population centers (NV Energy),
  - Local markets (in particular Mt. Wheeler Power), and;
  - Out-of-state markets, particularly California to the west;
  - Other markets, including those in Utah and other Nevada rural power cooperatives, may prove to be suitable for renewably generated power from the County in the near- to mid-term.
- Power Purchase Agreements (PPAs), transmission agreements, applicable transmission tariffs, and other project fiscal factors will need to be carefully explored and considered for each specific proposed renewable energy generating facility and transmission intertie project;
  - A study of existing transmission conditions and capacities at specific proposed intertie point(s) and for specific power generating capacity(ies) would need to be conducted as a necessary first step towards determining the specific project related transmission infrastructure impacts and upgrade costs that would be applicable to the proposed facility.

We appreciate the opportunity to support this project and are confident that the information attached will be found useful for the assessment of renewable power generation and transmission development within White Pine County. If you have any questions, don't hesitate contacting us at 702-202-6004.

Cordially,

S&B Christ Consulting, LLC.

PROFESSIONAL ENGINEER STATE OF NEVADA
JONATHAN D. TULL
Exp: 6/30/14
CIVIL
No. 14581
12-31-13

Jonathan Tull, PE, CEM, LEED AP
Senior Project Manager

Professional Design Associates, Inc.

PROFESSIONAL ENGINEER STATE OF NEVADA
GEORGE T. FOSTER, JR.
EXP 9-30-15
ELECTRICAL
No. 13078
12-31-13

George T. Foster, Jr., PE, NCEES
President/Electrical Engineer

Enclosures: Renewable Power Transmission Assessment Report

RENEWABLE POWER TRANSMISSION ASSESSMENT

White Pine County, Nevada

One Nevada Line (ON Line)
Source: Mesquite Local News,
www.mesquitelocalnews.com

Source: Lincoln County Power District #1,
www.lcpd1.com

December 31, 2013

White Pine County
Community and
Economic Development
957 Campton Street
Ely, Nevada 89301

Submitted By:

S&B Christ
Consulting, LLC.

In Association With:

Professional Design
Associates, Inc.

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EXECUTIVE SUMMARY

This report has been prepared for White Pine County (WPC) by the S&B Christ Consulting, LLC (SBCC) project team--consisting of SBCC providing civil engineering and environmental engineering consulting, and Professional Design Associates, Inc. (PDA) providing electrical engineering input--to provide an assessment regarding the location and capacity of existing and proposed electrical transmission, distribution and interconnection facilities in WPC utilizing readily accessible and publically available existing information, in order to inform an economic analysis of renewable resources available for renewable energy generation facility feasibility purposes.

White Pine County is positioned at a power transmission grid crossroads between existing east-west aligned transmission lines and future north-south aligned transmission lines. Opportunities for renewable power generation within WPC have been identified by others; however, generating facilities will need to be situated in close proximity (generally 25 miles or less) to existing power transmission lines, with shorter distances being least cost intensive, in order to reduce the applicable capital costs related to construction of new dedicated energy transmission lines and voltage transforming substations.

A large portion of land in White Pine County is Federal, and is managed by the various associated Federal agencies. Permitting for renewable energy generation and transmission facilities across federal lands will require detailed environmental studies and clearances prior to such development and such costs and associated preparation and review schedules will need to be incorporated into project pro-forma information for those facilities located on or crossing Federal lands.

Renewable energy generation is not created equal, with various renewable sources having differing annualized generation capacities and production costs, which translates to a wide range of energy production and transmission related capital and tariff costs and fees that will be specific to the type of renewable power generation implemented.

Potential customer markets for renewable energy generated in White Pine County include local markets (in particular Mt. Wheeler Power), in-state markets located at the northern and southern Nevada population centers (NV Energy), and out-of-state markets, particularly California to the west. Other markets, including those in Utah and other Nevada rural power cooperatives, may prove to be suitable for renewably generated power from the County in the near- to mid-term. Power Purchase Agreements (PPAs), transmission agreements, applicable transmission tariffs, and other project fiscal factors will need to be carefully explored and considered for each specific proposed renewable energy generating facility, target customer(s), and transmission intertie project.

1.1 STATE OF NEVADA POWER TRANSMISSION HISTORY

The history of electrical power generation and transmission in White Pine County is tied to the history of industry and development throughout the state of Nevada. White Pine County, located in the central-eastern portion of the state, is positioned along an existing power transmission corridor that links the Reno area population center located in the west central portion of the state with adjacent states to the east, primarily Utah (Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009). It also sits along a proposed north-south power transmission corridor linking Idaho to the north and power corridors crossing southern Nevada to the South (U.S. Department of Energy, 2008).

The history of power generation and transmission in Nevada is connected to the history of mining in the state and goes back to the time of the California Gold Rush and discovery of silver and gold deposits on the Comstock Lode located in Virginia City. The Farad Hydroelectric Plant was constructed on the Truckee River in 1899, and was reportedly the first electric generating plant on the eastern slope of the Sierra Nevada, generating power that was used to pump water out of Virginia City's silver mines. The Virginia City electric distribution system, designed by Thomas Alva Edison, was Nevada's first power company.

By 1928, electricity was primarily purchased from other utilities and brought into northern Nevada over high voltage electric transmission lines. Beginning in the 1960s, natural gas and oil-fired electrical power plants were constructed in Nevada to reduce the dependence on power generated out-of-state. Electrical power demand by the mining industry continues to account for a significant portion of NV Energy's electric sales in northern Nevada (NV Energy, 2012).

Electrical power generation and transmission in Southern Nevada is linked to the foundation of the City of Las Vegas as a stop along the San Pedro, Los Angeles and Salt Lake City railroad in 1905, and to the construction of the Hoover Dam, completed in 1935 (American Society of Civil Engineers Southern Nevada Branch, 2009). In 1937, Southern Nevada Power (a precursor company to today's NV Energy) was among the first utilities to distribute electricity from the Hoover Dam. Power generated by the Hoover Dam is sold pursuant to fifty-year contracts, the first of which was authorized by Congress in 1934, and ran from 1937 to 1987. This contract was reauthorized by Congress in 1984 and set to expire in 2017. In 2011, the contract was again re-allocated and re-authorized after setting aside 5 percent of produced power for sale to Native American Tribes, with this authorization expiring in 2067 (Lien-Mager, 2011). The current power allocation through 2017 is as follows (Bureau of Reclamation, 2009):

AREA	PERCENTAGE ALLOCATION
Metropolitan Water District of Southern California	28.53%
State of Nevada	23.37%
State of Arizona	18.95%
Los Angeles, California	15.42%
Southern California Edison Company	5.54%
Boulder City, Nevada	1.77%
Glendale, California	1.59%

Pasadena, California	1.36%
Anaheim, California	1.15%
Riverside, California	0.86%
Vernon, California	0.62%
Burbank, California	0.59%
Azusa, California	0.11%
Colton, California	0.09%
Banning, California	0.05%

In the 1950's, growing demand on the Southern Nevada system exceeded the power available from the Dam, and Southern Nevada Power started construction of steam turbine generator stations. In the 1960s, Southern Nevada Power became Nevada Power Company when it acquired the Elko-Lamoille Power Company in northern Nevada (NV Energy, 2012).

In 1999, Nevada Power Company (NPC) in southern Nevada merged with Sierra Pacific Power Company (SPCC) in northern Nevada. The combined company initiated a corporate name change in 2008 to "NV Energy", although each separate business unit maintained its respective corporate name, "doing business as" (dba) NV Energy. In 2013, NV Energy was acquired by MidAmerican Energy Holdings Company (NV Energy, 2012), and with the projected completion of the One Nevada power transmission line (ON Line) linking the former SPPC and NPC areas, both of the formerly separate areas will be brought under a single state-wide system on January 1, 2014 (OATI, 2013).

In 1963, Mt. Wheeler Power was incorporated as a community power co-operative to bring electricity to parts of eastern Nevada and western Utah. The cooperative started operations in 1971, bringing low-cost power to White Pine County and parts of Elko, Eureka and Nye counties in Nevada, and western parts of Tooele, Juab and Millard counties in Utah (Mt. Wheeler Power, 2013). Power demands in the Mt. Wheeler Power service area are primarily residential, industrial (minining), and agricultural (S&B Christ Consulting, LLC, 2012). Mt. Wheeler does not operate or maintain transmission lines (230kV+), but does operate numerous sub-transmission lines (69kV) within it's service area (Robison, 2013).

1.2 POWER TRANSMISSION CURRENT STATUS

White Pine County (WPC) encompasses just under 9,000 square miles in area, with approximately 95% of this area controlled by the Federal Government. As of the 2010 Census, the County population is 10,030, with the majority (over 95%) of this population living in the three major towns of Ely (the County seat), Ruth, and McGill (Rural Desert Southwest Brownfields Coalition, 2013). WPC primary industries include Natural Resources and Mining, Public Administration, Education and Health Services, Leisure and Hospitality, Trade, Transportation and Utilities (Nevada Department of Employment, Training and Rehabilitation, 2013).

The Western Area Power Administration (WAPA) classifies power lines, including those located in WPC, based on the voltage levels associated with those lines. Power transmission lines are defined as those of 230 kilovolt (kV) through 1,000+ kV. Existing and planned power transmission lines in WPC include lines owned and operated by NV Energy Company, Intermountain Power Agency, and Great Basin Transmission, LLC, described in greater detail in the following sections. Power transmission lines with voltages ranging from 69kV to 138 kV are defined as Sub-transmission lines (Western Area Power Administration, 2013), and in WPC these lines are generally 69kV in voltage and owned and operated by Mt. Wheeler Power (Robison, 2013).

In keeping with the WAPA convention, Governor Jim Gibbons' Renewable Energy Transmission Access Advisory Committee identified in the 2007 Phase 1 Report that the minimum voltage for effective renewable energy transmission is 230 kilovolts (kV), although the report also assumed a typical renewable project generation capacity of 30 megawatts (MW) or greater. The S&B Christ Consulting, LLC. project team (SBCC), consisting of S&B Christ Consulting, LLC., in association with Professional Design Associates, Inc. (PDA) understands that renewable energy generation subject to this assessment is targeting opportunities of 10 MW of generating capacity and greater (Bourg, 2013). Governor Jim Gibbons' Renewable Energy Transmission Access Advisory Committee Phase 1 Report identified that challenges exist for analysis of transmission lines lower than 230kV capacity, including availability of the applicable transmission line information, but acknowledged that opportunities to interconnect to transmission lines at lower voltages, such as those operated by Mt. Wheeler Power in WPC, were possible (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007).

The Committee found that interconnection between renewable energy resources and transmission lines of 25 miles or less would be most acceptable, and that transmission interconnection greater than this distance might not be cost justified (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007). This document continues with the 25 miles or less convention, with a primary focus on connection with transmission facilities that are 230kV or greater in capacity, although sub-transmission facilities in WPC are identified when such information is obtained. Coordination and connection with existing transmission systems is highly regulated by the public utility commission and in many cases can also be technically challenging (Franz, 2013). Understanding the extent of the local transmission network, including geographical reach and extent of all distribution systems served by the transmission lines, is key to understanding transmission connection and needs. This collective relationship of power generation and transmission (system input) with power distribution and use (system output) is managed by the local balancing authority (BA) (Hurlbut, 2012).

The majority of transmission lines in WPC are owned and operated by SPPC, dba NV Energy. When SPPC and NPC merged into a single business in 1999, each entity maintained it's own balancing authority, with SPPC responsible for northern Nevada and NPC responsible for southern Nevada service areas. In 2013, NV Energy was acquired by MidAmerican Energy Holdings Company (NV Energy, 2012), and finally, with the anticipated completion of the north-south ON Line transmission infrastructure joining the two areas (SPPC and NPC), the two separate BA's will be merged on January 1, 2014 into a single NV Energy BA encompassing the entire state of Nevada (Franz, 2013).

Each transmission provider maintains an Open Access Transmission Tariff (OATT) that allows for interconnection with the transmission system for each power generator. Procedures for interconnections with transmission systems are based on the size of the power generator, and are broken down as follows:

- Less than 20 MW – Small Generator Interconnection Procedures (SGIP);
- Greater than 20 MW – Large Generator Interconnection Procedures (LGIP);
- Load Serving Entity (LSE) – Procedures for Net Metering (Assumes power not sold to an entity other than LSE).

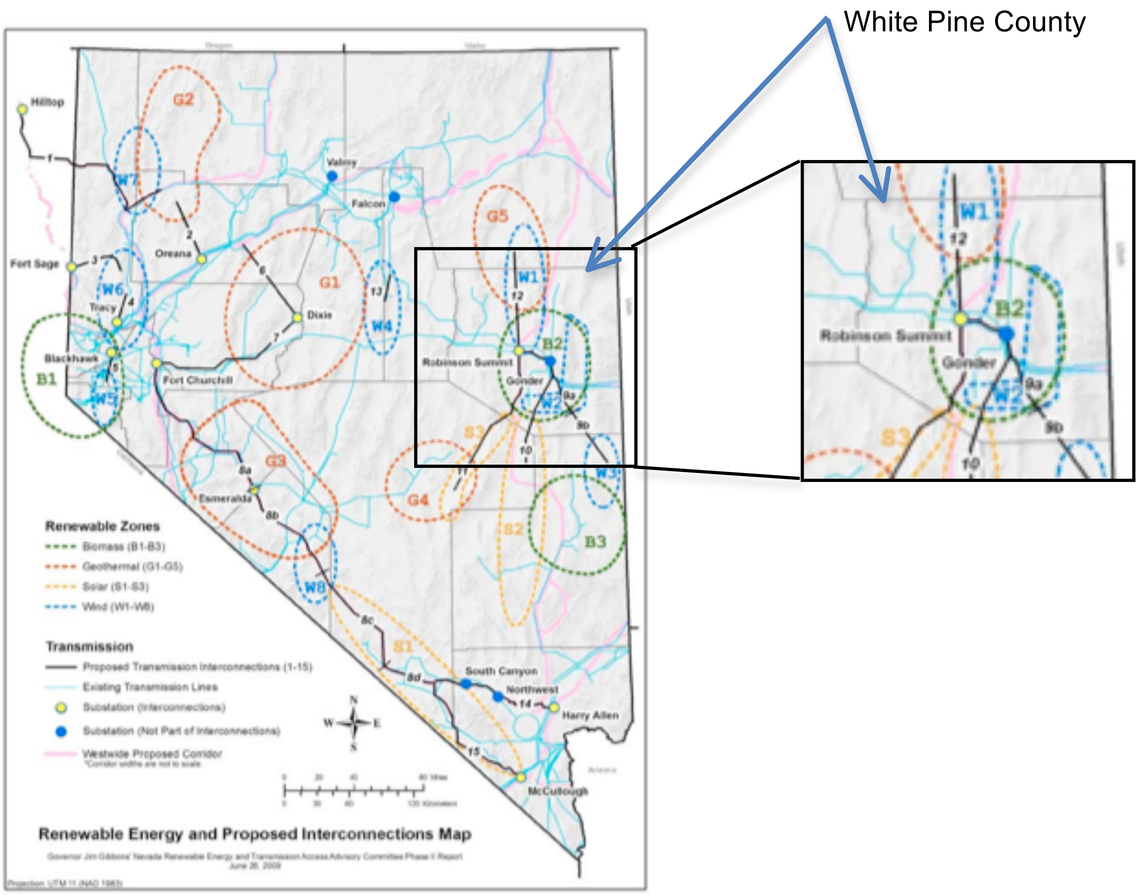
Each interconnection may have impacts to the overall grid. A power generator cannot be denied access to transmission, but the generator will be required to expend funds to upgrade transmission grid components in the event of overall grid impacts, and in some cases these impacts and associated costs will negatively impact the project pro-forma assessment (Western Area Power Administration, 2013).

Proposed power transmission interconnections in WPC should be carefully examined and planned prior to development of renewable energy resources, and not only for OATT and grid interconnection issues. In most cases right-of-way for interconnections will require federal government action due to the high percentage of Federal land holdings in the County, and will likely be subject to National Environmental Policy Act (NEPA) process submittals and review (Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009).

Furthermore, many of the existing systems in WPC are greater than forty years old, with some infrastructure elements dating back to the 1930's and 1940's (S&B Christ Consulting, LLC, 2012), which pre-date the enactment of NEPA. Any associated modifications or co-locations of transmission or intertie transmission within existing identified power corridors may therefore be subject to NEPA review as if they were new projects with no prior environmental studies, reviews or decisions that could provide background or context to the permit process.

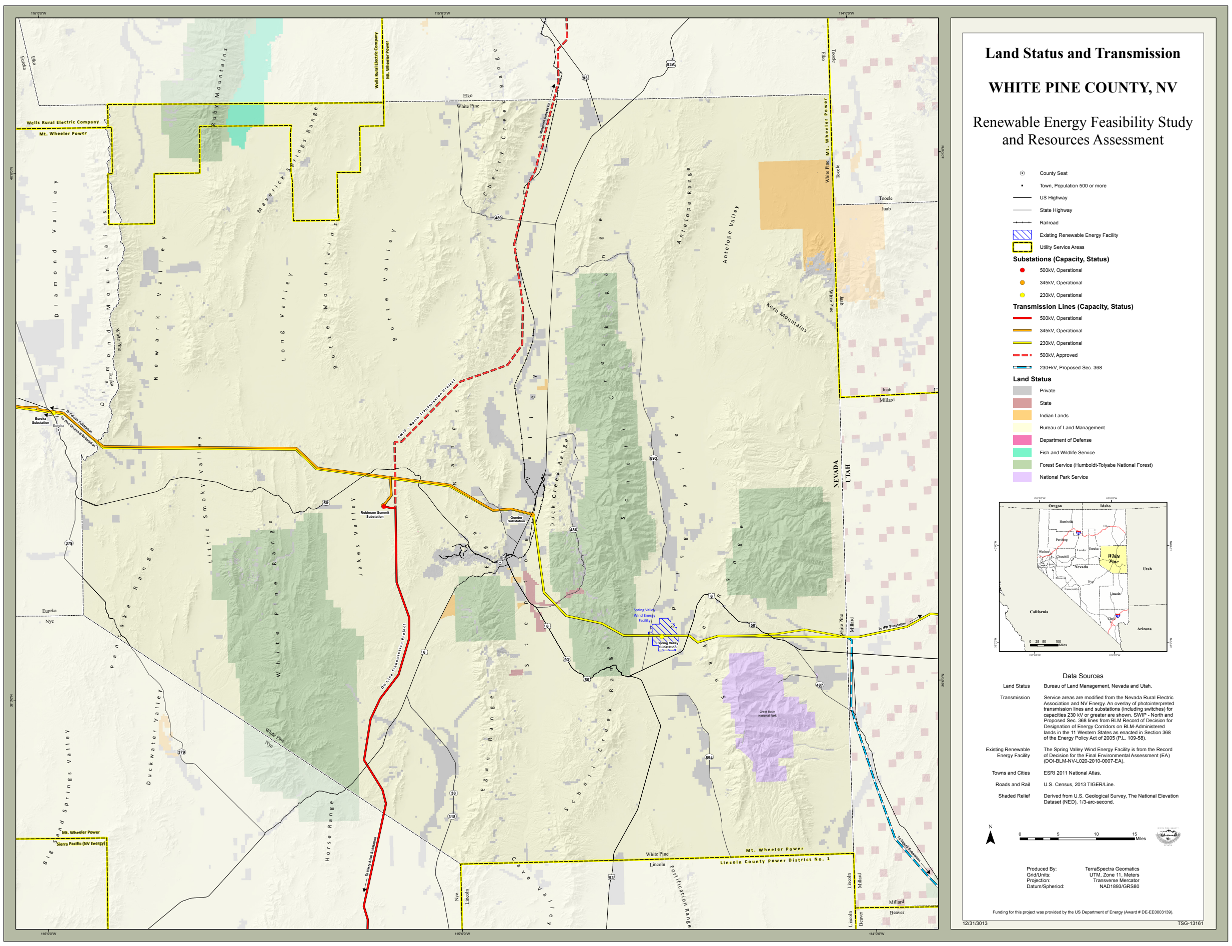
For purposes of this study, it is assumed that the proposed renewable power generator will be a captured Independent Power Producer (IPP), operating in a point-to-point transmission service configuration; that is, a non-utility power producer operating under a Power Purchase Agreement (PPA), or long-term power purchasing contract with an LSE that provides power to the transmission system at one point to be utilized by the LSE at a separate point (the "transmission path") (Hurlbut, 2012). Other options include IPPs for delivery to the open market, which entail greater risk and less long-term certainty than operating under PPAs (Western Area Power Administration, 2013).

Project financial considerations will be the key to development of renewable power generation facilities in WPC, and in particular connection with high voltage transmission lines will require more capital-intensive infrastructure in the form of voltage transforming substations and interconnection facilities. Cost sharing of this infrastructure between multiple power generators, including alternate types of renewable power may be one solution for distribution of the associated capital costs among various power producers, although this may require production facilities geographically close to each other to be cost effective. Other power options include establishing renewable power production as a "network service" that bundles local load, generation and transmission (Hurlbut, 2012, p. 11)—in the case of WPC, renewable power generation as a network service would likely require integration with the Mt. Wheeler Power system. Discussions with Mt. Wheeler Power staff indicate that most their sub-transmission lines in WPC are 69kV and age to the mid 1970's. Portions of these lines have undergone conductor improvements within the last ten years, but many are older. Any proposed connections to these lines would be subject to specific condition and capacity studies to identify necessary upgrades prior to any proposed interconnection on these lines (Robison, 2013). The MWP system, including existing hurdles to proposed transmission use, is discussed in greater detail below. The primary benefit of a network service configuration would be lower required voltage transformation requirements, and therefore lower substation capital costs, but this would need to balanced with the realities of whether Mt. Wheeler Power has an actual need for additional local power production, and whether such power production could be implemented economically in comparison to other Mt. Wheeler Power energy sources (Hurlbut, 2012, p. 11-12).



Map Source: Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009

Power transmission in White Pine County consists of various line capacities and ownership with higher voltage transmission lines (defined as those being equal to or greater than 230kV) generally passing through WPC areas and conveying power between power generation sources and population centers to the west and south (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007). Existing power transmission lines in White Pine County generally exist on an east-west alignment running between the eastern County border with Utah, and the western County border, and pass through the Gonder Substation located adjacent to US 93 approximately halfway between the towns of Ely and McGill (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007). Publically available information indicates that the NV Energy and Mt. Wheeler Power transmission systems are interconnected with power deliveries taking place at the Gondor Substation (NV Energy-Sierra Pacific Power Company, 2013).



Map Source: TerraSpectra Geomatics, 2013

In addition, White Pine County sits at a planned crossroads in terms of power transmission, with the 500kV Southwest Intertie Project (SWIP), originally proposed by the Idaho Power Company (IPC) and Los Angeles Department of Water and Power (LADWP) to run from the Midpoint Substation near Twin Falls, Idaho, to the Harry Allen Substation located in Dry Lake Valley Northeast of Las Vegas, Nevada, passing north-south through White Pine County and intercepting the existing east-west transmission lines in the vicinty of the Robinson Summit Substation (Thirty Mile Substation) located to the west of the town of Ely (U.S. Departement of Energy, Western Area Power Administration, 2010). Currently, the SWIP transmission line has been divided into two distinct transmission segments which have become separate projects: the SWIP-South project (Currently known as the "One Nevada Transmission Line", or "ON Line") that starts at the Thrity Mile/Robinson Summit Substation and extends south to Las Vegas, and the SWIP-North project that also starts at the proposed intertie substation near Robinson Summit and extends north to the northern White Pine County border and eventually runs to Idaho (Great Basin Transmission, LLC, 2013).

These existing and proposed transmission lines and alignments are each addressed in greater detail in the sections outlined below. Information regarding the local White Pine County electric utility, Mt. Wheeler Power, is included as a separate section.

1.2.1 EAST WHITE PINE COUNTY POWER TRANSMISSION

The existing power transmission facilities located to the east of the Gonder Substation north of Ely, Nevada, consists of two (2) 230kV transmission lines that run east into Utah. One of the lines is operated by the Los Angeles Department of Water and Power (LADWP) and connects with the Intermountain Power Project (IPP), which includes the Intermountain Generating Station located near Delta, Utah, established in the 1970s, and currently providing power to multiple Utah, California and Nevada Utilities. The IPP is owned by the Intermountain Power Agency (IPA) - a political subdivision of the State of Utah - and has assigned LADWP as its manager (Los Angeles Department of Water and Power, 2013).

In 2012, the Nevada Energy Assistance Corporation published a report titled *Transmission Routing Study Initiative* which indicates that "the current transmission infrastructure is fully utilized by generators in and outside of Nevada to export or transmit resources through of the state Nevada." (Nevada Energy Assistance Corporation, 2012, p.1-1). This report identifies the existing LADWP 230kV transmission alignment as a suitable corridor for transmission upgrade to 345kV or 500kV for purposes of exporting renewable energy produced in Nevada to consumer markets located in California via transmission facilities in Utah (the "East Project" as identified in the report). The report acknowedges that transmission from the IPP to Southern California markets is highly constrained by current power production and assumes that current coal production will be decreased through California initiatives, to be replaced by renewable energy sources (Nevada Energy Assistance Corporation, 2012). A Scenario report prepared subsequently has identified the "East Project" in the above referenced report as the second most favorable of the identified long-term transmission scenarios in terms of investment and payback to Nevada (Synapse Energy Economics, Inc., 2012).

The second identified 230kV transmission line runs to the southeast once it crosses the Utah state line and connects with Utah's parallel 345kV north-south transmission lines at the Sigurd Substation located near Sigurd Utah (Sierra Pacific Power Company, 2001). This line is also known as the Gonder-to-Pavant line since it connects through the Pavant Substation in Utah prior to connecting to the Sigurd Substation. This line is currently owned by NV Energy. More recently, the Spring Valley Wind Energy Facility was constructed in White Pine County southeast of Ely, located northeast of the junction of Highway 893 and Interstate 6 in the Spring Valley. The Spring Valley Substation and Osceola Switchyard were constructed along this portion of the NV Energy 230kV transmission line to facilitate transmission of the generated renewable energy from this facility. The Spring Valley Wind Energy Facility is subject to a 149.1 Megawatt (MW) maximum power purchase agreement (PPA), and is designed to contribute no more than this amount of power to the existing transmission line (Spring Valley Wind LLC, 2010).

The Gonder Substation was formerly operated by MWP (Sierra Pacific Power Company, 2001), but is currently operated by NV Energy (Robison, 2013). A separate Mt. Wheeler Power-owned 69kV transmission line (Spring Valley Wind LLC, 2010) conveys power from the Gondor Substation in central WPC to a substation that services the WPC community of Baker (Robison, 2013) on an alignment generally parallel with the LADWP transmission alignment described above (Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009).

1.2.2 WEST WHITE PINE COUNTY POWER TRANSMISSION

The existing power transmission facilities located to the west of the Gonder Substation north of Ely, Nevada, consists of one (1) 230kV transmission line that runs west toward the Reno/Carson City population center and the NV Energy service area on the west side of Nevada (Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009), and one (1) 345kV transmission line that runs northwest toward the Falcon Substation located in the Carlin Trend mining area southeast of Valmy, Nevada (Sierra Pacific Power Company, 2001). Both lines are operated by NV Energy (NV Energy, 2010) and both run through the Robinson Summit/Thirty Mile Substation, which represent a transmission inter-tie with the proposed 500kV SWIP-North and the 500kV SWIP-South/ON Line that is currently nearing construction completion by NV Energy in association with Great Basin Transmission (Great Basin Transmission, LLC, 2013). The 345kV Gonder to Falcon transmission line was formerly a 230kV line that underwent a power upgrade by Sierra Pacific Power Company in the early 2000’s (Sierra Pacific Power Company, 2001).

1.2.3 SOUTH WHITE PINE COUNTY POWER TRANSMISSION

Power transmission in the area south of the existing east-west power transmission facilities described above is currently under development as the 500kV SWIP-South/ON Line being constructed by NV Energy in association with Great Basin Transmission (Great Basin Transmission, LLC, 2013). This line ties into the primary east-west power transmission facilities at the Robinson Summit/Thirty Mile Substations located west of the Gonder Substation. Recently reported current status of the ON Line project is that it is nearing completion, with full operation of this line anticipated by January 2014 (Maxwell, 2013).

Mt. Wheeler Power representatives have indicated the presence of 69 kV power sub-transmission infrastructure, including power lines and substation facilities, in the vicinity of the US 93 corridor to the west of Ely (S&B Christ Consulting, LLC, 2012). Transmission line mapping indicated by Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee in their Phase II Report indicates the presence of power transmission lines less than 230kV (likely 69kV or less based on the size of Mt. Wheeler Power’s transmission line from Utah) immediately to the west of Ely along the US 93 corridor, and south and west of Ely generally following the US 6 corridor (Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009). Discussions with MWP representatives revealed that the 69 kV sub-transmission line oriented to the southwest toward Nye County has been recently upgraded including the replacement of conductors. In addition, dedicated power infrastructure for large mining concerns southwest of Ely exist in this area (Robison, 2013).

1.2.4 NORTH WHITE PINE COUNTY POWER TRANSMISSION

Power transmission in the area north of the existing east-west power transmission facilities described above is currently under development as the 500kV SWIP-North transmission line currently planned by Great Basin Transmission (U.S. Departement of Energy, Western Area Power Administration, 2010). This line ties into the primary east-west power transmission facilities at the Robinson Summit/Thirty Mile Substations located west of the Gonder Substation. Construction was planned to begin on the SWIP-North project in 2012, with completion in 2014 (LS Power, 2011); however, recent updates regarding status were unable to be located, with Great Basin Transmission LLC recent news focusing on the ON Line segment (Great Basin Transmission LLC, 2010).

Mt. Wheeler Power representatives have indicated the presence of 69 kV power sub-transmission infrastructure, including power lines and substation facilities, in the vicinity of the US 93 corridor to the west of Ely (S&B Christ Consulting, LLC, 2012). These lines run north from the Gondor substation and serve WPC communities located north of Ely along the US 93 corridor (Robison, 2013).

1.2.5 TRANSMISSION INTEGRATION CONSIDERATIONS

Power transmission costs for renewable energy generation facilities has been shown to vary significantly not just between renewable energy facility types, but also within specific renewable energy generation segments. In 2009 Lawrence Berkeley National Laboratory (Mills & Wiser, 2009) prepared a comprehensive report that analyzed renewable energy transmission costs, specifically for wind energy transmission, which indicated that among a sample of 40 detailed wind energy transmission studies located nationwide, transmission costs varied from $0 - $2,000/kW, with a majority of studies reporting transmission costs below $500/kW. The renewable power generating size threshold of 10 MW established in this study would therefore anticipate associated transmission costs ranging from approximately $5,000,000 - $20,000,000 based on these criteria. The following primary conclusions regarding wind power transmission were reached and presented in the referenced report; however, the descriptions and assumptions indicated may be applied to other means of renewable energy production (Mills & Wiser, 2009, p.xi-xii):

- *"Unit transmission costs of wind, among our sample, do not appear to increase significantly with higher levels of wind additions*. Two effects may influence the unit cost of transmission as wind capacity increases: a supply curve effect where transmission costs increase as lower cost resources are accessed, and an economies of scale effect where transmission costs decrease as higher voltage lines are used to more efficiently access large resource areas. While our sample is not ideally suited for directly measuring either of these effects, we do not find that those studies that analyze large amounts of wind additions necessarily predict higher per-unit costs of transmission. In fact, the studies with the largest additions of wind energy tend to have relatively low unit costs of transmission, indicating that the economies of scale effect may contribute to lower costs among our study sample.
- *Unit transmission costs do not unambiguously increase in scenarios with increasing transmission length*. Several studies with large quantities of new transmission investments across broad geographic regions had unit transmission costs that fell in the mid-range of our sample.
- *Unit transmission costs do, however, appear to increase in scenarios that added long transmission lines and relatively little new generation*. Studies found to have the highest unit costs of transmission often add long transmission lines without adding substantial

amounts of new generation. The majority of the high unit cost scenarios were multi-state transmission lines designed to deliver all of the new generation added in the scenario from remote resource areas to distant load centers.

- *Equipment cost assumptions vary widely across studies in our sample*. These variations may be influenced by regional factors, when the study was conducted, and the level of detail used in the equipment cost estimates. These differences are likely to contribute to a portion of the variation in the unit costs of transmission across our sample."

Although the conclusions of this transmission study are related to wind, the conclusions reached may be applicable to other types of renewable power generation projects, particularly those with variable, or intermittant power generation profiles such as wind and solar (National Renewable Energy Laboratory, 2012), and should be considered with respect to any planned renewable power production utility interconnection. Due to the variable nature of wind power generation, these renewable power projects have typical operational capacities in the range of 30-40%, resulting in transmission facilities that are under-utilized a large portion of the year (Mills & Wiser, 2009). It would not be unrealistic to have similar results from solar generation facilities, with sources placing Solar Photovoltaic (Solar PV) in the 20-30% capacity range and Concentrated Solar Power (CSP) in the 30-40% range. Geothermal generaton typically shows results in the 70-80% range; however, it should be noted that geothermal generation typically entails higher operational and O&M costs than other renewable resources (United States Environmental Protection Agency, 2012). SBCC assumes that Biomass generation capacity ranges would be comparable to geothermal generation results. The greater the capacity factor and controllability of the renewable generation, the more desirable is the power generation resource (Western Area Power Administration, 2013). The implication for renewable power generation and transmission within WPC is that significant transmission cost variability would be expected to occur not only between types of renewable energy generation, but also within any particular class of generation. The importance of project-specific generation and transmission review and analysis should not be overlooked. All other things being equal, renewable power generation facilities that have lesser degrees of generation variability, are larger, and are closer to existing established transmission corridors, will have lower project transmission capital costs than projects which are further away, and therefore represent the preferable development option.

Capacity limitations, particularly with respect to the addition of renewable energy generation sources, have been documented to occur to such a degree as to threaten the ability of some states to achieve their stated Renewable Portfolio Standards, or RPS (Dombek, 2012). In White Pine County, as in much of Nevada, the most favorable renewable energy resource areas have limited access to the transmission grid to allow the produced power to be transmitted throughout the State (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007). The existing and proposed power transmission lines in Nevada, including White Pine County, "can currently accommodate renewable energy export", but the issue of capacity utilization presents a barrier as "the current transmission infrastructure is fully utilized by generators in and outside of Nevada to export or transmit resources through the state of Nevada" (Nevada Energy Assistance Corporation, 2012, p. 1-1). The majority of power transmission infrastructure in Nevada is owned and operated by NV Energy (Nevada Energy Assistance Corporation, 2012), with some existing and proposed transmission and sub-transmission facilities in White Pine County being operated by the LADWP, Mt. Wheeler Power, or Great Basin Transmission LLC., as detailed earlier in this report. The completion of the ON Line from central White Pine County to a termination point north of Las Vegas should improve the potential for transmission of renewable energy from White Pine County to applicable markets in southern Nevada, in addition to bringing all of Nevada under a single BA managed by NV Energy. Available transmission capacity on this line, as with all transmission lines, will be determined by the owner/operator(s), in this case NV Energy and Great Basin Transmission LLC. Any proposed use of this or any other transmission infrastrature will be subject to applicable transmission capacity studies, as well as use and power purchase or transmission agreements negotiated with the owner(s). This should be viewed as a necessary preliminary engineering step for any proposed renewable energy transmission integration.

1.2.6 TRANSMISSION INTEGRATION SCOPE AND GENERAL COSTS

Renewable power transmission integration projects should include consideration of the following project cost elements (Western Area Power Administration, 2013):

- Environmental Studies
- Interconnection Studies
- Engineering for the Interconnection
- Coordination with Lenders/Financial Institutions
- Costs of Capital
- Land Acquisition
- Construction Costs
- Strategic Positioning
- Operations and Maintenance
- Regional Transmission Operator (RTO) fees (transmission use "tolls")
- North American Electric Reliability Corporation (NERC) Compliance
- Federal Tax Credits

More specific element costs as identified are as follows:

- Interconnection studies
  - Project and utility-specific
- Transmission use agreements and power purchase agreements
  - Project and utility specific
- Transmission integration costs (Silverstein, 2011)
  - Wind - $5/KWh
  - Photovoltaic - $2.50/KWh
  - Solar Thermal - $2.50/KWh
- Right of way acquisition for power lines and substations (Western Electricity Coordinating Council, 2012)
  - Bureau of Land Management Zones 1-12: Rental per year: $9-$3,449 per Acre
- Environmental clearances and associated permitting
  - Possible project delays as long as 3-5 years (Silverstein, 2011)
- A/C Transmission power lines >10 Miles (Western Electricity Coordinating Council, 2012)
  - 230kV Single Circuit: $927,000/Mile
  - 230kV Double Circuit: $1,484,000/Mile
  - 345kV Single Circuit: $1,298,000/Mile
  - 345kV Double Circuit: $2,077,000/Mile
  - 500kV Single Circuit: $1,854,000/Mile
  - 500kV Double Circuit: $2,967,000/Mile
- Transmission power line considerations (Infrastructure Project Estimating, 2013);
  - Vehicle and aircraft (Helicopter) access facilities
  - Tower design and tower foundations and appurtenances
  - Conductor lines
  - Lengths

- Terrain
- Base Substations (Western Electricity Coordinating Council, 2012)
  - 230kV: $1,648,000
  - 345kV: $2,060,000
  - 500kV: $2,472,000
- Line and Transformers, Assume Ring Bus Multipliers (Western Electricity Coordinating Council, 2012)
  - 230kV: $1,442,000
  - 345kV: $2,163,000
  - 500kV: $2,884,000
- Transformers (Western Electricity Coordinating Council, 2012); Substations per mVA
  - 230kV: $7,000-$11,000 Each.
  - 345kV: $10,000-$13,000 Each
  - 500kV: $10,000-$13,000 Each
  - Installation Labor – Add 50% (RSMeans, 2013)
- Reactive components (Western Electricity Coordinating Council, 2012); Static VAr Compensators (SVCs) and gas HV Breakers, as indicated:
  - SVC Low Voltage: $250,000 Each
  - SVC Medium Voltage: $142,000 Each
  - SVC 115kV: $141,000 Each
  - SVC 230kV: $50,000-$94,500 Each
  - SVC 345kV: $85,000 Each
  - SVC 500kV: $85,000 Each
  - Gas HV breakers: $1,370,000 Each Installed (RSMeans, 2013)
- Allowance for Funds Used During Construction (Western Electricity Coordinating Council, 2012)
  - Private Developer: 10%
  - IOU (NV Energy): 8.6%
  - Public Utility: 4.1%
- Overhead Cost (Western Electricity Coordinating Council, 2012)
  - Private Developer: 10%
  - IOU (NV Energy): 6.2%
  - Public Utility: 23.0%

For a single 10 MW renewable power generation facility, the configuration would likely include the following elements (Hurlbut, 2012):

- Power production facility
- Voltage Transformers and protective devices
- 34.5 kV single circuit local conveyance to transmission substation
- Transmission substation including transformers, switch, reactive components
- Transmission intertie line to connect substation to transmission line

1.3 POWER COMPANIES AND MARKETS

White Pine County is positioned along an existing power transmission corridor that links the Reno area population center located in the west central portion of the state with adjacent states to the east, primarily Utah (Governor Jim Gibbons' Nevada Renewable Energy and Transmission Access Advisory Committee, 2009), and a proposed north-south power transmission corridor linking Idaho to the north and power corridors crossing southern Nevada to the South (U.S. Department of Energy, 2008). In order for proposed renewable power generating facilities to be cost effective, they should be located as close as possible to power transmission facilities, but generally no further than 25 miles from such facilities (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007). Capital costs will include at a minimum a power substation to boost generated power to applicable transmission voltages, and associated power conveyance line distance that will be necessary to bring power to the transmission facility (Western Electricity Coordinating Council, 2012).

From White Pine County, numerous in-state and out-of-state markets for generated renewable power are able to be reached; it will be up to the individual renewable power producer to determine the best market for the produced power, subject to transmission agreements, power purchase agreements, tariffs, and the like. Transmission lines in the Reno area are connected with the northern California transmission grid and population centers such as Sacramento in the central valley and the San Francisco Bay area further to the west (United States Departement of Energy, 2008). In addition, infrastrucure exists in Utah, east of White Pine County, that transmits power to markets in Southern Nevada and Southern California (Los Angeles Department of Water and Power, 2013). All things being equal (power purchase agreement fees, power generating facility costs, etc.), providing power to out-of-state markets will typically be less advantageous than in-state markets due to state-specific transmission tariffs and fees that would be applied, and in-state markets should prove to be generally more advantageous; however, the economics of each individual project will need to be explored, as out-of-state markets that might not be favorable in the near-term (7 years or less) may prove more favorable in the intermediate term (15+ years) due to changing market conditions and demands for renewably generated power. Furthermore differential power pricing between markets may also be considered in terms of seeking point-to-point markets for generated power--for instance in 2006 the average cost of electricity in Nevada was $0.0902/kWh while during the same year the average cost of electricity in California was $0.1200/kWh (National Renewable Energy Laboratory, 2012).

With the projected completion of the ON Line project the separate power transmissions facitlities in northern Nevada, formerly operated by Sierra Pacific Power Company, and transmission facilities in southern Nevada, formerly operated by Nevada Power Company, will be connected through an in-state transmission line facilitating transmission of renewable power to growing areas of the desert southwest (United States Bureau of Land Management, 2010), including the Las Vegas, Nevada and Los Angeles, California population centers.

In terms of development of renewable energy resources within White Pine County, SBCC has identified the most probable customer entity to be NV Energy, followed by Mt. Wheeler Power, and the renewable energy markets in California; although other markets for renewable power, such as other small rural cooperatives in Nevada, and energy companies in Utah or other neighboring states, may be possible. Each of the three identified most likely customer entities is addressed in the following sections.

1.3.1 NV ENERGY

NV Energy, Inc. (NVE) is a publicly traded investor-owned holding company listed on the New York Stock Exchange. In 1999, Nevada Power Company (NPC) in southern Nevada merged with Sierra Pacific Power Company (SPCC) in northern Nevada. The combined company initiated a corporate name change in 2008 to "NV Energy", although each separate business unit maintained its respective corporate name, "doing business as" (dba) NV Energy. In 2013, NV Energy was acquired by MidAmerican Energy Holdings Company (NV Energy, 2012), and with the projected completion of the One Nevada power transmission line (ON Line) linking the former SPPC and NPC areas, both of the formerly separate areas will be brought under a single state-wide system on January 1, 2014 (OATI, 2013).

Through its principal subsidiaries of Nevada Power Company and Sierra Pacific Power Company, NVE serves over 2.4 million Nevada residents and over 40 million tourists annually in a 45,592 square mile service area that extends from Elko to Laughlin, Nevada, and includes Nevada's primary population centers of Las Vegas and Reno-Carson City (NV Energy, 2012). The NVE service area entails approximately 7.4 GW in peak electrical load demand. NVE recently surpassed 1 GW in renewable energy production through a broad portfolio including energy efficiency measures, geothermal, solar, wind and hydro resources, and has a stated RPS of at least 25% of retail energy sales by 2025 (NV Energy, 2012). NVE owns, manages and operates the majority of in-state power transmission lines (Governor Jim Gibbons' Nevada Renewable Energy Transmission Access Advisory Committee, 2007).

According to information obtained from the transmission section of NVE's public website (NV Energy, 2013), as of 2002 (the most recent date of posted information) the Las Vegas Valley maintained 17 MW of transmission capacity rights available, and the northern Nevada system maintained 31 MW of transmission capacity rights available for eligible customers. Note that that this information predates the construction of the ON Line, which once completed would be anticipated to increase the amount of transmission capacity rights that might be available for eligible customers. The effect of other transmission capacity reservations on the available capacity rights which may have occurred since 2002 are unexplained (NV Energy, 2002).

NV Energy maintains transmission policies and procedures applicable to their systems in WPC in a publically available repository for information located online at http://www.oasis.oati.com/sppc/, although this repository will be combined into a single NV Energy repository for the northern and southern Nevada combined BA on January 1st, 2014 located at http://demo.oasis.oati.com/NVE/index.html (Franz, 2013). This site serves as a public portal managed by Open Access Technology International, Inc. (OTAI) for purposes of public disclosure as required by governing bodies, and should serve as the initial point of reference for inquiries regarding the NVE transmission system, policies and procedures. The initial process stage includes completing and submitting to NVE an application for obtaining transmission on the system, which will be followed by conducting condition and capacity assessment of the transmission line with respect to the proposed renewable energy production facility and transmission intertie point. More information can be obtained on the OTAI (OATI, 2013) and NV Energy (NV Energy, 2013) websites. Agreements for system upgrade costs (if any), transmission tariffs, power purchase agreements, and the like would then follow.

1.3.2 MT. WHEELER POWER

Mt. Wheeler Power's (MWP) governance differs from many other power utilities in that MWP is a rural community power co-operative, and not a publically traded for-profit power provider. MWP was incorporated in 1963 and serves more than 4,600 member-owner accounts spread throughout a 16,000 square mile territory that includes portions of four rural Nevada and three rural Utah counties. MWP is governed by a Board of Directors selected through democratic district elections (Mt. Wheeler Power, 2013).

System-wide, the MWP service area peak energy demand is around 41 MW, with only a 100 kW difference noted between the winter heating load peak and summer load peak. This relatively flat seasonal demand is attributed to summertime load demands related to groundwater pumping for commercial agriculture within the service area versus the winter residential heating loads. Daily peak use loads are noted either in the morning or evening hours, which is attributed to residential power use and demands (S&B Christ Consulting, LLC, 2012). MWP currently obtains energy from a variety of sources, including hydro (which is used to satisfy most of MWP's renewable energy use), independent power producers (IPPs), and dedicated power generating stations located in Utah. The MWP sub-transmission system is connected to the NV Energy and IPP interstate transmission systems at the Gondor substation, where MWP takes delivery of the majority of its provided power (Robison, 2013).

MWP has been successful in securing low costs for wholesale power through long-term power purchase agreements (currently executed through 2025), which are passed along to member-owners (Robison, 2013). MWP's demand for additional renewable power is likely to remain low in the near term in the absence increased power demands due to development within the MWP service area, or regulatory changes or modifications in terms of the RPS requirements. The average member-owner power costs are currently around $0.068 per kWh, with the lowest MWP block at $0.042 per kWh. As a cooperative, MWP's philosophy is to keep operating and energy costs low and pass the savings along to the member-owners. Unspent income (known as "margins") are refunded through a "capital credits" program (Mt. Wheeler Power, 2013). Sub-transmission capacity is reported to generally be better to the east of central (downtown) Ely, as the transmission lines and MWP substation infrastructure are located in the vicinity of the US 93 alignment (S&B Christ Consulting, LLC, 2012), but available transmission capacities on MWP systems are relatively low in comparison to other power transmission facilities, particularly the NVE transmission systems, located within White Pine County as described above.

MWP staff have indicated that they would be open to utilization of their existing sub-transmission infrastructure for connection and conveyance of renewable energy, but any such proposal would have to start with an assessment of existing system conditions and capacity with respect to the specific proposed connection. The majority of MWP's sub-transmission infrastructure consists of 69 kV lines installed in the 1970s, with some sections experiencing capacity upgrades in the form of replacing originally installed conductors and upgrading ancillary systems (Robison, 2013). Given the stated MWP service area peak demand at 41MW, the size of renewable energy generation facilities proposed (10MW and greater) represents approximately 25%+ of the peak demands on the MWP system, and would likely require a large capital outlay in terms of upgrades to existing sub-transmission infrastructure. Utilization of existing MWP sub-transmission facilities may be an option, particularly in the event of smaller renewable energy generating facilities.

1.3.3 CALIFORNIA

The California power market is primarily served by three publicly traded investor-owned utilities: Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison, with a handful of smaller more localized providers. The three companies serve the primary population centers in the state of California (Federal Energy Regulatory Commission, 2013). The California electrical energy market service area entails approximately 302,000 GW in electrical load, with most of the energy coming from in-state resources and lesser fractions coming from adjacent states in the northwest and southwest (The California Energy Commission, 2013). California has a stated RPS of at least 33% of retail energy sales by 2020 (California Public

Utilities Commission, 2013). As of May 2010, California predicted a 50,000 GW gap in renewable energy production for meeting the RPS; however, the Renewable Energy Transmission Initiative identified 80,000 GW in potential in-state renewable energy sources, although some of the in-state renewable energy sources were more expensive and less environmentally advantageous in comparison to identified out-of-state resources. The current political climate in California favors developing in-state renewable energy resources; however, once the development of low cost in-state resources occurs in the immediate term, future mid-term to long-term conditions and changes to the California regulatory environment may increase the potential for importing energy from regional out-of-state resources, such as those identified in White Pine County (Renewable Energy Transmission Initiative, 2010).

1.4 CONCLUSIONS

Review of existing and planned transmission facilities located in White Pine County (WPC) Nevada, reveal the following implications regarding the locating of renewable power generating facilities within the County:

- WPC is positioned at a power transmission grid crossroads between existing east-west aligned transmission lines and future north-south aligned transmission lines.
- To lower transmission intertie costs, generating facilities should be situated in close proximity (generally 25 miles or less) to existing power transmission lines, with shorter distances being more desirable.
- A large portion of land in White Pine County is Federal, and is managed by the various associated Federal agencies;
  - Permitting for renewable energy generation and transmission facilities across federal lands will require detailed environmental studies and clearances prior to such development;
  - Land use fees will be applicable for utilized federal lands.
- Renewable energy generation types are not created equal, with various renewable sources having differing annualized generation capacities and production costs;
  - Energy source variability translates to a wide range of energy production and transmission related capital and tariff costs and fees that will be specific to the type of renewable power generation implemented;
  - Renewable power sources with greater capacity factors and controllability are generally more desirable.
- Identified potential customer markets for renewable energy generated in White Pine County include the following:
  - The markets with the greatest potential includes in-state markets located at the northern and southern Nevada population centers (NV Energy),
  - Local markets (in particular Mt. Wheeler Power);
  - Out-of-state markets, particularly California to the west;
  - Other markets, including those in Utah and other Nevada rural power cooperatives, may prove to be suitable for renewably generated power from the County in the near- to mid-term.
- Power Purchase Agreements (PPAs), transmission agreements, applicable transmission tariffs, and other project fiscal factors will need to be carefully explored and considered for each specific proposed renewable energy generating facility and transmission intertie project;
  - A study of existing transmission conditions and capacities at specific proposed intertie point(s) and for specific power generating capacity(ies) would need to be conducted as a necessary first step towards determining the specific project related transmission infrastructure impacts and upgrade costs that would be applicable to the proposed facility.

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S&B Christ Consulting, LLC

Ops Research & Civil/Env Engineering

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S&B Christ Consulting, LLC

5580 South Fort Apache Road, Suite 130

Las Vegas, NV 89148

702-202-6004

www.sbchristconsulting.com

Professional Design Associates, Inc.

108 Market Street

Henderson, NV 89015

702-567-1022

www.pdacorp.com

Appendix B: Pinyon-Juniper Biomass Assessment for White Pine County, Nevada – Resource Concepts, Inc.

PINYON-JUNIPER BIOMASS ASSESSMENT FOR WHITE PINE COUNTY, NEVADA

White Pine County Renewable Energy Feasibility Study and Resource Assessment

Prepared By: Resource Concepts, Inc.

EXECUTIVE SUMMARY

For the purpose of managing natural resources in a healthy and sustainable condition, the Resource Management Plan (RMP) for the Bureau of Land Management (BLM) Ely District provided for the treatment and removal of 674,000 acres of Pinyon-Juniper (PJ) found to be encroaching into sagebrush ecological sites. In addition, the RMP identified the need to treat 2.7 million acres of 'over mature PJ woodlands' (BLM, 2008). While the Ely District includes White Pine, Lincoln, and a portion of Nye County, much of the necessary PJ treatment would be located within White Pine County. A significant portion of the Ely Ranger District of the Humboldt-Toiyabe National Forest is also located in White Pine County, and lands under this Forest Service jurisdiction are also in need of PJ treatment. If the woody biomass resulting from these vegetation treatments can be developed into a viable and economically feasible product, then the economics associated with commercial utilization has the potential to assist in offsetting agency costs for large-acreage treatment of PJ. Such planned vegetation treatments will also result in the restoration of wildlife habitat (i.e. critical Sage-grouse habitat), improved watershed and woodland health, increased plant diversity and range condition, and reduced hazardous fuels loads. All of these ecological functions also have a positive economic affect to White Pine County and the multiple uses and associated industries that rely upon public lands.

The focus of this report was to define the available PJ biomass resources near Ely, Nevada and identify a potential energy development scenario and associated infrastructure requirements that in turn could lead to the evaluation of PJ utilization for energy production in White Pine County. The County's Community and Economic Development Office directed Resource Concepts, Inc. (RCI) to focus its analysis on the potential development of a 10 Megawatt Combined Heat and Power (CHP) Plant as its potential development scenario. Such a project would generate electrical power that could be sold for renewable energy credits, and also generate steam and heat that could be used by a nearby large existing facility (i.e. Nevada State Prison or Great Basin College) or a future industrial facility. This development scenario is based upon an expressed desire of several companies to develop such a project in the area, and relies upon a proven biomass utilization technology. However, there are a multitude of existing and emerging biomass utilization technologies and industries that may also have applicability in terms of future development in White Pine County.

Earlier assessments have reviewed alternative uses and products from PJ biomass and have determined, due to the isolated and remote nature of this resource and high costs for bulk transport, PJ does not represent a competitive wood fiber based on the biomass that is commercially available in other regions. There are PJ products that have a value and potential in the local market area; however, the local demand for these wood products does not nearly approach the utilization levels needed to support the landscape restoration goals established in White Pine County by the BLM and Forest Service.

Ely was selected as the PJ biomass utilization hub for this analysis because it is located near the center of White Pine County, at the cross-road for the two major highways, near primary transmission power lines and central to the PJ biomass resources identified for restoration. Further, Ely represents the largest city and commercial hub in the county and has a skilled labor force. The City also represents the area within White Pine County where heat and steam generated by a CHP Plant may be utilized, which would further help to improve the economic feasibility of such a facility.

Based on existing satellite vegetation mapping, a PJ distribution map was compiled for White Pine County. This mapping indicated approximately 1,421,000 acres of PJ within a 50 mile radius of Ely. Further analysis concluded that there are approximately 750,000 acres of PJ within 50 miles of Ely that fall in areas that would allow mechanical harvest methods. Based on a conservative yield rate of five bone dry tons of biomass per acre of PJ treated it was determined that this identified area could support a sustainable harvest of 13,400 acres per year, or the amount of biomass that would be required to supply a 10 megawatt biomass energy generation plant.

Both the BLM Ely District and the Forest Service Ely Ranger District have implemented priority programs to plan and develop watershed management or project plans. Products from this agency planning involve the development of project restoration plans and National Environmental Policy Act (NEPA) compliance documents. Currently completed restoration plans in the planning area have identified over 100,000 acres in eastern Nevada with the potential for mechanical PJ harvest. Resource planning under this initiative continues with nearly 1.6 million acres identified for agency planning and evaluation in 2014-2015.

Based on these preliminary estimates, it is the conclusion of this analysis that there exists a potential for PJ biomass utilization to occur within White Pine County based on restoration needs and potential available biomass. The economic feasibility for a power generation plant fed by PJ biomass falls outside the scope of this analysis but should be evaluated through further analysis. It should also be noted that a majority of the biomass within the planning area is located on public lands resulting in long-term feedstock availability, location and quantities that are subject to restoration planning progress, federal land management agency budgets and the NEPA process.

RESOURCE DESCRIPTION

White Pine County is located in east central Nevada. It is bordered on the east by Utah, Elko County to the north, Eureka County to the west, and Lincoln and Nye Counties on the south. The County is roughly square in shape and covers 8,941 square miles (5.7 million acres) and ranks fifth in size in Nevada covering 8.1 percent of the State. Ely, the county seat, represents the largest population center in the County and is located to the west and south of the County's center at the cross roads of US Highways 50 and 93 (White Pine County, 2012).

5.4 million acres, or 95.6 percent of the County, represent lands administrated by federal agencies. 4.5 million acres, or 79 percent of the County, is administered by the US Department of Interior Bureau of Land Management (BLM), Ely District which includes the entirety of White Pine County, nearly all of Lincoln County, and the northeast margins of Nye County (White Pine County, 2007).

With only four percent of the County representing private land, the BLM Ely District RMP, adopted in 2008, largely influences the direction for resource management in White Pine County. This agency resource management plan indicates 31 percent of the Ely District (or nearly 3.6 million acres) is represented by Pinyon-Juniper (PJ) woodlands dominated by single leaf pinyon pine and Utah juniper (BLM, 2007).

Due to the suppression of natural fire regimes, land uses, and climate change over the past 150 years, pinyon and juniper trees have expanded into the adjoining plant communities (i.e. areas previously dominated by sagebrush) and in-filled within traditional PJ woodlands. The continuing trend of tree expansion into shrublands (estimated at 674,315 acres) and increasing tree density in PJ woodlands (e.g., 2.7 million acres in over mature woodland phase) has lead to two distinct trends in the Ely BLM District (BLM, 2007). Increased tree densities contribute to exponential fuel loading which in-turn leads to extremely hot stand-removing fires when ignitions occur. Based on the ecological void left after these catastrophic wildfire events, invasive weeds species often occupy the affected sites leading to a decline in habitat quality and site stability. Secondly, increased tree densities have resulted in widespread reduction of sagebrush, other shrub species, and herbaceous understory through completion of sunlight and nutrients. The displacement of sagebrush by the expansion of PJ woodlands into shrub-dominant ecological sites has reduced the extent and habitat quality of sagebrush plant communities in the Ely BLM District.

The Humboldt-Toiyabe Forest Plan, which provides management direction for the Ely Ranger District, also provides goals and objectives for managing PJ encroachment and woodland tree densities for the purpose of maintaining habitat quality for wildlife and forest health and resilience (Forest Service, 1986).

As a sagebrush obligate species, the Greater sage-grouse, an agency-listed sensitive and a high priority candidate species under the Endangered Species Act, is highly dependent on extensive, non-fragmented, naturally functioning and persistent sagebrush rangelands. The encroachment of PJ woodlands into sagebrush rangelands is identified as one of the primary threats to the conservation of the Greater sage-grouse in eastern Nevada and the Ely BLM District (FWS, 2013).

For the purpose of managing the resources in the Ely BLM District in a healthy and sustainable condition, the Record of Decision (ROD) for the recent resource management plan provided for the treatment and removal of PJ encroachment in sagebrush rangelands up to the amount of 674,000 acres and 2.7 million acres of over mature woodlands (BLM, 2008). The identification and location of these vegetation treatment areas are determined through watershed assessments presently being conducted by both the BLM and Forest Service in White Pine County.

REPRESENTATIVE PROJECT DESCRIPTION/SCENARIO

PJ biomass represents an effective feedstock for energy production and fiber source for other wood products. If this biomass resource can be developed into a viable and economically feasible product, then the economics associated with commercial utilization has the potential to assist in offsetting agency costs in the removal of PJ biomass and site reclamation.

Earlier assessments, including The Beck Group (2011), have reviewed alternative uses and products from PJ biomass and have determined due to the isolated and remote nature of this resource and high costs for bulk transportation to developed manufacturing and customers, PJ does not represent a competitive wood fiber based on what can be obtained from other regions already under commercial use (e.g., lodge pole pine in the intermountain west, roundwood from commercial harvest, and by-products from sawmill operations). Despite this competitive limitation, there are PJ products that have a value and a potential market in the local area, including: firewood, posts and poles, and custom furniture. Unfortunately, the local demand and market for these wood products does not nearly approach the utilization levels needed to support the landscape restoration goals established in White Pine County by the BLM and Forest Service.

Energy production through biomass combustion represents an alternative approach for PJ utilization. Energy generation from PJ biomass involves an approach where the bulk biomass is transported a reduced distance to a local power generation plant, combusted, and converted to electricity that is readily transported to distant markets. The difference associated with this alternative is that the consumer market for electrical energy is vast and ever increasing and, once the costs for power interconnection are recovered, transmission costs to distance markets is comparatively inexpensive.

The focus of this report was to define the available PJ biomass resource and identify a potential energy development scenario and associated infrastructure requirements that in turn could lead to the evaluation of PJ utilization for energy production in White Pine County. A primary limitation placed on this report was that it is to be based on existing information.

Considerations for siting a biomass power facility in White Pine County include:

- Proximity to a dependable and competitively priced biomass fuel supply (feedstock);
- Proximity to an existing power transmission line that has the capacity to “wheel” generated power to distant buyers for the purpose of reducing interconnection expenses;
- Ease and expense of permitting for both the power plant and biomass feedstock; and,
- Price and availability of water and land for the facility.

Based on this criteria Ely was selected as the PJ utilization hub because it is located near the center of White Pine County, at the cross-road of the two major transportation highways, near primary transmission power lines and PJ resources identified for treatment in the BLM Ely District RMP, and represents the largest city in the county with a ready supply of skilled labor. In a statewide assessment and strategy report the Nevada Division of Forestry (NDF) also identified the concept of locating a PJ biomass utilization hub near Ely (NDF, 2010).

RESOURCE ASSESSMENT

A starting point for assessing the potential for PJ utilization in White Pine County is determine how much is currently present and available. To address this question Resource Concepts, Inc. (RCI) developed PJ distribution mapping for White Pine County[1]. With this resource layer RCI conducted a mapping exercise in order to determine the potential available biomass within a reasonable haul distance of 50 radial miles from Ely, Nevada (Figure 1).

[1] Based on the Southwest Re-GAP land cover data (USFWS 2005).

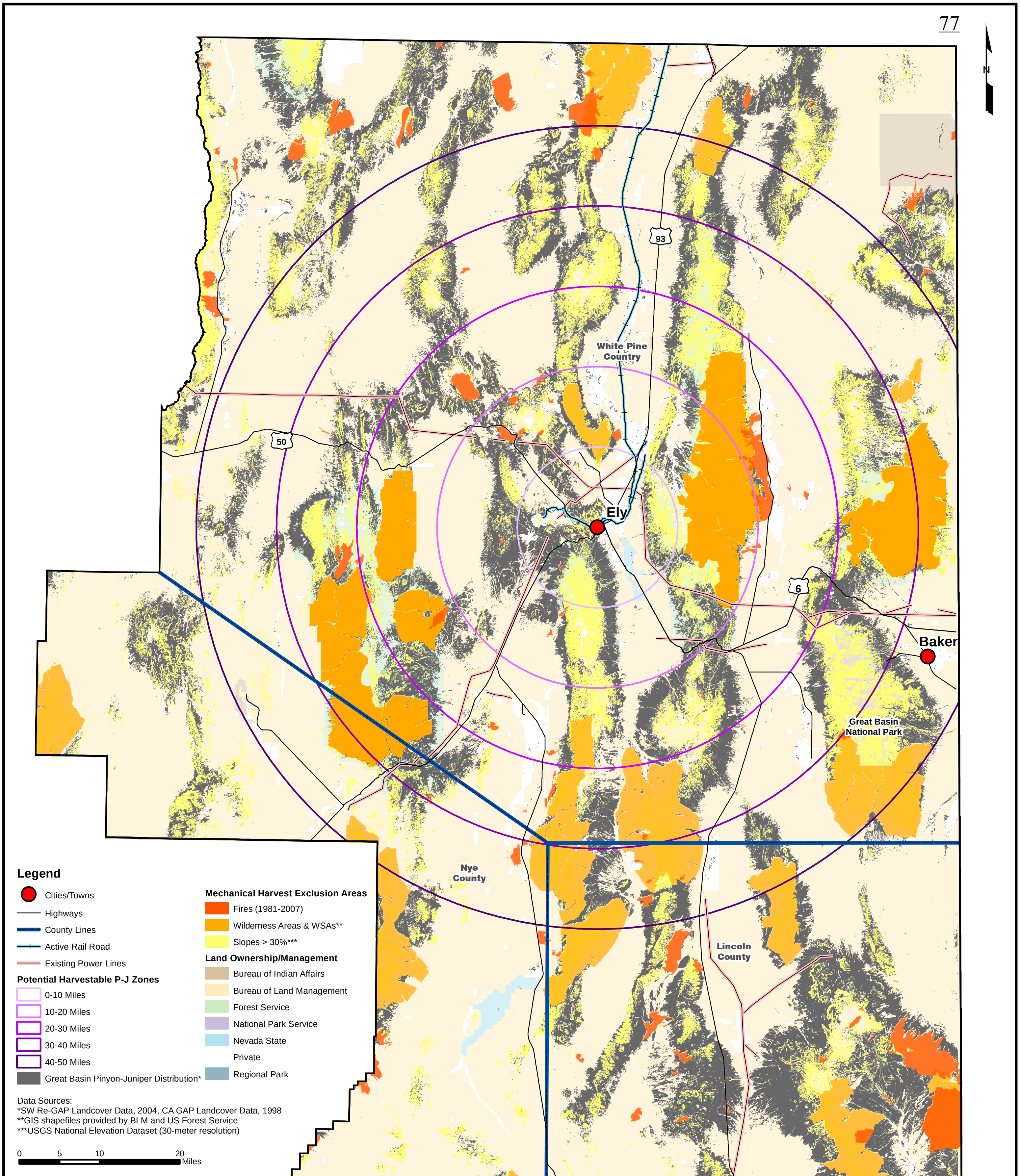

Figure 1
Potential Harvestable Pinyon-Juniper within 50 Miles of Ely, Nevada

Date: 12/30/2013

RCI Resource Concepts Inc

Path: R:\projects\White_Pine_CED\MXDs\Harvest_Map_8x11_Ely.mxd

This initial mapping indicated approximately 1,421,000 acres of PJ within 50 miles of Ely. RCI then determined areas that would likely be excluded from potential mechanical harvest based on the following parameters:

- Areas where slopes exceed 30 percent[2]
- Wilderness or Wilderness Study Areas[3]
- Areas that have recently burned[4]

The analysis concluded that there are approximately 750,000 acres of PJ within 50 miles of Ely that fall outside of the identified exclusion areas (Table 1). It should be noted this very basic analysis did not identify potential exclusion areas relating to cultural, ecological, and access concerns (i.e. lack of existing roads), etc. Such areas would need to be identified based on site specific information developed as part of the required National Environmental Policy Act (NEPA) analysis for the identified vegetation restoration projects.

Based on the lack of detailed information, it was difficult to estimate the total amount of potential biomass that would be yielded from these radius zones without site-specific inventory and development of restoration plans. However, based on data collected for past restoration projects, the Ely BLM District has generated up to five bone-dry tons per acre for treatments in Phase II woodlands and up to 11 bone-dry tons per acre for restoration treatments in Phase III woodlands depending on the desired outcome (mosaic harvest, thinning, etc.)[5]. These values are similar to those provided by Dr. Robin Tausch who suggested assuming a harvest regime of all trees eight inches or larger in diameter within areas designated for thinning, which would generate approximately five bone-dry tons per acre in Phase II woodlands and 15 bone-dry tons / acre in Phase III woodlands[6].

To place these estimates in context, a 10-megawatt biomass power facility would require approximately 67,000 bone-dry tons of biomass annually (The Beck Group, 2011). Assuming a relatively conservative average yield of five bone-dry tons per acre for restoration treatments, approximately 13,400 acres of restoration per year would have to be implemented to sustain the plant. Assuming that the plant operated for 20 years; approximately 268,000 acres of total restoration treatment would be implemented, or slightly over a third of 750,000 acres of mechanically harvestable PJ estimated to occur within a 50-mile radius of Ely, Nevada.

For further context, BLM (2008) identified the goal to remove up 674,000 acres of PJ encroachment in sagebrush rangelands and 2.7 million acres of over mature woodlands over the 15 to 20 year life of the agency plan. At a utilization rate of 13,400 acres per year, it would take approximately 250 years to complete the 3.4 million acres identified for restoration. This comparison does not include areas where PJ has expanded into Forest Service administered lands in White Pine County.

[2] Based on USGS national elevation database at 30-meter resolution.
[3] Based on BLM and Forest Service GIS database for wilderness and wilderness study area boundaries.
[4] Based on BLM GIS database for fire areas from 1981-2007. This database also includes areas burned on National Forest System land.
[5] Based on personal communication with Project Managers and Specialist located in the Ely BLM District.
[6] Based on personal communication with Dr. Robin Tausch, US Forest Service, Rocky Mountain Research Station.

Table 1
Estimated Acreage of Pinyon-Juniper Biomass
Near Ely, Nevada by Land Status

Potential Harvestable PJ (Acres)

Agency	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Agency Totals
Bureau of Indian Affairs	929	2	0	0	7	938
Bureau of Land Management	29,301	93,789	126,806	162,386	171,823	584,105
Forest Service	19,026	19,610	37,031	60,126	3,410	139,202
National Park Service	0	0	0	3,005	3,884	6,889
State of Nevada	298	1,038	0	0	0	1,336
Private	4,892	4,800	2,788	5,019	3,794	21,294
Total Harvestable PJ (Ac.):	**54,446**	**119,239**	**166,625**	**230,536**	**182,918**	**753,764**

The US Geographical Survey (USGS) in Dixon, California has been contracted by the State of Nevada to utilize recent satellite imaginary to refine the location and extent of woodland phases for PJ vegetation types in Nevada, including White Pine County. Based on the analysis of satellite imaginary at a 30-meter pixel resolution, this analysis is contracted for completed by mid-January 2014[7]. This initial analysis is further being refined to produce an inventory analysis at a one-meter pixel resolution by mid-2014. With this new and more detailed imaging and analysis, PJ biomass estimates in White Pine County will become much more refined and certain in the near future.

INFRASTRUCTURE REQUIREMENTS

The technology of combusting biomass to fire a boiler is mature and reliable (The Beck Group, 2011). A moving grate, air-swept stoker system has been used with success to burn western juniper in northern California over the past several decades. A standard direct connected stream turbine-generator converts the stream energy into electricity. The process begins when wood fuel is combusted in a furnace with walls containing water filled piping (e.g., boiler). The high-pressure water in the piping boils to steam that enters the turbine and creates rotational energy. The mechanical energy of the rotating turbine is converted into electrical energy by a direct or gearbox connected generator that uses a magnetic spinning rotor to induce electrical current in the windings of the fixed stator that surrounds it.

An air-cooled condenser would likely represent the exhaust stream cooling technology of choice for a biomass energy facility in eastern Nevada due to the limited availability of water. This technology has proven effective in similar situations; however, this particular design feature would increase the facility costs and reduce plant efficiency. The alternative use of a standard two-cell wet cooling tower would lower the capital costs for a 10 megawatt (MW) plant by roughly 10 percent and allow 5.7 percent more power to be generated from the same fuel quantity (The Beck Group, 2011). However, these advantages would have to be balanced with the annual requirement of 180 acre-feet of water consumption associated with this cooling method.

In 2011, The Beck Group from Portland, Oregon completed a feasibility study for locating a 10 MW air-cooled biomass heat and power facility in Lincoln County, Nevada, which is located immediately to the south of White Pine County (The Beck Group, 2011). This comprehensive report resulted the following findings:

- Fuel supply identified for treatment or removal by the land management agencies was not a limiting factor to the feasibility of biomass power in Lincoln County.
- The cost of PJ fuel delivery to a prospective power plant was very high and approached an estimated amount of $97.50 per bone dry ton (BDT). On a BDT basis, this estimate included $79.00 for felling, skidding, chipping and transport up to a 50 mile radius, plus $3.65 for rehabilitating harvested areas, and $15.00 incurred by the BLM for planning, administration, and monitoring to ensure consistency with the 2008 Ely District RMP.
- Results from this analysis indicated that the allowable fuel costs, or the costs which a plant can afford to pay and remain attractive for private investment, was $27.00/BDT, or about $70.00 less that the estimated inclusive delivered price at $97.50/BDT.

7 Based on personal communication with Dr. Peter Coates, Lead Researcher, US Geological Survey, Dixon Field Station.

- This detailed analysis did not identify a reasonable scenario where a PJ biomass utilization project in Lincoln County could afford to pay all the inclusive costs of PJ restoration and still remain attractive for private investment.
- In this analysis the project parameters were modified in regarding to financing, owner's equity, and rate of return to determine whether the expected project expenses could be brought in line with the high PJ fuel costs. Despite these project modifications the best-case scenario still returned an upper delivered fuel cost approaching $52.00/BDT.

One additional option presented but not analyzed in The Beck Group (2011) was the use of a portion of the generated plant steam to supply heat to commercial-sized customers. This option was not analyzed in this study because no suitable customers could be identified within the Lincoln County project area. However, this optional use would provide a second and possibly important revenue source for improving the economic feasibility for a PJ biomass power generating plant in other areas where there was a market for heat customers. Ideal conditions for developing heat customers in conjunction with a PJ power plant included: proximity to suitable commercial-sized customers that could utilize up to 10 percent of the steam output, use of low pressure stream for maximizing power generation, and limited variation in daily and season heat demands.

Ely has several large, potential heat consumers in the area including the Nevada State Prison and the Great Basin Community College. Development of an industrial or business park, utilizing stream heat and power, also represents a possibility in the immediate area based on economic development opportunities presently being pursued.

ENVIRONMENTAL AND CULTURAL CONSIDERATIONS

This basic PJ inventory analysis did not identify harvest exclusion areas associated with cultural or ecological concerns, access (i.e. lack of existing roads), etc. Such areas would have to be identified based on site specific information developed as part of the required NEPA analysis for the identified restoration projects.

Based on the resource goals set in current land use plans and agency directives, both the BLM Ely District and the Forest Service Ely Ranger District have implemented priority programs to plan and develop watershed management or project plans that include a detailed review and analysis of current resource conditions and the subsequent development of vegetation restoration plans. An important component associated with many of these agency plans includes the identification of areas suited for PJ treatment and the assessment of treatment methods for achieving the identified future resource conditions.

Through this ongoing agency planning two vegetation restoration projects, which provided the option for 20,200 acres of mechanical PJ harvest, have been completed (Table 2). Results from this interagency planning indicate that currently completed restoration plans in this planning area have identified an additional 100,000 acres with the potential for mechanical PJ harvest. Resource planning under this initiative continues with nearly 1.6 million acres identified for agency planning and evaluation in 2014-2015.

Table 2
Status of Habitat and Watershed Management Planning on the BLM Ely District and Forest Service Ely Ranger District

PROJECT INFORMATION		PROJECT STATUS		MANAGEMENT DIRECTION		
					Identified Area for Mechanical P/J Treatment (Ac)	
Name	Agency	Agency Planning Completion Date	Status	Planning Area Public Lands (Ac)	Approved	Estimated
Stonehouse Sagebrush habitat improvement project	BLM-NV-L000-2011-0002	2011	Completed	23,676	17,000	
Loury hazardous fuels reduction program	USFS	2013	Completed	4,500	3,200	
South Steptoe Valley watershed restoration plan	BLM-NV-L020-2011-0013	2011	Implementation	195,235	29,511	
North Schell Creek project	USFS	2012	Implementation	78,000	12,361	
Cave Valley/Lake Valley watershed assessment	BLM-NV-L020-2011-0021	2012	Implementation	561,372	59,042	
Kious Basin sagebrush steppe restoration project	BLM-NV-L020-2011-0019	2013	Implementation	850	850	
Central White Pine project	USFS	2013	Implementation	------	0	
Egan & Johnson Basin restoration project	BLM-NV-L010-2013-0014	2014	Planning	16,700		13,700
Newark / Huntington watersheds assessment	BLM-NV-L010-2012-0033	2014	Planning	577,528		36,315
South Spring / Hamblin watershed assessment	BLM-NV-L020-2011-0022	2014	Planning	633,202		55,234
Overland Pass Habitat restoration plan	BLM-NV-L010-2011-0036	2014	Planning	40,000		17,000
Current-Ellison watershed restoration project	USFS	2014	Planning	184,921		16,600
Ward Mt. Interagency landscape restoration & fuels reduction project	USFS-lead agency	2014	Planning	117,467		5,000
Duck Creek Basin hazardous fuels reduction project	BLM-NV-L020-2012-0031	2015	Planning	29,000	------	------
			Totals (Ac.):	**2,462,451**	**121,964**	**143,849**

Sources: Project status and management direction verified by personal communication with Carol Carlock, Forest Service Ely Ranger District, and Cody Coombs, BLM Ely District on December 17-18, 2013.

COMPARISON OF TECHNOLOGIES OR SYSTEM REQUIREMENTS

In addition to the combined-heat and power technologies discussed in this report, there is a host of proven woody biomass utilization technologies and markets as well as a handful of emerging technologies and developing markets.

Proven technologies and markets include: residential firewood, heating pellets, individual residential and commercial heating systems (boilers), niche wood markets (i.e. custom furniture), and traditional wood markets (i.e. fence posts, particle board). While these technologies and markets have been in existence for quite some time, it has been difficult to match the market's demand with the scale of the resource challenge. Large-scale firewood operations, niche and traditional wood markets are capital intensive and require a high front-end investment, which has limited the growth and expansion of existing small-scale operators. Heating pellets from PJ biomass have proven a challenging venture. The characteristics of PJ biomass (i.e. high ash content) do not provide an avenue to access the highly-competitive residential premium pellet market. While PJ heating pellets may meet commercial pellet standards and a growing global demand, there is no nearby market to take advantage of. Residential and commercial systems are small, and demands can be easily satisfied. For example, the "Fuels for Schools" Program implemented in Ely that utilizes a biomass boiler to heat a local school has been provided with enough biomass to run for decades without putting a sizeable dent in the product coming off recently implemented projects.

Emerging technologies, such as pyrolysis, torrefaction, and distillation have opened the door to a handful of developing markets. Pyrolysis and torrefaction is the process of burning biomass at high temperatures and low oxygen. Both processes produce a series of general products whose quantity and chemical composition depend upon the feedstock type, feedstock preparation (wet vs. dry), and processing conditions (heat and oxygen). Generally a small quantity of gas (syn-gas) product is generated along with a larger liquid (bio-oil) and solid (bio char) product. The gas product is usually recycled as part of the process leaving behind a potential marketable bio-oil and bio char.

Recent studies have been conducted on refining the bio-oil from PJ biomass for uses ranging from low-value (heating oil) to very high value (bio-fuels, bio-chemicals and bio-plastics). The same can be said for bio char ranging from products associated with soil amendments, filtration media, and coal substitute. Two primary challenges have been identified in regards to these technologies and markets. First, these processes have not been developed at a large-scale production level. At this time most torrefaction or pyrolysis units are small-scale (i.e. 1 ton of feedstock per day), and pilot in nature with the lone exception being a handful of commercial bio char production units. As a result, new markets have yet to fully develop for bio char and woody biomass based bio-oil. Bio char has gained a relatively small market for use as soil amendments with more studies and target markets being developed. There has also been an emerging demand in the arena of 'home-grown, non-crop, green', bio-fuels being in high demand by the US Departments of Defense and Energy. At this time, feedstock and technology development for woody biomass derived bio fuels has focused on big timber forests rather than PJ woodlands. As these technologies are further developed and vetted at a commercial scale, there is a real likelihood that present emerging markets could result more high-value end products for PJ biomass than exists today. Higher-value end products of PJ would better offset the high input costs of the feedstock in the future. In addition, mobile applications of these emerging technologies, such as Amaron Energy's 10-ton/day mobile pyrolysis unit, may result in reduced transportation costs by replacing the transport distance of raw biomass with transport of end (bio char) or intermediate (bio oil) products.

CONCLUSIONS

Based on these preliminary estimates, there exists a potential for biomass utilization to occur within White Pine County based on restoration needs and potential available biomass. However, resource restoration planning and not commercial development or diversification should dictate where, how, and by what standards PJ could be accessed, harvested, restored, and utilized. This agency planning and implementation process should be conducted in accordance with approved plans and policies and in conformance with all existing laws and regulations including NEPA. It should also be noted that the major barrier to achieving the needed level of restoration planning and implementation, regardless of biomass utilization, is a lack of secure, long-term sufficient agency budget and staffing in addition to the uncertainties associated with the NEPA process.

Fortunately, both the BLM Ely District and the Forest Service Ely Ranger District have implemented a progressive and often collaborative approach toward identifying suitable areas where PJ can be removed and restored for more sustainable resource conditions and attainment of land use plan goals and objectives. To date, this combined agency planning has identified nearly 100,000 acres of PJ woodland that is available for mechanical harvest. Under this program, restoration planning on an additional 1.6 million acres in eastern Nevada is planned for completion in 2014-2015.

The economic feasibility for a power generation plant fed by PJ biomass in White Pine County falls outside the scope of this analysis and this question will need to be determined through further analysis.

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Appendix C: Concentrating Solar Power Resource Assessment for White Pine County – Millennium Energy, LLC.

MILLENNIUM ENERGY LLC

FINAL REPORT
Concentrating Solar Power Resource Assessment for White Pine County

Submitted to:
White Pine County
Community and Economic Development
957 Campton Street
Ely, NV 89301

In Support of:
Department of Energy Award Number DE-EE0003139
Renewable Energy Feasibility Study and Resources Assessment

Submitted by:
Joe Bourg, President
Millennium Energy LLC
Golden, Colorado 80402
Voice: (303) 526-2972
Email: jbourg@millenniumenergysolar.com
Date: December 2013

CONCENTRATING SOLAR POWER

EXECUTIVE SUMMARY

White Pine County (County) is home to an abundant solar resource that provides potential opportunities for development of concentrating solar power (CSP) plants, and associated economic development. For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for CSP energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they are unregulated and not subject to state RPS regulations, and sales outside of Nevada would likely be uncompetitive due to additional transmission service costs.
- **Anticipated market prices for energy sales:** Based on historical sales prices to NV Energy and current solar plant costs, CSP-based energy sales prices were estimated to be in the eight to nine cent per kilowatt-hour (kWh) range, with a mid-point price of 8.5 cents per KWh. This is the same range as solar photovoltaic resources as they are competing within the same market.
- **Solar resource data and expected annual energy generation potential:** Based upon modeling of a 10 MW CSP plant utilizing the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM), it was estimated that the annual energy generation would be 25,386 MegaWatt-hours (MWh).
- **CSP construction and operations and maintenance (O&M) costs:** Utilizing the NREL Jobs and Economic Development Impact (JEDI) and SAM models, the CSP construction cost was estimated to be $71.5 Million with total annual O&M costs of ~$1,080,000.
- **Financing parameters and tax incentives:** Project financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, five-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the NREL JEDI model, it was estimated that 79 construction and 21 O&M full-time jobs would be supported by a 10 MW CSP project.
- **Project Locations:** Potential project locations were limited to areas within a five-mile radius of the NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines, and within the southern portion of the county due to the better solar resource. It should be noted that projects of larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection.

METHODOLOGY AND ASSUMPTIONS

The analysis of CSP opportunities was based on a 10 Megawatt (MW) plant to provide a consistent comparison among the renewable resource technologies. In addition, 10 MW is typically of sufficient size to analyze, such that the results would scale up in a linear manner if larger system sizes were to be considered.

The first step in the analysis was to review and analyze the market opportunities for CSP energy sales. Based on this review, it was determined that NV Energy would likely be the only plausible off-taker of the power. This is due the fact that the utility serving the entire County, Mt. Wheeler Power, is an unregulated rural electric cooperative. As such, Mt. Wheeler is not subject the State of Nevada Renewable Portfolio Standard (RPS) requirements, and therefore would not be a candidate for renewable energy purchases from projects located in the County. In addition, selling to out-of-state utilities is not an economic option due to costs that would be incurred related to transmission wheeling and other transmission-related ancillary charges. Since CSP and other solar technologies are in a highly competitive market, adding additional transaction costs to energy sales prices would make the overall sales price non-competitive in out-of-state markets. However, two high-voltage transmission lines owned by NV Energy intersect the County, one from east-to-west and one from north-to-south. As a result, CSP projects in the County could potentially interconnect with one of these lines, and avoid transmission wheeling and ancillary costs if the energy were sold to NV Energy. Therefore, NV Energy was determined to be the only likely off-taker of energy from a CSP project in the County, and this assumption served as the basis for the remainder of the analyses.

With NV Energy as the assumed off-taker of energy from the potential 10 MW CSP plant, the next step was to research and determine expected sales prices for the power. Currently, the market for large-scale solar energy sales to NV Energy is in a state of flux as regulatory considerations are sorted out. With NV Energy currently ahead of schedule with respect to its RPS requirements, the utility has not awarded a solar power purchase agreement (PPA) since 2011. PPA prices in 2011 were in the low nine-cent per kWh range. Since then, CSP's solar technology competitor, photovoltaic solar (PV), has seen moderate declines in system costs, as have PPA prices in neighboring states. Based on these facts, CSP energy sales prices were estimated to be in the eight to nine-cent per kWh range, with the midpoint of 8.5 cents per kWh recommended as the sales price for the economic analysis. These sales prices were assumed to be without annual escalation factors, as NV Energy has historically required that all PPA bids be offered at a fixed price for the 20-year contract duration (although this may or may not change in the future).

The next step in the CSP resource assessment for the County was to review and analyze the solar resource, develop a basic conceptual design of a 10 MW plant, and model the annual energy generation resulting from plant operations. For this assessment, Millennium utilized the National Renewable Energy Laboratory's (NREL) System Advisor Model (SAM), to incorporate the weather and resource data for the County, specify CSP system components, and model the output. Based on weather and resource data for the Ely area, it was determined that a 10 MW CSP system would generate approximately 25,386 MWh annually.

Once the off-taker, sales price, and output values were ascertained, Millennium began collecting data on construction and O&M costs for the hypothetical 10 MW CSP plant. Construction costs were tabulated based on information derived from NREL's JEDI and SAM models and included cost breakdowns for capital cost, labor, and land. Similarly, O&M costs were derived from the same models for fixed and variable costs, including materials, labor, insurance, and other costs. The 10 MW CSP system assumed for this study was estimated to cost ~$71.5 Million including interconnection and transmission spur costs, with total annual O&M costs estimated at ~$1.1 Million. Complete breakdowns of construction and O&M costs are included in Appendices A and B as part of the data request responses.

In an effort to support the economic and feasibility assessments of the hypothetical 10 MW CSP project, Millennium provided input into the financing parameters (including loan terms, interest rates, and debt ratios), as well as the tax treatments of Federal and state incentives applicable to the project. Specifically, details were provided on Federal tax credits, five-year accelerated depreciation schedules and basis determination, and treatment of the 10-year 55% property tax exemption for 10 MW+ renewable energy systems in Nevada.

The final assessment performed for this project was to develop data to assist in the economic development analyses to be completed by UNR under this project. This data development effort was based on the NREL JEDI databases and resulted in the development of estimates of labor and benefits expenditures within the County and the state. This data assisted in determining the economic development impacts of 10 MW increments of CSP projects in the County. Key findings from this assessment were that 79 full-time employment (FTE) construction jobs would be needed to build a 10 MW CSP project, and 21 FTEs would be required for O&M. Additional economic development input data is provided in Appendix B.

Finally, Millennium provided input into the mapping studies in terms of defining screening criteria and project parameters to assist in identifying potential areas for project development based on identified markets, resource potential, and distance to transmission lines. The resulting map for the CSP resource assessment indicates that areas within a 10-mile wide corridor of the NV Energy east-west or north-south transmission lines (i.e., five miles on either side of the transmission line) in the southern portion of the County have potential for CSP development, that are also located with a 5-mile radius of an existing substation. While most areas in the southern portion of the County meet the minimum threshold for solar resource potential, the commercially developable areas are limited based on the properties' proximity to NV Energy transmission lines and substations. However, this proximity is based on a 10 MW sized project, and projects of a significantly larger scale could potentially by developed that interconnect directly with the NV Energy transmission lines – as larger projects could potentially absorb the cost of building a required substation for interconnection at the high voltage transmission level.

RESOURCE DESCRIPTION

White Pine County has an abundant solar resource to fuel potential CSP projects. On a nation-wide basis, the County has some of the best solar resource potential. However, the market for solar energy sales in Nevada is NV Energy, and this market is statewide. As such, CSP projects in the northern half of the state must compete with projects in the southern half of the state, in most cases. While the solar resource in the County is high, the solar resource in southern Nevada is higher. This is an important consideration since, all factors being equal in a CSP plant (i.e., CSP construction and O&M costs), a CSP plant in southern Nevada will produce energy more cheaply than an identical plant in the north. This is due to the fact that more solar insolation hits a square meter in southern Nevada than in northern Nevada, hence more power is generated per unit area in the south than in the north. This means that in order to compete statewide, a CSP plant in the north would need to be built for less capital costs and/or with more efficient equipment to minimize cost and maximize system performance.

The County's solar resource is comparable to most counties at similar latitudes in Nevada. The solar resource for CSP systems is typically evaluated based on its Direct Normal Irradiance (DNI) value. Direct Normal Irradiance is the component of solar irradiation that reaches the surface of the earth (normal to the direction of the sun) without any atmospheric scattering or absorption. Its value is measured in terms of $kWh/m^2/day$. For White Pine County the DNI range is from ~6.0-7.5. For project screening purposes, the higher the DNI value the better, since more energy will be generated per unit area in locations with higher DNI values. It should be noted that a DNI value of 6.0 was designated as the minimum threshold criteria for CSP project consideration. The DNI value gradually decreases as one moves north within the County, with the northern regions having the lowest DNI values. Therefore, screening for potential CSP project sites in the county needs to consider these DNI values. While a lower DNI value of 6.0 in some areas of the country may be considered a good resource, it would likely not be enough to develop a competitive project in Nevada, or within the county given the higher DNI values in the southern portions of the County.

RESOURCE LOCATION

As mentioned previously, many areas in the County meet the minimum threshold DNI value of 6.0. However, not all areas of the County are considered potential sites for CSP development due to market factors and differences in the solar resource. These two factors limited the areas that were considered for CSP development potential under this study. Firstly, since NV Energy was determined to be the most likely off-taker of the energy from any project in the County, any potential project sites must be located within a reasonable distance (i.e., five miles) of one of NV Energy's east-west or north-south transmission lines. Secondly, while all areas of the county have a good solar resource, the highest solar resource areas are in the southern portion of the County. Based on these two factors alone, it was determined that potential resource locations for CSP plants would be located along a 10-mile corridor of NV Energy's transmission lines, within five miles of existing substations, and with a preference for locations within the corridors that are co-located in the southern portion of the County. Figure 1, below illustrates the resulting resource locations determined from this study.

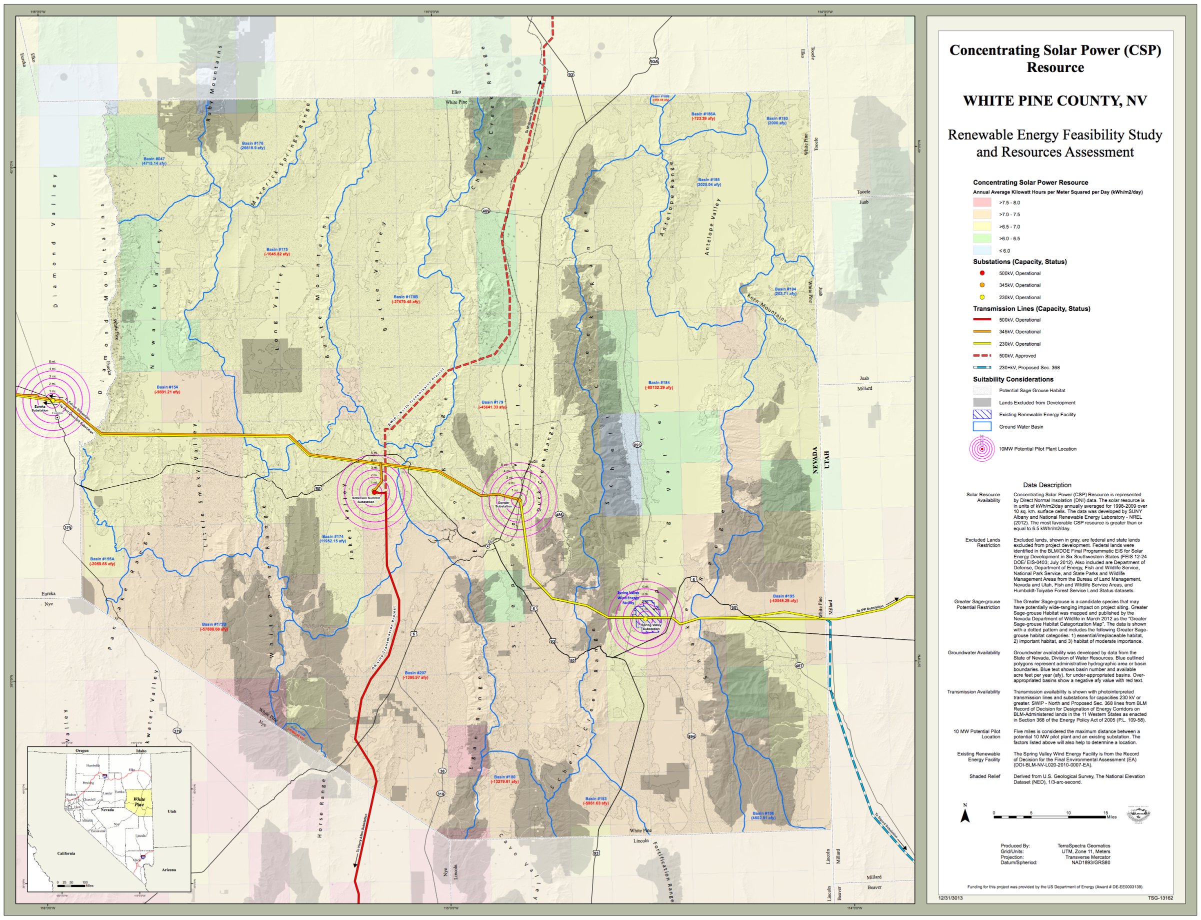

Figure 1 CSP Resource Locations

INFRASTRUCTURE REQUIREMENTS

Compared to many other renewable generation technologies, CSP has minimal infrastructure requirements. The biggest and most expensive infrastructure requirement will be the interconnection equipment with a substation interconnected with the NV Energy high-voltage transmission system. However, this requirement is common to all of the electricity producing renewable resources considered by this study. In addition, any project connecting directly to a high-voltage transmission line would require a substation and large step-up transformers, and would likely have to be significantly larger in size in order to justify the additional cost.

Beyond the interconnection equipment, the infrastructure requirements are marginal. During the construction phase, passable dirt or paved roads are required to deliver the CSP system components and construction equipment, as well as to allow for water trucks to reach the site for dust control.

Access to water at the site is desirable, but not critical as water can be trucked in. Fencing would also be required during construction, as well as on-site security personnel to prevent theft.

Once the plant is complete, in addition to the interconnection infrastructure, road access will be required to allow for maintenance vehicles. On-site access to water is critical for CSP plants as they require water for both steam make-up and cooling purposes (unless dry-cooled), in addition to water required for frequent mirror washing. Perimeter fencing will also will required at the site, as will some form of security protection (i.e., on-site personnel or electronic security systems).

ENVIRONMENTAL AND CULTURAL CONSIDERATIONS/IMPACTS

CSP power plants have relatively low environmental and cultural impacts. CSP plants emit zero pollutants, and have no long-term impacts on the land. However, moderate water resources are required even with dry cooling technology. During the construction phase of a CSP project, some grading and land leveling may be required, but these impacts are typically minimal (although it is critical to have a dust control plan in place), given the best sites for project development tend to already be level and require a minimum of land disturbance. In addition, many development contracts for CSP projects require the owner to return the land to its original state at the end of the project's life. In some instances, communities have raised concerns over the visual impacts of large CSP projects and their reflective troughs; however, due to the remoteness of the area, this issue is not anticipated to be a concern – especially given the fact any potential projects would likely be developed within sight of NV Energy's large high voltage transmission lines.

As with any project development, environmental concerns would need to be assessed during the project planning phase. Few CSP projects have been cancelled due to environmental issues. The most prevalent environmental issues associated with CSP projects are the disturbance of land in threatened or endangered species habitat areas, water use in areas with short water supply, and dust control during construction.

COMPARISON OF TECHNOLOGIES/SYSTEM REQUIREMENTS

There are several types of CSP systems in use throughout the west, namely parabolic troughs, power towers, and dish sterling systems. The most prevalent system in the market today is the parabolic trough system using a steam Rankine cycle turbine. Due to its lower costs and more proven commercial reliability, this system was selected for analysis under this project. The main system components of a CSP plant include the mirrored parabolic trough, the linear receiver or heat collection element, the steam turbine, the cooling equipment and balance of system (BOS) equipment. For this study, Millennium compared various CSP system configurations to arrive at the overall system design, which balanced obtaining the highest system efficiency at the lowest cost. This balance was selected due to the fact that prospective solar CSP plants in the County would likely need to compete with other plants in the state located in areas with a higher solar resource.

One of the key considerations in the specification of system components for this analysis was the type of cooling system. One of the potential drawbacks of CSP systems is that they work best in hot, dry climates – areas that are often water constrained. As with any power turbine technology, the units need to be cooled while in operation. There are typically three types of cooling technologies employed in CSP systems: 100% water cooled with cooling towers, hybrid cooling making use of both wet and dry cooling, and 100% dry cooling using air-cooled condensers. Hybrid systems are often the cooling system of choice as they strike a balance between the higher water use of cooling towers and the lower efficiencies of air-cooled condensers. Since a hybrid system can reduce water requirements by 50% during the hotter summer months, this option was specified for this analysis.

REPRESENTATIVE PROJECT DESCRIPTION

Based on the research, analyses, and evaluations completed for this study, the following CSP plant characteristics were specified for this study, and were used to the support evaluation of the economic and economic development opportunities for the County.

- 10 MW nameplate capacity CSP plant
- Annual energy generation of 25,386 MWh
- CSP system components
    - Mirrored parabolic trough
    - Linear heat collection element
    - 10 MW Rankine cycle steam turbine (37.7% efficiency)
    - Hybrid cooling plant
- Located within a five-mile radius of NV Energy transmission lines, within a five-mile radius of existing substations connected to NV Energy transmission lines, and within the southern portion of the County with a DNI value of greater than 6.0.

APPENDIX A

DATA REQUEST FEASIBILITY ANALYSIS

for

CONCENTRATING SOLAR w/ HYBRID COOLING

This completed data request form is for the stochastic feasibility analysis. This specific form is for the CONCENTRATING SOLAR POWER TROUGH (CSP) w/ HYBRID COOLING technology. Below are some assumptions of the Power Plant:

Power Plant 10 Mega-Watts

- Assumes that at this level, larger capacity sizes are approximately linear in scale in terms of economies of scale and production values.

Length of Feasibility Analysis 30 Years

- Typically, the lifecycle analysis is set to the expected system life (i.e., CSP = 30 years)

Assumed rate of return by investors. 10-15%

- Due to the highly competitive nature of the renewable energy industry in the current market, ROIs in the 10-15% range are common.

REVENUE DATA:

POWER PRODUCTION: Typically, renewable energy studies look at the annual production value (MWH) that includes downtime. For this study, this value was calculated for a 10 MW CSP plant in White Pine County (Ely TMY weather data) using the NREL System Advisor Model (SAM)[1]. Using the assumptions from the SAM, and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated at 25,385,765 kWh. This is a more accurate assessment than max power per day – as the max daily power fluctuates widely due the seasonality of the resource. The modeled annual energy output is equivalent to 69,550 kWh/day (average).

PRICES OF OUTPUT: The latest benchmark for NV Energy for Solar PPA prices is ~$0.09/kWh from the 2011 round of RPS bids. Since PV and CSP compete with one another, the sales prices

[1] (National Renewable Energy Laboratory, 2013)

would be the same for both resources. However, costs have come down for solar PV projects in the last couple of years, and based on what the industry has experienced in adjacent states the sales price range would be 8-9 cents per kWh – with 8.5 cents being the mid-point and zero annual escalation in PPA prices.

GOVERNMENT PAYMENTS or SUBSIDIES: CSP Plants are subsidized with tax benefits via three mechanisms: two that are Federal and one that is from the State of Nevada. The first is a 30% Investment Tax Credit[2]; the plant owner would see 30% of the plant cost as a tax credit in Year 1. The second is the Modified Accelerated Cost Recovery Mechanism (MACRS). MACRS allows for solar plants to be depreciated over 5 1/2 years[3]. The first step is to calculate the net basis of depreciation. In this case, it is the total plant cost (including interconnection equipment and transmission lines) minus the one-half 30% ITC amount. For example, for a plant costing $1M, the net basis would be $1M – 0.5*(30%*1M) = $850,000. This net basis is then depreciated according to the following schedule[4]:

Year 1: 20%
Year 2: 32%
Year 3: 19.2%
Year 4: 11.52%
Year 5: 11.52%
Year 6: 5.76%

Thirdly, at the state level, there is a property tax abatement of 55% for 20 years for CSP systems over 10 MW, hence qualifying this hypothetical facility[5].

COSTS: Construction and O&M cost data were derived from the default data set provide in the NREL System Advisor Model, unless otherwise noted.

Fixed Cost of Plant: This would cover the below:

Book Value Estimate of Plant and Transmission Lines $ 71,497,738

- Assumes 5 miles of transmission line to interconnection point

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[2] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)
[3] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)
[4] (Murray State University)
[5] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)

Plant Cost	$ 69,672,738
Capital Replacement Annually (Fixed O&M)	$ 643,500[6]
Land Value	$ 225,000

- Assumptions of 90 acres X $2500/acre

Amount of Down Payment for Plant	$ 21,449.321

- Assumes 30% down and the remainder is debt financed

Length of Loan (years)	20 years
Interest Rate on Plant Loan (%)	5.5 %
Any Government Loan Assistance	$ 0

- The DOE Loan Guarantee Program is not accepting any new applications at this time.

OTHER COSTS:

Annual Variable Costs	$ 434,671

- Includes production based O&M costs plus insurance
- Does not included property tax @ 45% of assessed value due to 55% abatement for first 20 years of operation

REFERENCES

Interstate Renewable Energy Council / North Carolina Solar Center. (2013). *Federal Incentives / Policies for Renewables / Efficiency: Modified Accelerated Cost Recovery System (MACRS) + Bonus Depreciation (2008-2015)*. (I. R. Center, Producer) Retrieved October 24, 2013, from Datebase of State Incentives for Renewables and Efficiency (DSIRE): http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06F&re=1&ee=1

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[6] (International Renewable Energy Agency (IREA), 2012)

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National Renewable Energy Laboratory. (2013). *NREL System Advisor Model (SAM)* . (N. R. Laboratory, Producer, & National Renewable Energy Laboratory) Retrieved Oct 18, 2013, from National Renewable Energy Laboratory : http://www.sam.nrel.gov

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APPENDIX B

DATA for ECONOMIC IMPACT ANALYSIS

ENERGY SOURCE: **Concentrating Solar Power – 10 MW**

CONSTRUCTION COSTS:

(1) Estimated Total Construction Costs: **$69,672,738**

- Total Construction Costs includes land and labor expenditures

(2) Percentage of Total Construction Costs that is Labor And Benefits **14.4%**

(3) Percentage of Labor and Benefits Costs that are Benefits **28.8**%

(4) Number of Construction Employees **79 FTE**

(5) Percentage of Construction Employees that Live In White Pine County **10**%

(6) Percentage of Construction Employees that Live In the State of Nevada **90**%

- Does not include employees that live in White Pine County)

(7) Percentage of Construction Costs LESS Labor And Benefits Spent in White Pine County **2.8**%

(8) Percentage of Construction Costs LESS Labor

And Benefits Spent in the State of Nevada **18.7**%

- Does not include costs spent in White Pine County

ANNUAL OPERATION COSTS:

- Data does not include debt or equity payments

1) Estimated Total Annual Operation Costs: **$1,078,172**

(2) Percentage of Total Operation Costs that is Labor

and Benefits **82.0**%

(3) Percentage of Labor and Benefits Costs that are

Benefits **28.8**%

(4) Number of Operation Employees **21 FTE**

(5) Percentage of Operation Employees that Live

In White Pine County **100**%

(6) Percentage of Operation Employees that Live

In the State of Nevada **0**%

- Does not include employees that live in White Pine County

(7) Percentage of Operation Costs LESS Labor

And Benefits Spent in White Pine County **3.1**%

(8) Percentage of Operation Costs LESS Labor

And Benefits Spent in the State of Nevada **8.5**%

- Does not include costs spent in White Pine County

References

The data provided in to support the economic impact analysis was derived from the National Renewable Energy Laboratory Jobs and Economic Development Impact (JEDI) model:

National Renewable Energy Laboratory. (2013). *JEDI: Jobs and Economic Development Impact Models*. (N. R. Laboratory, Producer) Retrieved November 2, 2013, from National Renewable Energy Laboratory: http://www.nrel.gov/analysis/jedi/about_jedi.html

Appendix D: White Pine County Renewable Energy Feasibility Study and Resource Assessment: Geothermal Component – Nevada Bureau of Mines and Geology, University of Nevada, Reno

White Pine County Renewable Energy Feasibility Study and Resources Assessment

GEOTHERMAL COMPONENT

Nicholas Hinz, Mark Coolbaugh, and James Faulds
Nevada Bureau of Mines and Geology
University of Nevada, Reno

Nevada Bureau of Mines and Geology

University of Nevada, Reno
Statewide • Worldwide

EXECUTIVE SUMMARY

Geothermal resources can potentially contribute toward the renewable energy portfolio of White Pine County (County) in two ways; first through the direct conversion of heat energy into electricity, and the second by way of direct use applications in which thermal energy is used as a source of heat for buildings, greenhouses, and related structures. Several known geothermal areas within the County lie proximal to the Southwest Intertie power line currently under construction.

A potential source of electricity could come from conventional geothermal systems associated with young faults and regions of active crustal deformation. These systems have a total installed capacity in the Great Basin region of nearly 1,000 Megawatts – electricity (MWe). The County hosts several geothermal systems of this type, but none are currently producing electricity. The County has relatively low rates of crustal deformation (e.g., faulting accommodating crustal extension). However, based on a review of the geology in the region, we conclude that sustained and reasonable exploration efforts could result in the discovery and development of one or more electricity-grade geothermal systems, with potential generation capacity at each system in the range of 1-20 MWe.

In addition, a new type of potential geothermal resource termed “deep stratigraphic reservoirs” or “hot sedimentary aquifers” has recently been recognized in the western United States. The County, and in particular, the northern Steptoe Valley, has some of the most promising potential for electricity generation from this type of reservoir in the U.S. Preliminary calculations suggest that as much as 500 MWe of baseload electricity in the northern Steptoe Valley could be produced from this type of reservoir using wells reaching depths of 1.25 to 2.5 miles (2-4 km). The economic feasibility remains unproven, but initial estimates are encouraging.

Based on observed surface temperatures and flow rates of springs, several geothermal systems in the County also have the potential for direct use, including the heating of buildings or greenhouses. Such uses could reduce the consumption of electricity generated from fossil fuels and could lead to economic expansion by extending the growing season for certain agricultural products and reducing utility costs.

RESOURCE DESCRIPTION AND LOCATION

Conventional Fault-Controlled Geothermal Systems

Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy naturally radiates outward from the Earth’s hot core and mantle through the crust. The temperature difference between the ground surface and the base of the Earth’s crust determines the geothermal gradient in the crust. Geothermal systems are defined by areas of locally elevated geothermal gradients and enhanced permeability (i.e., fluid flow) in the upper few miles of the crust. Elevated geothermal gradients are related to one or more of the following attributes: 1) absolute crustal thickness (thinner crust facilitates higher geothermal gradient), 2) thermal conductivity of lithologic units (the ability of a specific rock type to conduct heat transfer), 3) convection of fluids along faults, fractures, and/or through lithologic units with naturally high permeability (convection is a more efficient mode of heat transfer than conduction), and 4) heat from magma in the crust (active volcanic regions). Electricity is generated in geothermal systems through a process in which hot water is extracted through wells installed to depths of 0.5 to 1.25 miles (<1 to 2 km). This hot water either boils at the surface or induces boiling in a secondary fluid, with the resulting steam driving turbines to produce electricity. The spent fluids, which are still hot, are then injected back into the ground to recharge the subsurface reservoir. Proper design of a well field with balanced flow rates from production and injection wells can yield long-term sustained energy production for decades or more. Geothermal power has added value as a "baseload" source of electricity, meaning that production is available 24 hours a day, 7 days a week, with minimal impacts from weather (sun, wind, temperature, and rain).

White Pine County is located near the center of the Great Basin (Fig. 1), an area that hosts more than 400 known geothermal systems with temperatures ranging from 100 to 520° F to (37 to 270° C) (Faulds, Hinz, Kreemer, & Coolbaugh, 2012). Most of these geothermal systems are not related to upper crustal magmatic heat sources but are instead structurally (fault) controlled. Temperatures are generally >390° F (>200° C) at 3 to 3.75 miles (5-6 km) depth across much of the Great Basin, whereas average temperature gradients range from 60 to 175° F/0.6 miles (15-80° C/km) in the upper 0.6 miles (1 km) of crust (SMU, Temperature-at-Depth Maps 2011 Update, 2011). The conventional structurally controlled geothermal systems in the Great Basin are associated with permeable fault zones that facilitate convective heat flow. Currently, there are 24 geothermal systems that have been developed and are producing electricity within the Great Basin region (Faulds, Hinz, Dering, & Siler, 2013). Excluding the four higher enthalpy magmatic systems (e.g. Coso, 419° F , 215° C, 274 MWe) and the four lowest temperature systems (approximately 220° F, 105° C, 0.3-2.2 MWe each) that have been developed, the average producing, amagmatic (i.e., not related to volcanic or magmatic activity) geothermal system in the Great Basin region generates approximately 20 MWe from 285 to 480° F (140-250° C) reservoirs at 0.5 to 1.25 miles (<1 to 2 km) depth. A new power plant scheduled to come online in the spring of 2014 near Paisley, Oregon, is expected to produce about 3 MWe from a 240 to 250° F (115-120°C) reservoir (Crawford, 2013) and is a good example for what can be achieved in the 230 to 265° F (110-130°C) temperature range throughout the Great Basin region.

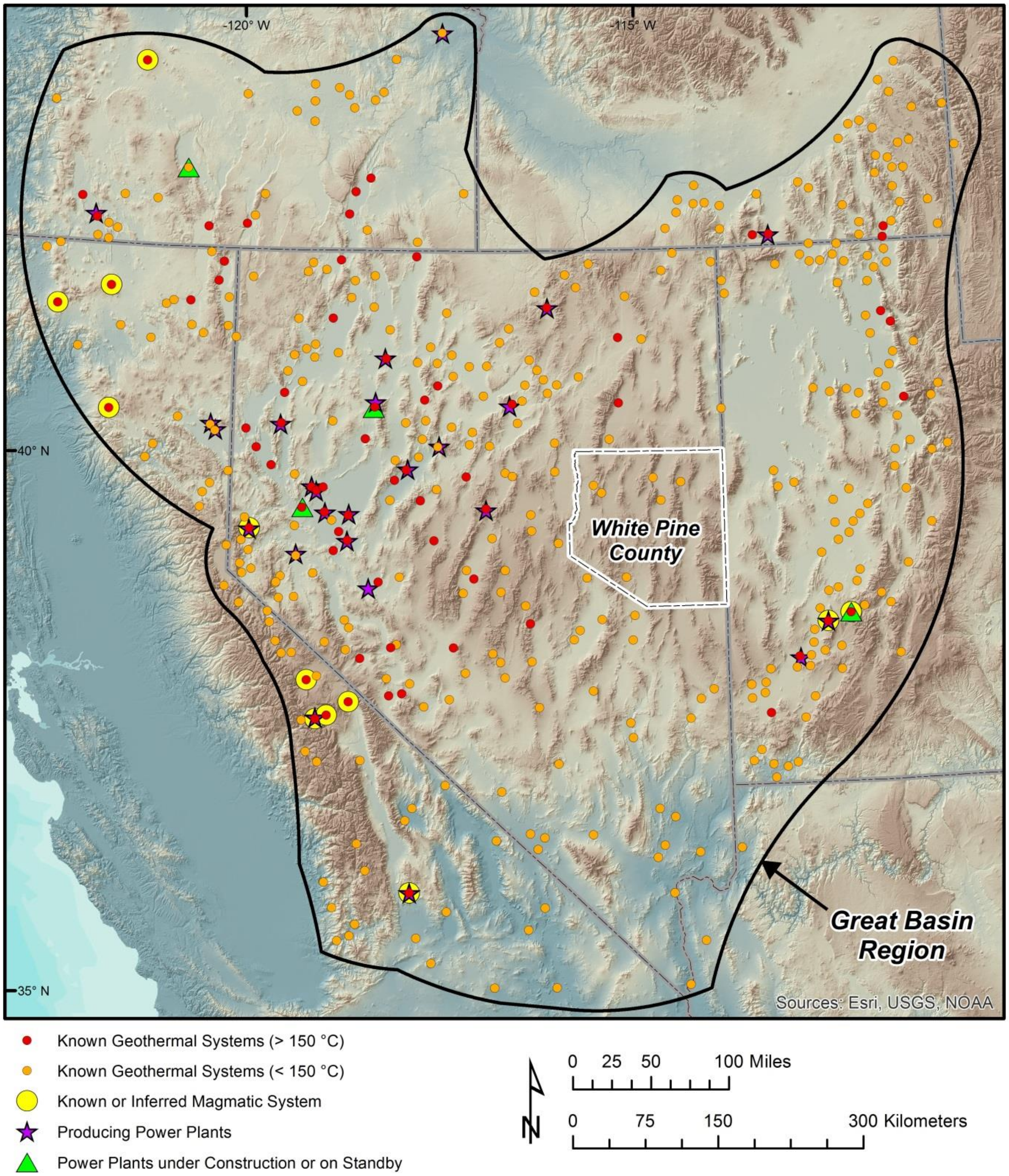

Figure 1. Geothermal systems and geothermal power plants in the Great Basin region (modified from (Faulds, Hinz, Kreemer, & Coolbaugh, 2012).

Evaluation of publically available geothermal databases (NBMG & GBCGE, 2012) (SMU, SMU Nevada Database, 2008) has identified six areas with shallow thermal groundwater in the County (Table 1, Fig. 2), with temperatures in springs and wells ranging from 73 to 190° F (23-88°C).

Table 1. Measured temperature and geothermometry of known geothermal systems in the County (Figure 2). Water analytical data and sources of data available on request.

GIS Id	Geothermal System	Structural Setting	Maximum Measured Temperature (°F)	(°C)	Average Geothermometry (°F)	(°C)
1	Williams Hot Springs	Undetermined	127[2]	53[2]	194-253[1,3]	90-123[1,3]
2	Monte Neva Hot Springs	Stepover	190[2]	88[2]	138-149[1,3]	59-65[1,3]
3	Cherry Creek Hot Springs	Stepover	189[2]	87[2]	210-228[1,3]	99-109[1,3]
4	Spring Valley Well	Fault Intersection	90[3]	32[3]	174[3]	79[3]
5	Alligator Ridge well	Fault Intersection	93[3]	34[3]	111[3]	44[3]
6	Warm Springs Ranch	Stepover	73[3]	23[3]	108[3]	42[3]

[1]The range of "average" geothermometry calculated using two methodologies: 1) the method of (Reed & Mariner, 2007), involving silica and K-Mg geothermometers, and 2) the average of silica and Mg-corrected K-Na-Ca geothermometers using the choice of silica geothermometer based on the procedure of (Mariner, Presser, & Evans, 1983).
[2]Temperatures from (Garside & Schilling, 1979).
[3]Temperatures and geothermometry from (NBMG & GBCGE, 2012).

Of greatest interest for possible direct or indirect energy utilization are three geothermal systems, located at Monte Neva Hot Springs, Cherry Creek Hot Springs, and Williams Hot Springs (Fig 3.), which have surface or near-surface temperatures of 190, 189, and 127° F (88, 87, and 53°C), respectively. Geothermal water at each of these areas has a strong bicarbonate/carbonate signature (Fig. 4), which in many parts of the world indicates relatively low to moderate temperatures at depth (up to 248° F, 120°C). However, the eastern Great Basin, including White Pine County, has thick sequences of carbonate rocks (limestone and dolomite), and in such terrains, thermal fluids could have relatively high temperatures at depth in spite of the strong bicarbonate/carbonate fluid signature. Two examples of electricity-producing geothermal systems with bicarbonate fluid signatures and subsurface temperatures approaching or exceeding 390° F (200°C) are Beowawe, Nevada, and Kizildere, Turkey (Fig. 4).

Geothermometry can be used to estimate the temperatures of underlying fluid reservoirs beneath surface springs. This is important in geothermal energy development, because the higher the subsurface fluid temperature, the greater the potential for producing renewable energy. Geothermometry involves the prediction of subsurface temperatures based on the concentration of certain dissolved constituents in thermal waters, such as silica, sodium, and potassium. For example, higher concentrations of silica can be dissolved at higher temperatures, and similarly, the ratio of potassium to sodium increases as temperatures increase. When thermal fluids rise from depth toward the surface, they may cool significantly, but they commonly retain solute concentrations (e.g., silica, potassium, sodium) characteristic of their higher temperature history, because the chemical reactions that could cause re-equilibration at lower temperatures become sluggish or act slowly as temperatures decrease.

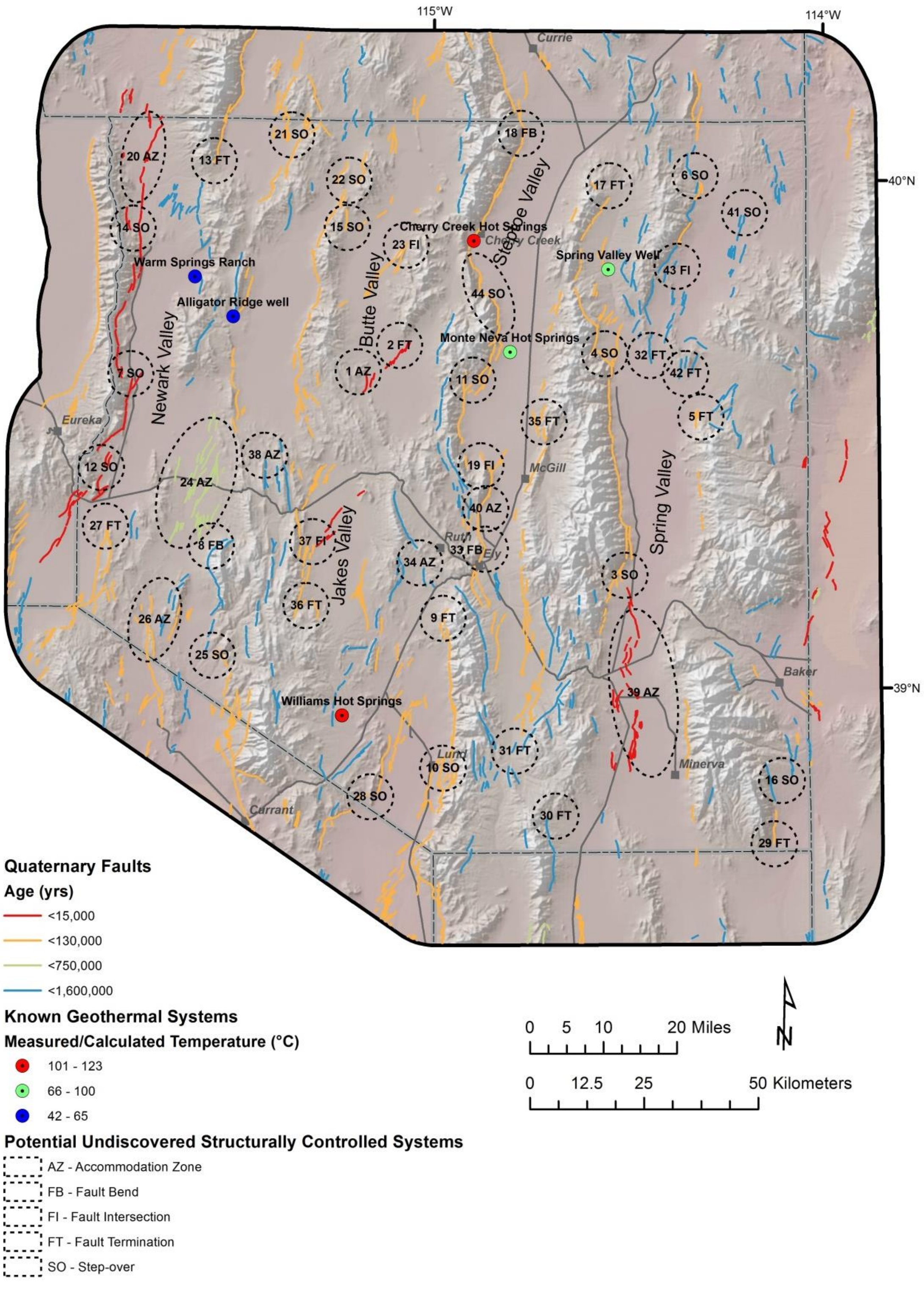

Figure 2. Shaded relief map of the County showing known geothermal systems (Table 1), Quaternary faults (USGS, 2010), and potential structural settings that could host undiscovered blind geothermal systems (Table 2). Potential structural settings are depicted with a circle or oval that is larger than most well fields of producing systems (1-3 square miles; e.g., Fig. 9). The size of the polygon depicts the general target area within which a resource may reside.

Figure 3. A) Williams Hot Springs overview. View is looking west at the east side of the White Pine Range in the background. B) One of the primary hot springs at Williams Hot Springs emanates into a broad ditch constructed for pipes to collect water for a concreted recreational soaking pool down slope. Photos by Jim Faulds, 2012.

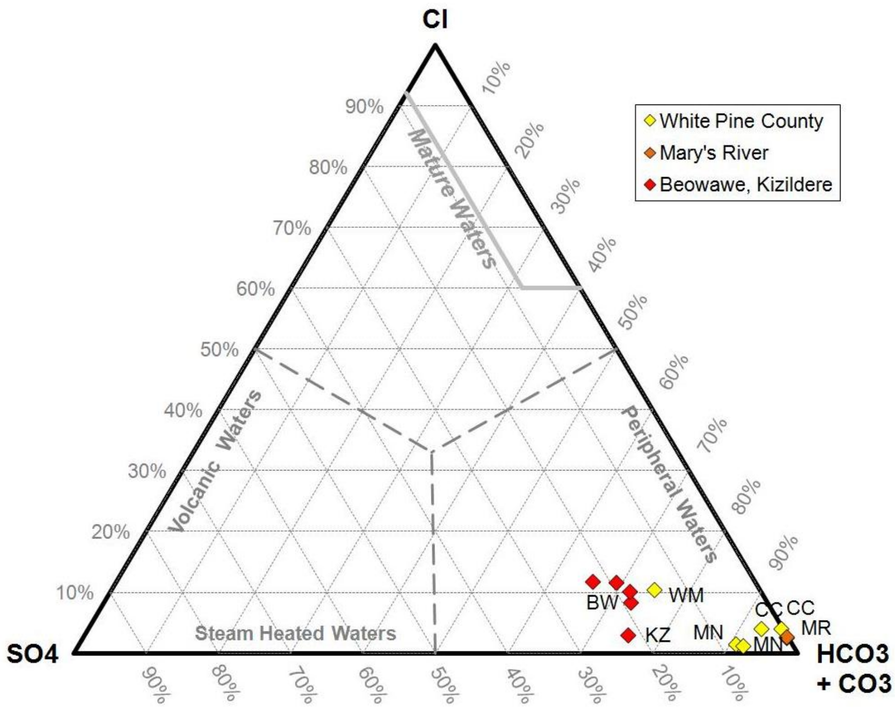

Figure 4. Ternary Cl-SO_4-HCO_3 plot of ion proportions in hot spring fluids from White Pine County compared with Mary's River (Elko County, NV), and producing systems in carbonates from Beowawe (Lander and Eureka Counties, NV) and Kizildere, Turkey. CC = Cherry Creek, MN = Monte Neva, WM = Williams, MR = Mary's River, BW = Beowawe, KZ = Kizildere.

The silica, K-Mg, and Mg-corrected Na-K-Ca geothermometers of spring waters from Monte Neva, Cherry Creek, and Williams Hot Springs suggest relatively low to moderate subsurface geothermal reservoir temperatures, in the range of 138 to 253° F (59 to 123° C) (Table 1). Similarly, a ternary plot of Na, K, and Mg concentrations in hot spring waters (Fig. 5) predicts relatively low subsurface temperatures utilizing the Na-K and K-Mg geothermometers and methodology of (Giggenbach, 1988). For comparative purposes, it can be seen that the known high-temperature geothermal systems producing electricity at Beowawe, Nevada, and Kizildere, Turkey, have higher predicted subsurface temperatures, as do thermal waters from the Mary's River area of Elko County, Nevada (Fig. 5).

Although subsurface fluid temperatures predicted by geothermometry are moderate, they still indicate the potential for generating electricity where temperatures exceed 212° F (100°C). Geothermal power plants in the Great Basin with inlet water temperatures near 212° F (100°C) include Wabuska in western Nevada and Amedee and Wendel in eastern California. In such cases, power production is likely to be on the order of a few megawatts or less.

Geothermometers are not always accurate predictors of subsurface fluid temperatures, because during their rise toward the surface, thermal fluids can precipitate minerals, re-equilibrate with surrounding rocks, or mix with shallow groundwater. Each of these mechanisms alters the

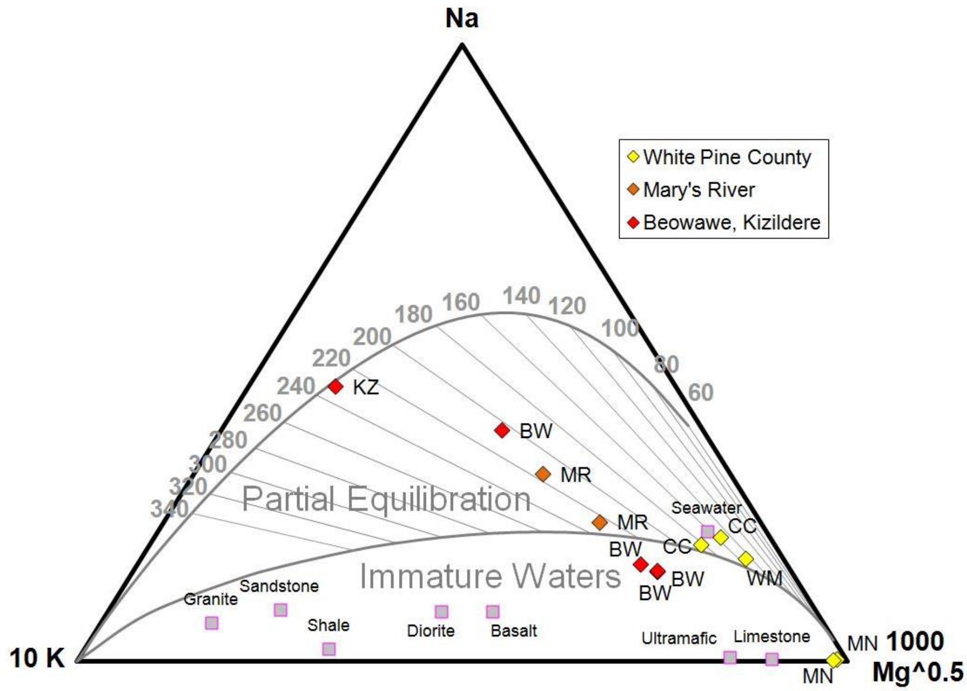

Figure 5. Na-K-Mg ternary geothermometer plot for hot spring fluids from White Pine County compared with Mary's River (Elko County, NV), and producing systems in carbonates from Beowawe (Lander and Eureka Counties, NV) and Kizildere, Turkey. See Fig. 4 caption site abbreviations. Higher subsurface temperatures are predicted for those symbols that plot a greater distance from the Mg apex and closer to the K apex.

original geochemical signature of the water, and in such circumstances, geothermometry can underestimate temperatures at depth. This may be the case for Monte Neva Hot Springs, where geothermometry predicts subsurface temperatures lower than that observed at the surface (Table 1). The presence of relatively high Mg concentrations in Monte Neva spring water is an indication of possible mixing with shallower, cooler groundwater, which commonly is enriched in Mg. Such fluid mixing typically reduces the calculated temperatures of the more reliable geothermometers, including silica geothermometers, the Mg-corrected Na-K-Ca geothermometer, and the K-Mg geothermometer.

The northern Steptoe Valley, where Monte Neva and Cherry Creek Hot Springs reside, is known to have relatively high temperatures at shallow depths based on deep drilling (see following section). Because of this, and because the chemistry of waters at Monte Neva Hot Springs appears modified, it is possible that fluid reservoir temperatures beneath Monte Neva Hot Springs are significantly hotter than predicted by geothermometry.

***Structural Controls on Geothermal Activity**:* Research has shown that most of the known geothermal systems in the Great Basin region are associated with specific fault patterns or structural settings. The most common settings include terminations of major normal faults, accommodation zones (belts of intermeshing, oppositely dipping faults), step-overs in range-front faults, and fault intersections (Faulds, et al., 2011) (Faulds, Hinz, Dering, & Siler, 2013). In contrast, the central segments of major normal faults with maximum displacement contain relatively few geothermal systems. Not every one of these settings across the Great Basin region host geothermal systems, but they are a good place to prospect for blind, undiscovered geothermal systems (e.g., (Kratt, Sladek, & Coolbaugh, 2010); (Anderson & and Faulds, 2013)). Both Monte Neva Hot Springs and Cherry Creek Hot Springs are associated with step-overs in the range-front fault along the western side of Steptoe Valley. The structural controls of Williams Hot Springs (Fig. 3) remain undetermined, but it is possible that fluid flows along a fault intersection that is poorly defined by existing mapping (Stewart & Carlson, Geologic Map of Nevada, 1978) (USGS, 2010).

Outside of the known geothermal areas, we have identified 44 potential structures that may host blind, undiscovered geothermal systems in the County based on an evaluation of geologic maps, publications, and fault databases (Table 2; (Stewart & Carlson, Geologic Map of Nevada, 1978); (Stewart, Regional characteristics, tilt domains, and extensional history of the late Cenozoic Basin and Range province, western North America, 1998); (USGS, 2010)). There is minimal existing temperature and geochemical data in these areas to confirm or deny whether these structures host geothermal systems. Without additional exploration work, there is no way to predict how many of these structures may contain undiscovered geothermal systems. The spatial density of known geothermal systems in eastern Nevada is overall lower than the density in northwest Nevada or central Utah (Faulds, Hinz, Kreemer, & Coolbaugh, 2012). However, it is not unreasonable to expect that one or more new structurally controlled economic resources could be found in White Pine County with the potential of producing 1-20 MWe per system.

To help prioritize the resource potential of the 44 structural settings identified in this study, we have listed the age of faulting (USGS, 2010) and slip and dilation tendency of the primary faults defining each of these areas (Siler, *in prep.*, 2014). The majority of the high temperature systems (≥300, ≥150°C) in the Great Basin Region are associated with faults active in the Holocene (i.e., past ~12,000 years) (Bell & Ramelli, 2007). Furthermore, critically stressed fault strands are the most likely fault segments to act as fluid flow conduits (Barton, Zoback, & Moos, 1995) (Sibson, 1994) (Townend & Zoback, 2000). The tendency of a fault segment to slip or to dilate provides an indication of which sections of a fault zone within a geothermal system are most likely to transmit geothermal fluids (Morris, Ferrill, & Henderson, 1996) (Ferrill, Wittmeyer, Sims, Colton, & and Armstrong, 1999). Nine of the 44 structures are associated with faults active in the past 15,000 years and have faults with high slip and dilation tendency. These systems should be considered higher priority in exploration for undiscovered systems (highlighted in gray boxes in Table 2). Exploration should be conducted in a methodical way using proven methodologies to first determine if a resource exists in one or more of these locations and then to vector in on the discrete productive zone (e.g., (Coolbaugh, Sladek, Kratt, Shevenell, & Faulds, 2006);

Table 2. Structures that may host undiscovered blind geothermal systems in the County (Figure 2). Age of faulting from (USGS, 2010). Slip and dilation tendency values were obtained for each fault in the USGS Quaternary fault database (USGS, 2010) within the County from Siler (*in prep, 2014)* and are based on unit-less ratios of the resolved stresses applied to the fault plane by the measured ambient stress field. Values range from a maximum of 1, a fault plane ideally oriented to slip or dilate under ambient stress conditions, to zero, a fault plane with no potential to slip or dilate. Each structural setting includes multiple individual faults of differing orientations relative to the regional stress field and each with specific slip and dilation tendency values. Therefore, we made a qualitative assessment of the overall slip and dilation tendency of each structure as a whole using statistical variation from the Great Basin region (High = most faults >0.84, Moderate = most faults <0.84 and >0.55, and Low = most faults <0.55 and > 0.24). Structures highlighted by gray boxes indicate most favorable structures based on age of faulting and slip and dilation tendency rating.

GIS Id	Structure	Age of faulting (yrs)	Slip and Dilation Tendency Rating	Description
1	Accommodation Zone	<15,000	High	South end of synclinal accommodation zone between the east-tilted Butte Mountains and the west-tilted southern end of the Cherry Creek Range
2	Fault Termination	<15,000	High	Termination of primary range-front fault along the southeast side of the southern Cherry Creek Range terminates into Butte Valley
3	Stepover	<15,000	High	Stepover in range-front fault along the east side of the Schell Creek Range between Black Mountain and Cave Mountain
4	Stepover	<130,000	High	Stepover in range-front fault along the east side of the Schell Creek Range in the Frenchmen Creek and North Creek area
5	Fault Termination	<130,000	Moderate	Termination of range-front fault at the north end of the Snake Range
6	Stepover	<130,000	High	Stepover along the east side of the Antelope Range in the Cottonwood Canyon-Chin Creek area
7	Stepover	<15,000	High	Stepover along the east side of the Diamond Mountains/west side of Newark Valley, northeast of Diamond Peak
8	Fault Bend	<1,600,000	High	Broad fault bend in range-front along northwest end of the White Pine Range near Seligman and Mohawk Canyons
9	Fault Termination	<130,000	Moderate	Termination and possible fault bend of the range-front fault at the northwest end of the Egan Range
10	Stepover	<130,000	High	Stepover in the range-front fault along the west side of the Egan Range in the Lund area
11	Stepover	<130,000	High	Stepover in the range-front fault along the east side of the Egan Range in the Water Canyon and Dry Canyon area
12	Stepover	<15,000	High	Stepover along the southeastern end of the Diamond Mountains
13	Fault Termination	<130,000	High	Southern termination of range-front fault along the east side of the Ruby Mountains
14	Stepover	<15,000	High	Stepover along the east side of the Diamond Mountains northeast of Christina Peak in the Conners Creek area
15	Stepover	<130,000	High	Stepover along the east side of the Butte Mountains, west side of Butte Valley
16	Stepover	<1,600,000	Moderate	Stepover along the east side of the Snake Range between Chokecherry Creek and Lexington Creek
17	Fault Termination	<130,000	High	Termination of the range-front fault along the northeast end of the Schell Creek Range in the Sampson Creek area
18	Fault Bend	<130,000	High	Fault bend along the range-front fault bounding the east side of

				the Cherry Creek Range in the Indian Creek area
19	Fault Intersection	<130,000	High	Fault intersection along the northeast side of Heusser Mountain in the Egan Range and a stepover along the east side of the Egan Range at "The Cove"
20	Accommodation Zone	<15,000	High	Synclinal accommodation zone between the east-tilted northern Diamond Mountains and the southern west-tilted Ruby Mountains
21	Stepover	<130,000	High	Stepover in range-front fault along the west side of Maverick Springs Range near the northern White Pine County boundary
22	Stepover	<130,000	High	Stepover along the west side of the Butte Mountains along Long Valley Wash
23	Fault Intersection	<130,000	High	Intersecting, oppositely dipping faults at the northeast end of Black Mountain, east side of the Cherry Creek Range
24	Accommodation Zone	<750,000	High	Anticlinal accommodation zone in southeastern Newark Valley between the northeast end of the Pancake Range and the northern White Pine Range
25	Stepover	<130,000	High	Stepover in the range-front fault zone along the west side of the White Pine Range in the Lampson Canyon and Freeland Canyon area
26	Accommodation Zone	<130,000	High	Anticlinal accommodation zone between the Pancake Range and White Pine Range north-northwest of Railroad Valley
27	Fault Termination	<130,000	High	Termination of range-front fault along the northwest side of the Pancake Range
28	Stepover	<130,000	High	Fault stepover along the west side of White River Valley, southeast of Lund
29	Fault Termination	<130,000	High	Fault termination along the southeast end of the Snake Range
30	Fault Termination	<1,600,000	High	Fault termination along the west side of the Schell Creek Range northwest of Mt Grafton
31	Fault Termination	<1,600,000	High	Termination of range-front fault along the west side of the Schell Creek Range and termination of antithetic fault along the east side of the Egan Range at the south end of Steptoe Valley
32	Fault Termination	<1,600,000	Moderate	Termination of range-front fault at the south end of the Antelope Range at the north end of Spring Valley
33	Fault Bend	<130,000	High	Prominent bend in the range-front along the east side of the Egan Range, directly north of Ely
34	Accommodation Zone	<1,600,000	Moderate	Synclinal accommodation zone northwest of Murry Summit in the Egan Range
35	Fault Termination	<130,000	High	Northward termination of range-front fault along the northwest end of the Duck Creek Range and a synclinal accommodation Zone between the northern Duck Creek Range and the Schell Creek Range
36	Fault Termination	<130,000	High	Southward termination of range-front fault along the southwest corner of Jakes Valley, east side of the White Pine Range
37	Fault Intersection	<15,000	High	Fault intersection along the west side of Jakes Valley next to Moorman Ridge
38	Accommodation Zone	<1,600,000	Moderate	Accommodation zone between two southward-terminating faults bounding either side of Long Valley at the north end of the White Pine Range
39	Accommodation Zone	<15,000	High	Accommodation zone in Spring Valley between the Schell Creek Range and the southern Snake Range
40	Accommodation	<130,000	High	Possible accommodation zone between Smith Valley and

	Zone			Steptoe Valley
41	Stepover	<1,600,000	High	Northward termination of the fault zone in northeastern Antelope Valley, north of the south Mountains
42	Fault Termination	<1,600,000	High	Termination of normal fault along the southwest side of the Red Hills into the north end of Spring Valley
43	Fault Intersection	<1,600,000	High	Intersection between interbasinal fault in Antelope Valley near Red Rocks and the range-front fault along the southeast side of the Antelope Range
44	Stepover	<130,000	Moderate	Broad step-over along the east side of the Cocomongo Mountains extending from north end of the Egan Range to the Cherry Creek Range

(Faulds, Coolbaugh, Vice, & Edwards, 2006); (Kratt, Sladek, & Coolbaugh, 2010); (Hinz, Faulds, & Siler, Developing systematic workflow from field work to quantitativ 3D modeling for successful exploration of structurally controlled geothermal systems, 2013)).

The 44 favorable structural settings (or fault patterns) identified in this study are broadly distributed across the County (Fig. 2), but the nine higher priority exploration targets are restricted to three parts of the County. The nine structures include 1) three fault step-overs and one accommodation zone along the west side of Newark Valley in the western part of the County; 2) a fault intersection, an accommodation zone, and a fault termination in Butte Valley and Jakes Valley in the central part of the County; and 3) a fault step-over and accommodation zone in southern Spring Valley in the southeastern part of the County.

Deep Stratigraphic Reservoir Description

Many deep sedimentary basins throughout the world have hot water aquifers that cover very large extents. Development of such aquifers for electricity generation has generally not been feasible due to the moderate temperatures (<300° F, <150°C) and/or cost-prohibitive depths at which these reservoirs/aquifers commonly occur. However, recent documentation shows that in western Utah and eastern Nevada, these aquifers could have higher than typical temperatures of 350 to 390° F (175-200°C) at potentially economically extractible depths of 1.85 to 2.5 miles (3-4 km) (Allis, Gwynn, Kirby, & Sprinkel, 2011) (Allis, et al., 2012) (Anderson T. C., 2013) (Deo, Roehner, Allis, & Moore, 2013). The occurrence of such aquifers at such depths is made possible by the relatively high heat flow and high temperature gradients in the western United States. Thick accumulations of sediments with low thermal conductivities in intermontane basins allow for high temperature gradients to develop where conductive heat flow is high (Allis, Gwynn, Kirby, & Sprinkel, 2011) (Allis, et al., 2012) (Allis, et al., 2013). In eastern Nevada and western Utah, where heat flow reaches 80-100 mW per 11 ft^2 (80-100 mW/m^2), temperatures can reach 350 to 390° F (175-200°C) at depths of 1.85 to 2.5 miles (3-4 km, Fig. 6).

Data compiled from oil and gas drilling indicate that lower Paleozoic carbonate rocks underlie basin fill in many valleys and that these carbonates commonly have permeabilities necessary to sustain the flow rates needed for power production (Allis, et al., 2012) (Kirby, 2012). Based on

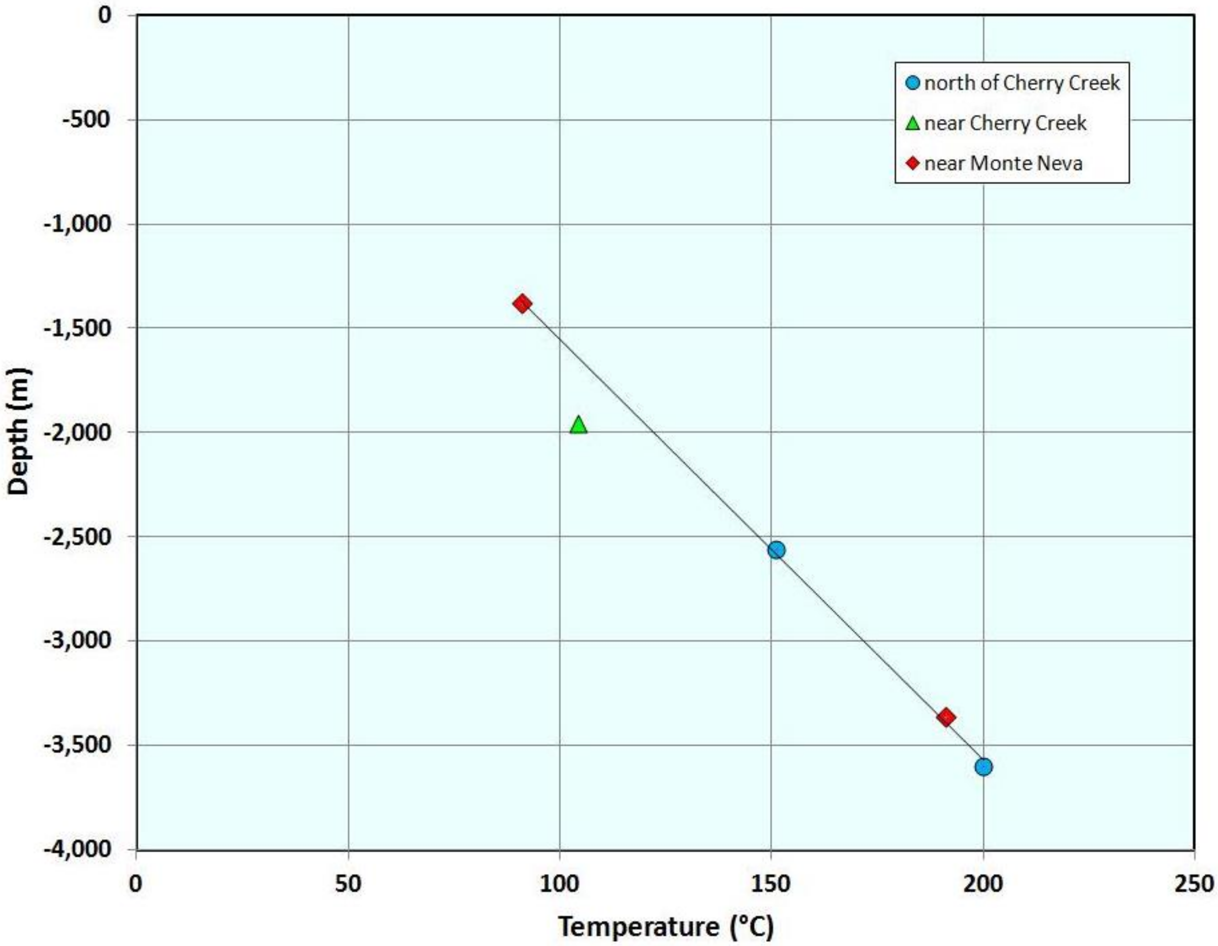

Figure 6. Graph showing relationship between depth and temperature in the northern Steptoe Valley. Potentially economic temperatures of 300 to 390° F (150 to 200° C) occur at depths of 1.6 to 2.2 miles (2.5 to 3.5 km) below surface.

available data, the most favorable valleys in the Great Basin for potential development of stratigraphic reservoirs are the Black Rock Desert in west-central Utah, the northern Steptoe Valley in White Pine County, Nevada, and the Mary's River area of Elko County, Nevada (Allis, Gwynn, Kirby, & Sprinkel, 2011) (Allis, et al., 2012). Preliminary modeling suggests that economic development of these deep aquifers is possible if sufficient permeabilities are present. The amount of produced power could range from 3 to 9 MWe per 0.38 square miles (3-9 MWe/km^2) over a period of 30 years (Allis, et al., 2013) (Deo, Roehner, Allis, & Moore, 2013). In the case of the northern Steptoe Valley, where temperatures of 375 to 390° F (190-200°C) at a depth of 2.2 miles (3.5) km have been measured in oil exploration wells (Fig. 6), it is conceivable that as much as 500 MWe of electricity could be produced, if a power density of 4MWe per 0.38 square miles (4 MWe/km^2) is assumed based on the work of (Allis, et al., 2013) and (Deo, Roehner, Allis, & Moore, 2013), and if the aquifer covers an extent of 50 square miles

(130 km^2), which is the area defined by gravity modeling with basin fill depths of 1.25 miles (2 km) or more (Jachens, Moring, & Schruben, 1996).

Available data indicate that in the County, the northern Steptoe Valley provides the best environment for possible energy production from deep stratigraphic reservoirs. The Steptoe Valley has the highest upper crustal temperature gradient in the County, based on temperature maps produced by Southern Methodist University (Fig. 7; (Coolbaugh, et al., 2005)). Estimated depths of basin fill deposits are also greatest for Steptoe Valley, based in part on modeling of regional gravity data (Fig. 7; (Jachens, Moring, & Schruben, 1996)). Direct measurements of temperatures in several oil exploration wells and deep geothermal exploration holes confirm temperatures of approximately 375 to 390° F (190-200°C) at a depth of about 2.15 miles (3.5 km) (Allis, et al., 2012) (UNR digital data). The area of principal interest extends northward in Steptoe Valley from Monte Neva Hot Springs approximately 15-20 miles (25-30 km) and corresponds to the region in Fig. 7, where the thickness of basin fill is predicted to exceed 1.25 miles (2 km). In one well (Placid oil exploration well), a thick section of lost circulation was encountered at a depth of about 1.85 miles (3 km), suggesting the possible presence of a significant thermal aquifer (Allis, et al., 2012).

Although Steptoe Valley has the best documented potential for deep stratigraphic aquifer development, insufficient data are present to adequately evaluate the potential in many valleys of the County. More detailed gravity, heat flow, and seismic reflection surveys would provide very helpful information for assessing this regional potential.

INFRASTRUCTURE REQUIREMENTS

One of the key requirements for development of electrical energy from geothermal sources is the presence of suitable transmission lines. Fortunately, the location of the 500kV AC Southwest Intertie Project (SWIP) transmission line is well placed for access to potential geothermal resources (Fig. 8). The southern half of this line, which has just been constructed, passes over Williams Hot Springs, and the northern half of the SWIP will pass directly over the potential deep stratigraphic aquifer target in northern Steptoe Valley. The SWIP will also pass within a few miles of Monte Neva and Cherry Creek Hot Springs.

Typical local infrastructure associated with geothermal power beyond regional transmission line networks includes the power plant, service and access roads, a well field, and a connecting power line to the primary transmission lines (e.g., Fig. 8). With the exception of possibly using some existing roads and the regional transmission line network (Fig. 8), the rest of the infrastructure will need to be built for each geothermal area. The well fields include multiple graded well pads, service roads, and above-ground piping to carry geothermal fluids from the production wells to the power plant and then to the injection wells (Fig. 9). The layout and size of each of these

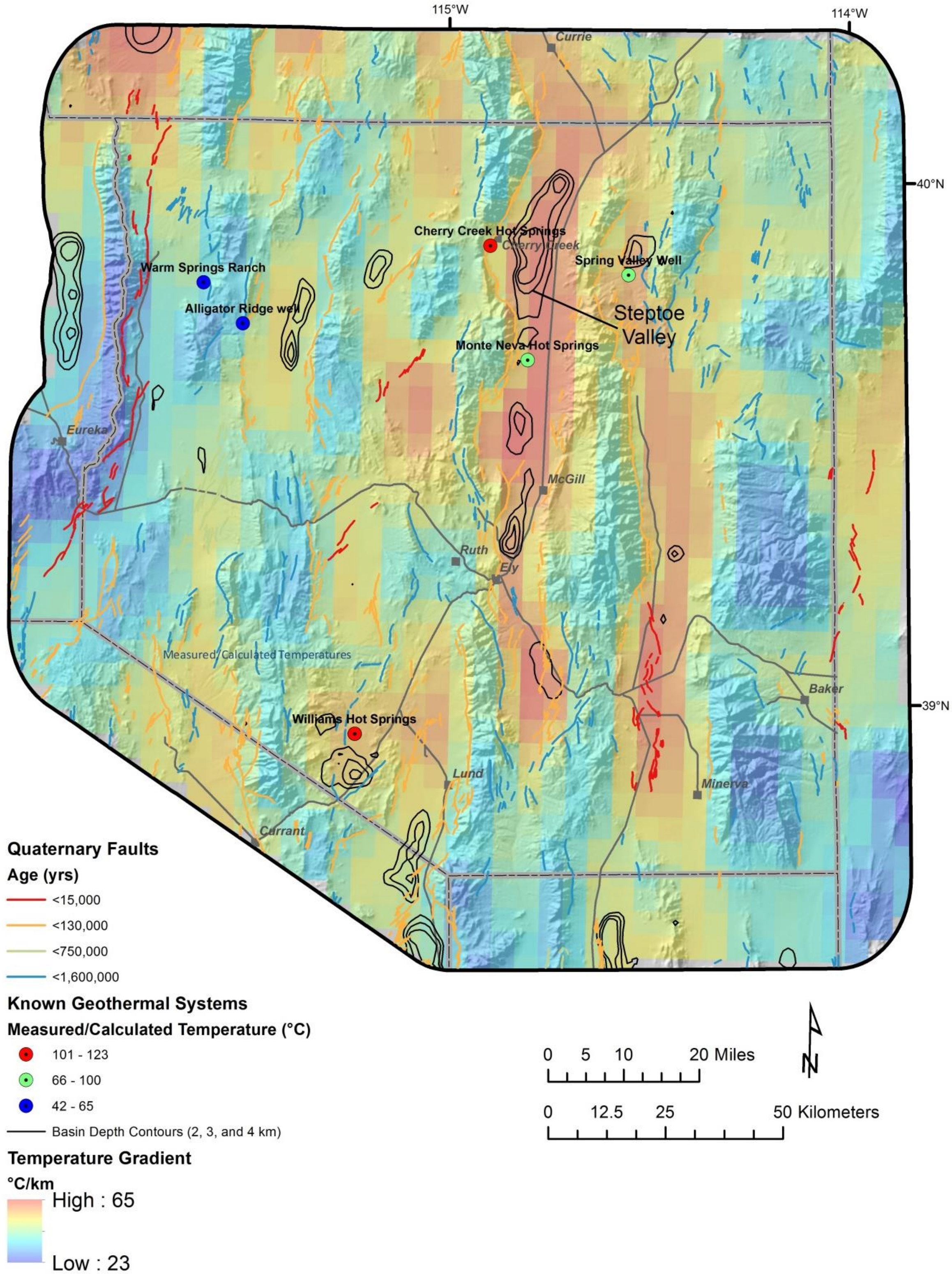

Figure 7. Shaded relief map of the County with known geothermal systems (Table 1) and Quaternary faults (USGS, 2010). Upper crustal temperature gradient provided by Southern Methodist University (Coolbaugh, et al., 2005). Estimated basin depth of poorly consolidated basin-fill sediments (black line contours) from (Jachens, Moring, & Schruben, 1996).

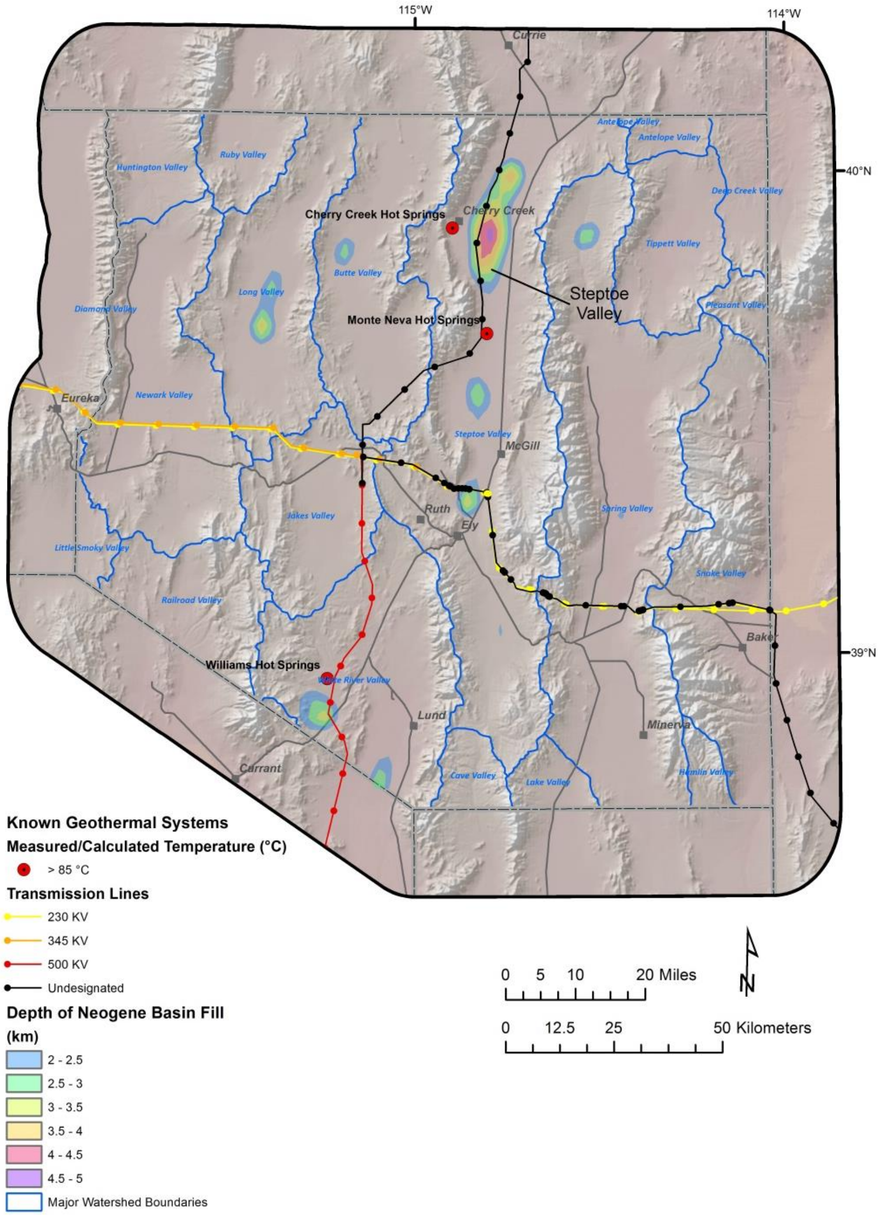

Figure 8. Map of transmission lines relative to the location of the principal geothermal resources in the County and the best potential economic geothermal systems, including Williams Hot Springs, Monte Neva Hot Springs, Cherry Creek Hot Springs, as well as the deep sedimentary reservoir in Steptoe Valley.

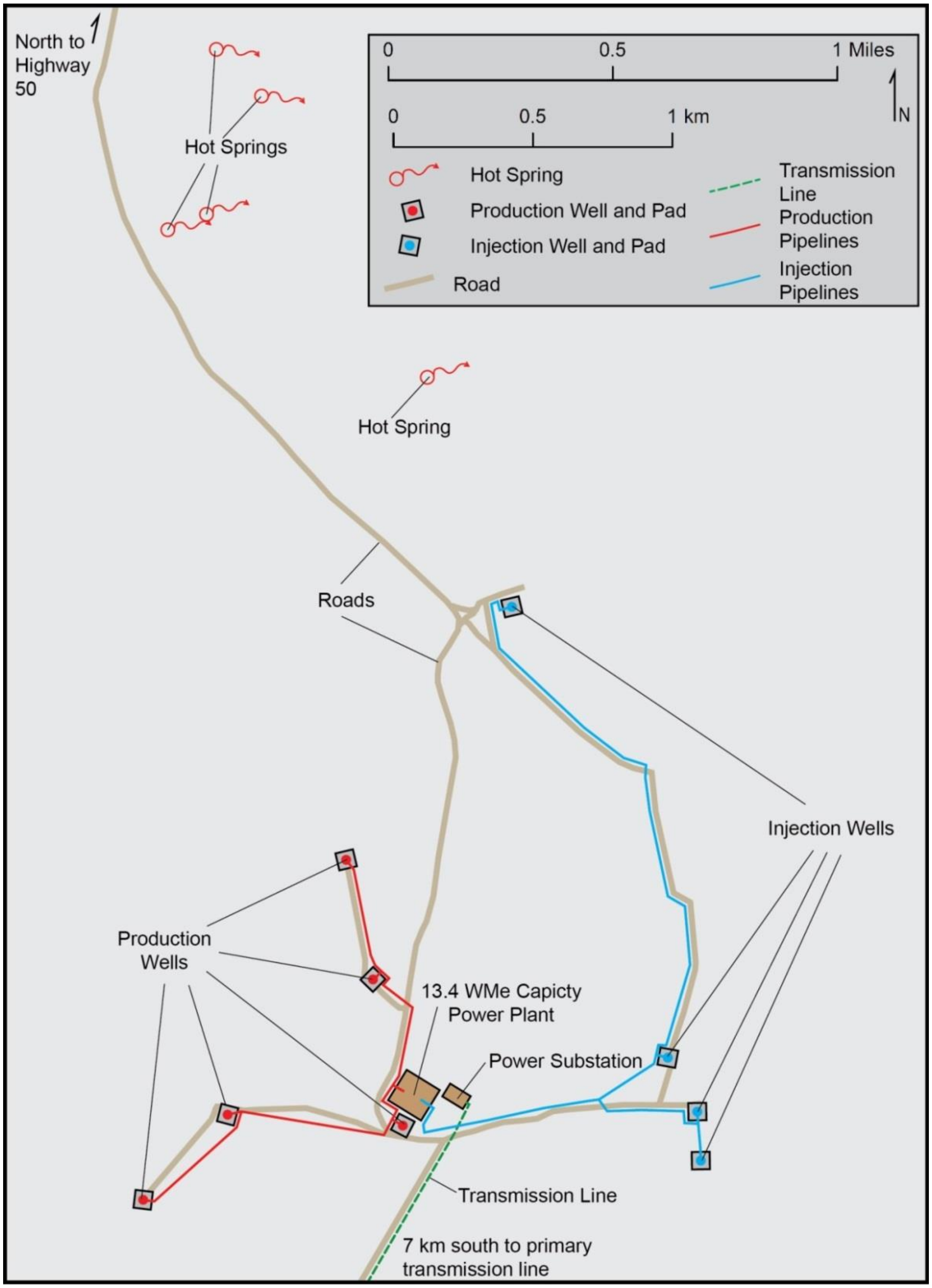

Figure 9. Generalized map showing primary infrastructure at the 13.4 MWe capacity Salt Wells geothermal power plant relative to active surface hot springs. Additional hot springs are present at the Salt Wells geothermal area to the north of this map area. The Salt Wells geothermal power plant is found in Churchill County, Nevada, is owned and operated by Enel Green Power North America, Inc., and has been in operation since 2009. This figure is a graphic illustration from a scaled map; generalized from (Coolbaugh, Sladek, Kratt, Shevenell, & Faulds, 2006), (Hinz, Faulds, & Bell, 2011), (Faulds, Hinz, Dering, & Siler, 2013), and (Hinz, unpublished).

infrastructure elements are custom designed for each geothermal area relative to the subsurface location of the productive reservoir, local topography and potential local environmental and cultural considerations. Generally, the area impacted by exploration and development of a geothermal resource is nearly identical to that involved in the operation of the power plant except that some wells may be plugged and abandoned. Well fields for existing geothermal power plants in the Great Basin region utilize from one to six or more production wells and generally fewer injection wells. In some cases, multiple production wells may be achieved with individually deviated well paths from a single well pad. In addition to production and injection wells, monitor wells may also be used to monitor fluid flow within the reservoir.

Productive geothermal reservoirs are commonly not found directly underneath surface manifestations in the Great Basin region, but are rather found within <1 to 3 miles (<1 to 5 km) laterally of the surface manifestations (e.g., Fig. 9). The three conventional, structurally controlled geothermal areas in the County with potential for power production all have active surface manifestations (hot springs). However, the reservoirs linked to these hot springs at depth have not been explored and thus the location of infrastructure necessary for exploration and development cannot be precisely constrained in this study.

ENVIRONMENTAL AND CULTURAL CONSIDERATIONS/IMPACTS (LAND AND WATER USE, ETC.)

Geothermal power plants have exceptionally small footprints (Figs. 9, 10). In the case of binary power plants (e.g., Fig. 10), which are typically utilized for resources <355° F (<180°C), carbon emissions are near zero, and all fluids from production wells are re-injected into the ground through injection wells for recirculation. Minor to moderate amounts of *makeup* water may be needed depending on the efficiency of the injected water to return to the deep hydrothermal flow system.

Geothermal wells are cased in steel and cement, and the casings are only left open at productive reservoir depths. This design restricts inflow of cold water into the production wells and also restricts contamination of shallow aquifers otherwise not naturally connected with the productive reservoir. In circumstances where a well is no longer needed, there is a procedure for proper permanent plugging and abandonment that mitigates potential groundwater contamination.

As discussed earlier in this report, the reservoirs linked to these hot springs at depth have not been explored and thus the location of infrastructure necessary for exploration and development cannot be precisely constrained in this study. Although the specific details relative to critical habitat for threatened and/or endangered species cannot be directly addressed for any geothermal area in the County as part of this study, the ability to customize the infrastructure layout at each

Figure 10. Photo of the 13.4 MWe capacity binary power plant at the Salt Wells geothermal area (Fig. 9).

geothermal area makes it possible to avoid conflicts with critical environmental habitat. In particular, deviated well-path technology allows great flexibility in well pad locations and ultimately road, pipeline, power plant, and power lines. The cumulative footprint for all parts of the infrastructure for a geothermal power plant is relatively small (Figs. 9, 10).

COMPARISON OF TECHNOLOGIES/SYSTEM REQUIREMENTS

The optimal power plant technologies for a given project are relatively easily identified once the parameters of flow rates, temperatures, depths, and pumping rates have been determined from engineering data. In White Pine County, production temperatures of potential resources are likely to be in the range in which binary power plants operate, thus minimizing need for water supplies and minimizing carbon emissions (which are small to start with).

REPRESENTATIVE PROJECT DESCRIPTION/SCENARIO

The geothermal system at Monte Neva Hot Springs provides an example of possible multi-stage renewable energy development. Monte Neva Hot Springs is one of the four most promising known resources in the County, including Williams Hot Springs, Monte Neva Hot Springs, Cherry Creek Hot Springs, and the deep sedimentary resource in Steptoe Valley east of Cherry Creek Hot Springs. All four of these areas are located within 10 miles (15 km) of the new Southwest Intertie power line.

After an initial detailed review of existing data to determine the extent of past exploration activities, the first stages of exploration could focus on the development of a 5 to 20 MWe power plant that would harvest fluids from a moderate to shallow (0.6-1.25 miles, 1-2 km) reservoir where fault-controlled convection has drawn higher-temperature fluids from depth. The knowledge learned during the development of this resource could be used to guide deeper exploration for fault-controlled permeable zones within the postulated deep carbonate stratigraphic aquifer at temperatures approaching 392° F (200°C) and depths of 1.85 to 2.5 miles (3-4 km). In this manner, development of the deep aquifer could begin by targeting the highest permeability zones intersected by faults. In parallel with the development of electricity-grade resources, the surface hot springs at Monte Neva could be developed to support greenhouses or aquaculture. The relatively high spring temperatures (174° F, 79°C) combined with high flow rates (625 gpm, (Garside & Schilling, 1979)) represent a significant heat flux well-suited for direct use heating of multiple buildings and greenhouses.

Previous geothermal exploration by Hunt Energy Corporation in the Steptoe Valley focused on an area approximately 6 miles (10 km) north of Monte Neva Hot Springs. Drilling by Hunt encountered only conductive temperature gradients, but at Monte Neva Hot Springs, a maximum temperature of 190°F (88°C) encountered in a shallow well (400 feet, 122 meter depth) drilled by Magma Power Corp. in 1965 (Garside & Schilling, 1979) is significantly higher than predicted by the conductive gradients found by Hunt, requiring the presence of a significant component of fluid convection from depth. The K-Mg and Mg-corrected K-Na-Ca geothermometers predict subsurface temperatures of 115 and 104° F (46 and 40°C), respectively, which are lower than the measured temperatures. These discrepancies, in combination with the relatively high Mg concentration of the spring water (21 mg/0.26 gallons, 21 mg/l), suggest that rising thermal fluids may be mixing with shallow, cooler groundwater. The rising thermal fluids could, therefore, have substantially higher temperatures before that mixing occurs, in turn indicating a more significant component of vertical convection.

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Appendix E: Pumped Storage Hydroelectric Resource Assessment for White Pine County – Millennium Energy, LLC.

MILLENNIUM ENERGY LLC

FINAL REPORT
Pumped Storage Hydroelectric Resource Assessment for White Pine County

Submitted to:
White Pine County
Community and Economic Development
957 Campton Street
Ely, NV 89301

In Support of:
Department of Energy Award Number DE-EE0003139
Renewable Energy Feasibility Study and Resources Assessment

Submitted by:
Joe Bourg, President
Millennium Energy LLC
Golden, Colorado 80402
Voice: (303) 526-2972
Email: jbourg@millenniumenergysolar.com
Date: December 2013

PUMPED STORAGE HYDROELECTRIC

EXECUTIVE SUMMARY

Pumped Storage Hydroelectric plants are a unique renewable energy resource. While they are overall net consumers of energy, they also provide the best form of energy storage in the market today. The plants operate by pumping water uphill into an upper storage reservoir when electricity prices are low, and generate electricity by releasing water when electricity prices are high from the upper reservoir through a penstock to a turbine located at a lower elevation. The water is then stored in a lower reservoir. Pumped storage hydro plants recover about 70-80% of the energy used to operate them.

Pumped hydro plants require very unique and specific land characteristics. They require a sufficient elevation gain between the lower and upper reservoirs, with flat areas located near the lower and upper bounds of the elevation gain to support the development of reservoirs. There are a number areas in White Pine County (County) with these land characteristics, but none that met the minimum screening criteria for the size of the project considered for this study (50 Megawatts). The 50 MegaWatt (MW) size was selected because it meets the criteria for "small hydroelectric" classification. However, if the size of the potential project were expanded along with the screening criteria, it is likely that potential projects would be identified in the County. This is evidenced by the fact that a 300 MW pumped storage hydroelectric project in the County has received initial approval from the Federal Energy Regulatory Commission.

For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they purchase power from Deseret Generation and Transmission Cooperative (Deseret), and Deseret manages the generation and transmission needs of the local utility.
- **Anticipated market prices for energy sales:** Since wholesale power price data for utilities is considered proprietary, Millennium had to estimate what the net energy sales price would be based on limited information. For this study, it was estimated that the price differential between off-peak and on-peak energy was five cents per kilowatt-hour (kWh). For the purposes of this study, it was assumed that 100% of the energy required to pump water to the upper reservoir would be purchased at the off-peak energy rate, and 80% of that energy would be recovered by the generation turbines and sold at the on-peak rate with a five cent per kWh price differential.
- **Hydroelectric resource data and expected annual energy generation potential:** The expected annual energy generation potential was estimated based on a 300 MW plant. This

value was derived from a linear scaling of the energy output of the 300 MW plant proposed within the County, based on publicly available information on the project. Based on this assessment, it was estimated that a 50 MW plant would produce 153,300 MWh per year.

- **Pumped storage hydroelectric construction and operations and maintenance (O&M) costs:** Utilizing a database developed for hydroelectric resources by Oak Ridge National Laboratories (ORNL), a 50 MW pumped storage hydroelectric plant's construction costs were estimated to be $139 Million with total annual O&M costs of $3.1 Million.
- **Financing parameters and tax incentives:** Projecting financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, seven-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the ORNL database, it was estimated that 736 construction and 6.5 O&M full-time jobs would be supported by a 50 MW pumped storage hydroelectric project.
- **Project Locations:** No potential project sites were identified that met the two critical land requirements contained in the screening criteria, and that were also located in areas within a five-mile radius of the NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines. However, projects of a larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection.

METHODOLOGY AND ASSUMPTIONS

The analysis of pumped storage hydroelectric opportunities was based on a 50 Megawatt (MW) plant size, as this was the largest plant that met the criteria for "small hydro-electric" classification. Initially, this task was designated as a study of "micro-hydro" power plants in the County, with specific emphasis on irrigation ditch-based micro-hydro. However, it was determined that this technology had limited applications and energy sales opportunities in the County, so the pumped storage hydro-electric option was substituted. Should larger size pumped storage hydro plants be considered, the values presented in this report would scale up in a linear manner.

The first step in the analysis was to review and analyze the market opportunities for pumped storage hydroelectric energy sales. Based on this review, it was determined that NV Energy would likely be the only plausible off-taker of the power. This is due the fact that the utility serving the entire County, Mt. Wheeler Power, is served by a Generation and Transmission Cooperative that provides and manages all of the local utilities power and transmission requirements. In addition, energy required to operate the plant and the energy generation sold from the plant would need to be contracted with the same utility, and transactions with out-of-state utilities would add costs to both the energy purchase and sales prices for transmission wheeling and ancillary charges. However, two high voltage transmission lines owned by NV Energy intersect the County, one from east-to-west and one from north-to-south. As a result, pumped storage hydroelectric projects in the County could potentially interconnect with one of these lines, and avoid transmission wheeling and ancillary costs if the energy were sold to NV Energy. Therefore, NV Energy was determined to be the only likely off-taker of energy from a pumped storage hydroelectric project in the County, and this assumption served as the basis for the remainder of the analyses.

The next step in the methodology was to research and determine the expected sales prices for the energy. The value of the energy from a pumped storage hydroelectric plant is in the value of its net energy output, on a marginal basis, between the cost of energy during off-peak and on-peak periods. However, wholesale cost data is not available from NV Energy, as it is proprietary. In addition, there may additional value from a pumped storage hydro plant as a firming resource for co-located renewable energy projects, as well as from providing ancillary services to the transmission system. Currently, and for the foreseeable future as natural gas prices remain low – the marginal value of energy between off-peak and on-peak is estimated at five cents per kWh. This estimate is based on current and forward looking prices of off-peak (coal) and on-peak (natural gas combined cycle combustion turbine) resources and some ancillary service value.

With respect to calculating the value of the energy output of a pumped hydroelectric storage plant, the methodology is not as simple as that for conventional renewables, as it is not just the energy output of the plant multiplied by the sales price. Pumped storage hydroelectric requires water to be pumped to the upper reservoir during low cost of energy off-peak hours, and then energy is generated during higher cost of energy on-peak hours (or when needed to firm renewable energy resources). In addition, new pumped storage hydroelectric systems are about 80% efficient, meaning that 80% of the energy generated from the turbines is recovered from the energy required to pump the water to the upper reservoir. Therefore, in the case of this 50 MW plant, the additional annual input costs (above those listed below) would be 191,625,000 kWh multiplied by the off-peak energy cost per kWh. The resulting dollar value of these input costs would then be subtracted from the gross revenues from the turbine generation output of 153,000,000 kWh multiplied by the on-peak energy sales price per kWh. The important variable in this equation is the marginal cost of energy between off-peak and on-peak energy. Assuming, that based on current and forecasted coal versus natural gas prices, that this difference is ~ five cents per kWh over the next 30 years – it was recommended that off-peak energy costs be valued at three cents per kWh and on-peak energy be valued at eight cents per kWh to arrive at a marginal cost of five cents per kWh.

The next step in the methodology was to estimate the construction and O&M costs for the hypothetical 50 MW plant. Construction costs were tabulated based on information derived from ORNL databases including cost breakdowns for capital cost, labor, land, and water. Similarly, O&M costs were derived from the same databases for fixed and variable costs, including materials, labor, insurance, and other costs. The 50 MW pumped storage hydroelectric plant assumed for this study was estimated to cost ~$139 Million including interconnection and transmission spur costs, with total annual O&M costs estimated at $3.1 Million. Complete breakdowns of construction and O&M costs are included in Appendices A and B as part of the data request responses.

In an effort to support the economic and feasibility assessments of the hypothetical 50 MW pumped storage hydroelectric project, Millennium provided input into the financing parameters (including loan terms, interest rates, and debt ratios), as well as the tax treatments of Federal and state incentives applicable to the project. Specifically, details were provided on seven-year accelerated depreciation schedules and basis determination, and treatment of the 10-year 55% property tax exemption for 10 MW+ renewable energy systems in Nevada.

The final assessment performed for this project was to develop data to assist in the economic development analyses to be completed by UNR under this project. This data development effort was based on the ORNL databases and resulted in the development of estimates of labor and benefits expenditures within the County and the state. This data assisted in determining the economic development impacts of 50 MW increments of pumped storage hydroelectric projects in the County. Key findings from this assessment were that 736 full-time employment (FTE) construction jobs would be needed to build a 50 MW project; and 6.5 FTEs would be required for O&M. Additional economic development input data is provided in Appendix B.

Finally, Millennium provided input into the mapping studies in terms of defining screening criteria and project parameters to assist in identifying potential areas for project development based on identified markets, resource potential based on land characteristics, and distance to transmission lines and substations. The resulting map for the pumped storage hydroelectric assessment indicated that no sites within the County met the overall siting criteria for a 50 MW project based on the required land characteristics, and located within a 10-mile wide corridor of the NV Energy transmission lines (i.e., five miles on either side of the transmission line), that are also located with a 5 mile radius of an existing substation. However, four sites were identified that met one of the two required land characteristic criterion, while a fifth site met neither. In addition, if larger project sizes were to be considered, this would expand the criteria for land characteristics and likely result in additional project sites being identified.

RESOURCE DESCRIPTION

The resource requirements for a pumped storage hydroelectric facility are primarily land based. For this study, Millennium worked with TerraSpectra Geomatics to develop siting criteria based on a review of planned and completed projects, and other screening studies completed in the nation and worldwide. Based on the collective research, the following criteria were developed to identify potential sites with resource potential for a 50 MW project:

Upper Reservoir Site

- Higher elevation area
- Areal extent greater than or equal to 15 acres
- Slope less than or equal to 5 degrees

Lower Reservoir Site

- Lower elevation area (valley less than or equal to 5 degrees slope)

- Assumed a point location at edge of mountains in valley was sufficient to identify a location
- No acre constraint used
- Point was used to measure distance to closest part of the upper reservoir site

Distance between upper reservoir and lower reservoir

- Less than or equal to 1000 feet

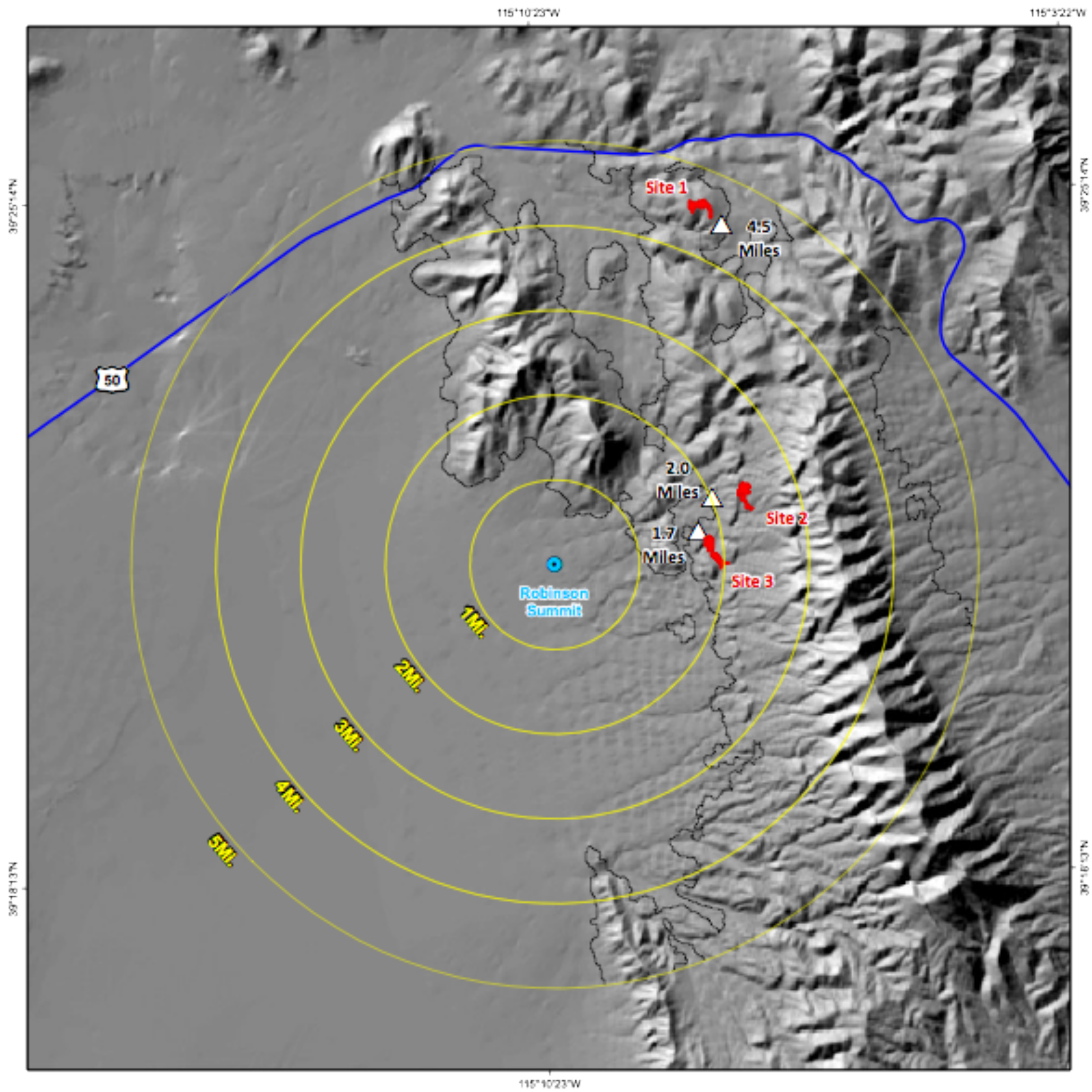
Distance between lower reservoir point (presumably the power station is located near here) and closest substation

- Less than or equal to 5.0 miles

Outside of excluded lands

RESOURCE LOCATION

As seen in the above screening criteria for resource potential based upon land characteristics, siting of a pumped storage hydroelectric plant is highly site specific. The initial screening was based on analysis of land areas within a five mile radius of an existing 230kV or greater substation, and where a site within a montane area had 15 or more contiguous acres with a maximum slope of 5 degrees. From this starting point five potential resource areas were identified. Each area was then compared to the closest montane-intermontane interface point to determine the horizontal and vertical distance. The assumption is that any montane-intermontane interface point is sufficient to locate the lower reservoir because the intermontane area was defined as less than or equal to five degrees, and therefore had sufficiently low slope anywhere for a lower reservoir. Based on these criteria, no potential sites were identified in the County for a 50 MW project. However, additional sites with resource potential may be identified if the project size was made larger, and the screening criteria expanded. Figures 1, 2, and 3 below illustrate the five initial sites that were identified via the GIS-based screening that met some of the site screening criteria. Figure 4 identifies where these sites are located within the County.

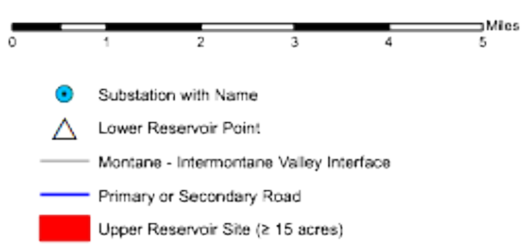


Site	Acres	Distance from Upper Reservoir Polygon to Lower Reservoir Point (Ft)	Elevation Difference between Upper Reservoir Polygon and Lower Reservoir Point (Ft)
1	16.0	712	79
2	16.0	1576	240
3	19.1	559	62

Numbers in red meet criteria of upper and lower reservoirs within 1000 ft. and elevation difference of at least 164 ft (50m).

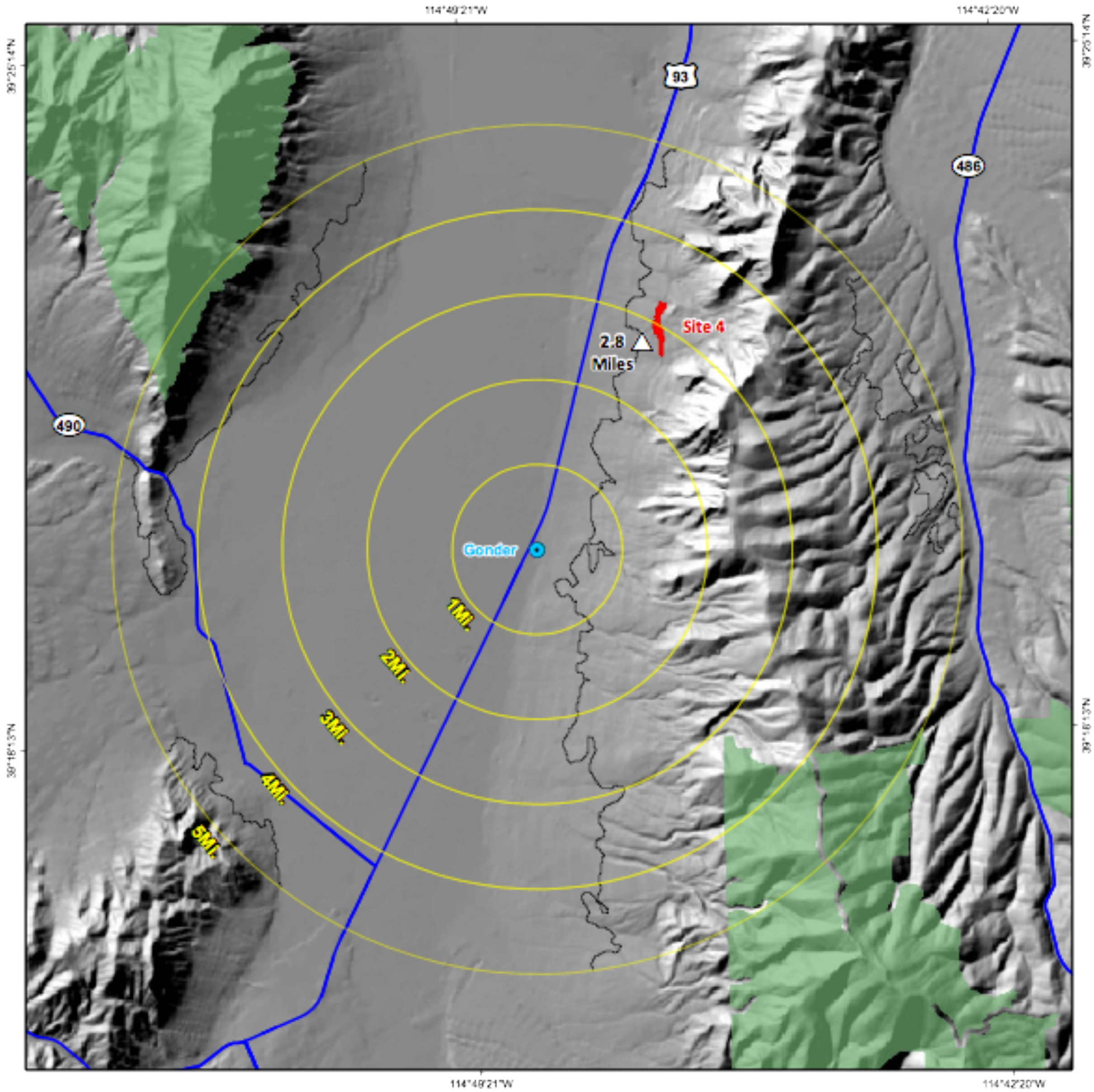
POTENTIAL MICRO-HYDRO PUMPED STORAGE SITES

within 5 Miles of Robinson Summit Substation



TSG-13180.1

Figure 1 Initial Screening - Pumped Storage Hydroelectric Sites within Five Miles of the Thirty Mile and Robinson Substations



Site	Acres	Distance from Upper Reservoir Polygon to Lower Reservoir Point (Ft)	Elevation Difference between Upper Reservoir Polygon and Lower Reservoir Point (Ft)
4	24.0	882	108

Number in red meets one of criteria of upper and lower reservoirs within 1000 ft. and elevation difference of at least 164 ft (50m).

POTENTIAL MICRO-HYDRO PUMPED STORAGE SITES

within 5 Miles of Gonder Substation

0 1 2 3 4 5 Miles

Substation with Name

Lower Reservoir Point

Montane - Intermontane Valley Interface

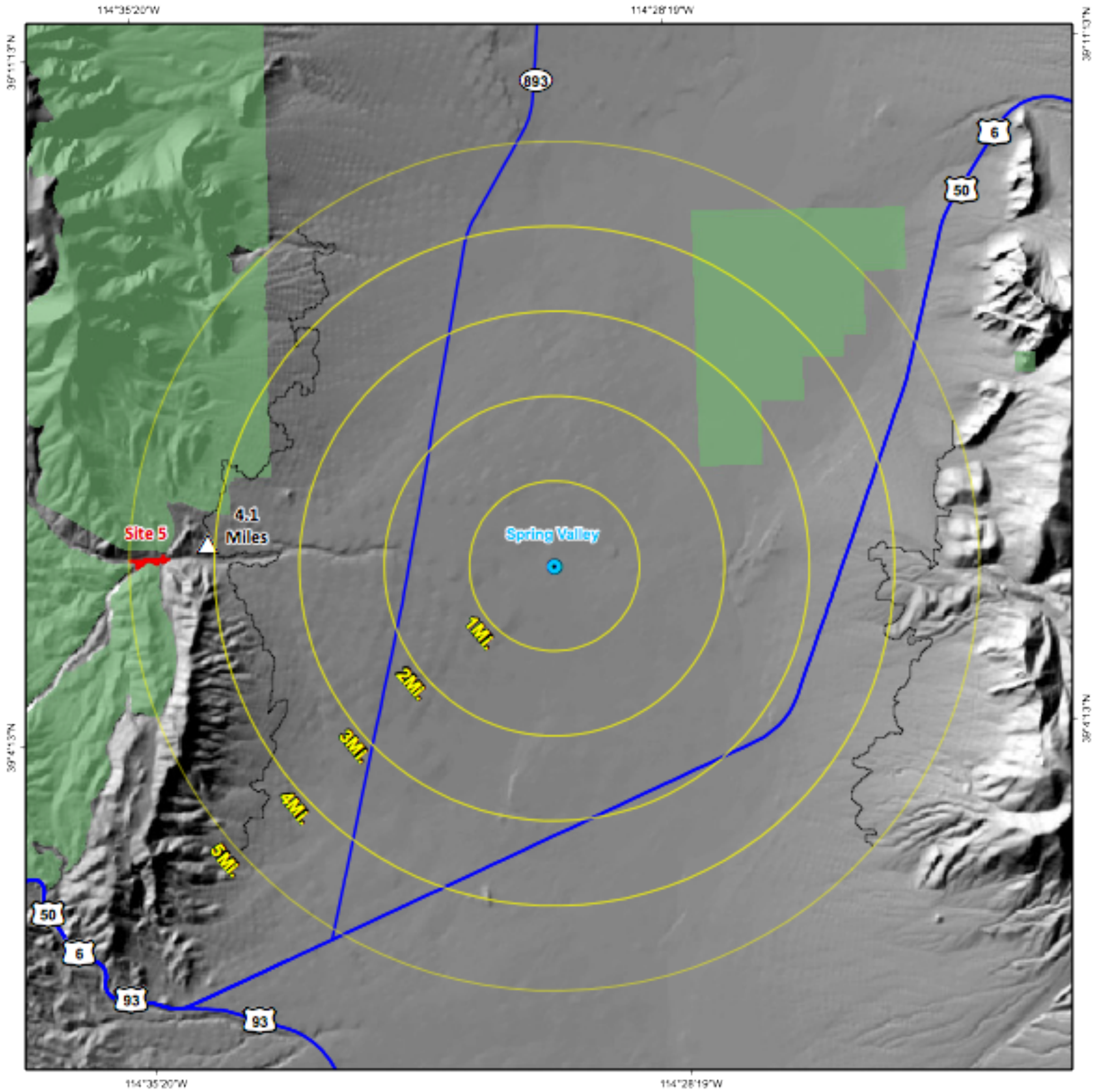
Primary or Secondary Road

Upper Reservoir Site (≥ 15 acres)

Excluded Lands

TSG-13181.1

Figure 2 Initial Screening - Potential Pumped Storage Hydroelectric Sites within Five Miles of the Gondor Substation



Site	Acres	Distance from Upper Reservoir Polygon to Lower Reservoir Point (Ft)	Elevation Difference between Upper Reservoir Polygon and Lower Reservoir Point (Ft)
5	15.7	2561	18

This site does not meet criteria of upper and lower reservoirs within 1000 ft. and elevation difference of at least 164 ft (50m).

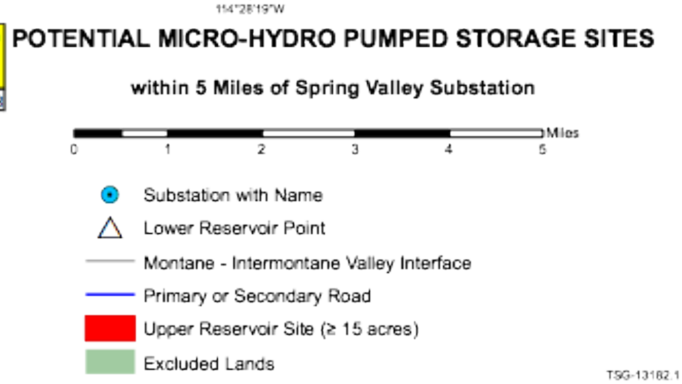


Figure 3 Initial Screening - Potential Pumped Storage Hydroelectric Site within Five Miles of the Spring Valley Substation

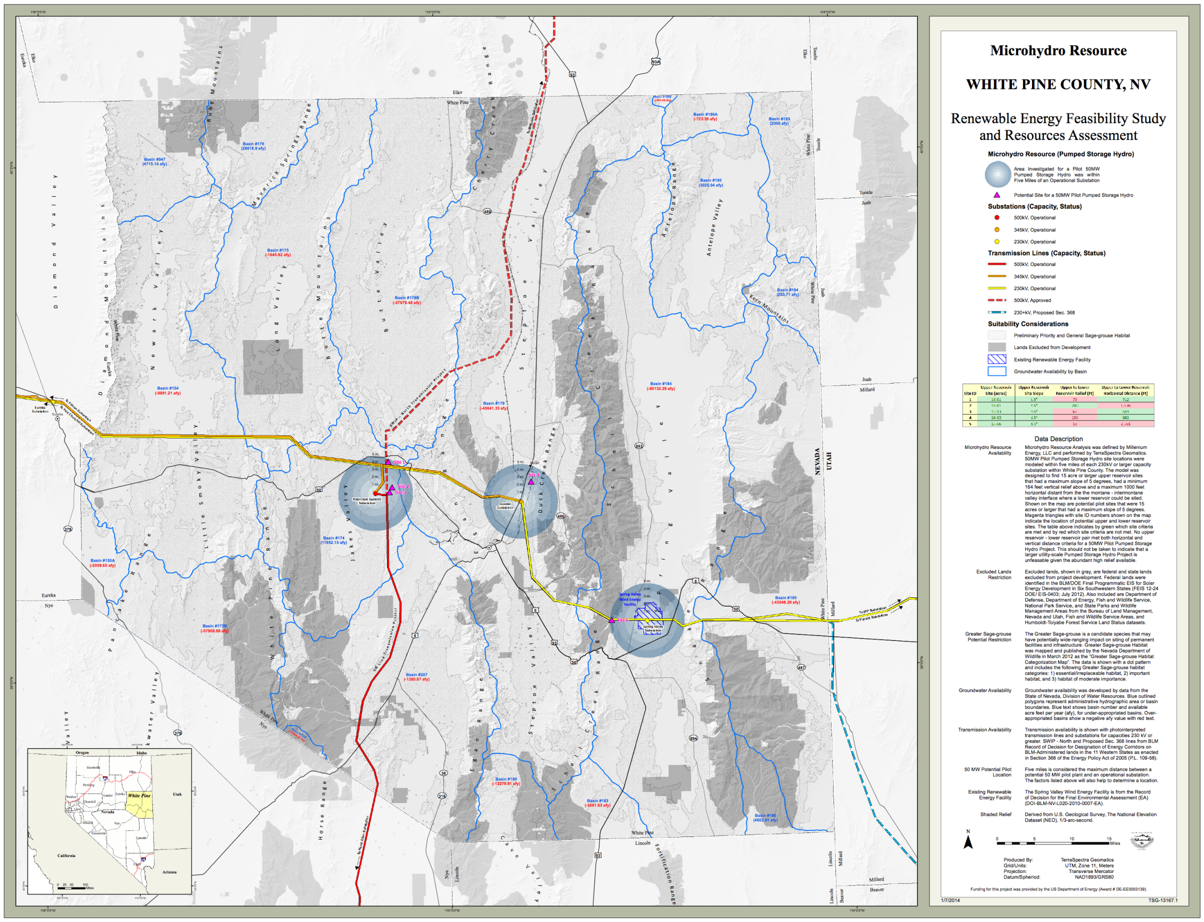


Figure 4 Initial Screening – Locations of Potential Pumped Storage Hydroelectric Sites In White Pine County

INFRASTRUCTURE REQUIREMENTS

The infrastructure requirements for a pumped storage hydroelectric plant are extensive compared to other renewable energy projects. As with all renewable energy projects, a major requirement will be the interconnection equipment and a transmission spur to interconnect with the NV Energy high-voltage transmission system. In addition, any project connecting directly to a high-voltage transmission line would require a substation, and would likely have to be larger in size than 50 MW in order to justify the additional cost.

Beyond the interconnection equipment, paved roads will be required. Construction of a pumped storage hydroelectric facility is a massive undertaking, and will require large construction equipment and vehicles, such as cement mixers. In addition, access to local rail lines may be required to facilitate transportation of large power generation equipment. The most important infrastructure requirement is long-term access to water. Large amounts of water will be required to fill the reservoirs, as well as to top them off periodically as water will be lost to evaporation and other system losses. For this study, it was assumed that the project owner would purchase water rights that would serve the project's needs over a 30-year period.

ENVIRONMENTAL AND CULTURAL CONSIDERATIONS/IMPACTS

A comprehensive environmental assessment will be required in the planning stages of a pumped storage hydroelectric facility. These facilities require large amounts of land and have a considerable impact on the landscape. Upper and lower reservoirs need to excavated and constructed, as well as tunnels. Penstocks need to constructed and set in place. Power control facilities need to be constructed. All of these activities can have considerable impacts on the land, and studies will be required to ensure that no protected flora or fauna will be disturbed, and that any potential impacts are mitigated. In addition, studies will be required to ensure that no cultural artifacts would be impacted.

In addition, pumped storage hydroelectric projects require massive amounts of water. This could potentially be an issue depending on the availability and cost of water in a water-constrained area such as White Pine County.

COMPARISON OF TECHNOLOGIES/SYSTEM REQUIREMENTS

Pumped storage hydroelectric projects utilize technology that has been commercially proven for decades. All pumped storage hydroelectric projects utilize similar designs and technologies. Therefore, for this study, a scaled down version of the proposed 300 MW project near Ely was used as a representative example of conventional technology.

REPRESENTATIVE PROJECT DESCRIPTION

Based on the research, analyses, and evaluations completed for this study, the following pumped storage hydroelectric plant characteristics were specified for this study, and were used to the support evaluation of the economic and economic development opportunities for the County.

- 50 MW nameplate capacity pumped storage hydroelectric facility
- Annual energy generation of 153,300 MWh
- Pumped storage hydroelectric system components
    - 50 MW reversible hydroelectric turbines
    - Powerhouse and control facility
    - Upper and lower reservoirs
    - Penstock and tunnel connecting upper and lower reservoirs
- Located within a five-mile radius of NV Energy transmission lines, within a five-mile radius of existing substations connected to NV Energy transmission lines, and on land which meets the siting criteria for a 50 MW project.

APPENDIX A

DATA REQUEST FEASIBILITY ANALYSIS

for

PUMPED STORAGE HYDROELECTRIC PLANTS

This data response form is in support of the stochastic feasibility analysis. Below are some assumptions of the pumped storage hydroelectric power pant:

Power Plant 50 Mega-Watts

- Assumes that at this level, larger capacity sizes are approximately linear in scale in terms of economies of scale and production values

Length of Feasibility Analysis 30 Years

- Typically, the lifecycle analysis is set to the expected system life (i.e., pumped storage hydroelectric = 30 years)

Assumed rate of return by investors 10-15%

Assumed Rate of Return by Investors 10-15%

- Due to the highly competitive nature of the renewable energy industry in the current market, ROIs in the 10-15% range are common.

REVENUE DATA:

POWER PRODUCTION: Similar to the other resource assessments, renewable energy production values are typically derived by calculating the annual production value, including downtime for schedule and maintenance and unscheduled interruptions. For this analysis, we derived the annual production values from the recent preliminary FERC approval of a 300 MW pumped storage hydro project near Ely, Nevada (located within the study area). Based on the estimated annual energy output from the Ely project, a similar, but smaller 50 MW project would generate an estimated 153,300,000 kWh per year.

PRICES OF OUTPUT: With respect to calculating the value of the energy output of a pumped hydro storage plant, the methodology is not as simple as that for conventional renewables, as it is not just the energy output of the plant multiplied by the sales price. Pumped storage hydroelectric requires water to be pumped to the upper reservoir during low cost of energy off-peak hours, and then energy is generated during higher cost of energy on-peak hours (or when needed to firm renewable energy resources or to provide grid support). In addition, newer pumped storage hydro systems are about 80% efficient, meaning that 80% of the power generated from the turbines is recovered from the power required to pump the water to the upper reservoir. Therefore, in the case of this 50 MW plant, the additional annual input costs (above those listed below) would be 191,625,000 kWh multiplied by the off-peak energy cost per kWh. The resulting dollar value of these input costs would then be subtracted from the gross revenues from the turbine generation output of 153,000,000 kWh multiplied by the on-peak energy sales price per kWh. The important variable in this equation is the marginal cost of energy between off-peak and on-peak energy. Assuming, that based on current and forecasted coal versus natural gas prices[1], that this difference is ~ five cents per kWh over the next 30 years – it was recommended that off-peak energy costs be valued at three cents per kWh and on-peak energy be valued at eight cents per kWh to arrive at a marginal cost of five cents per kWh.

GOVERNMENT PAYMENTS or SUBSIDIES: Pumped storage hydroelectric plants qualify for the Federal Modified Accelerated Cost Recovery Mechanism (MACRS). MACRS allows for pumped storage plants to be depreciated over 7 years[2]. Unlike other renewables, pumped storage hydro does not qualify for investment or production tax credits, therefore its depreciation basis is the total plant cost. This net basis is then depreciated according to the following schedule[3]:

Year 1: 14.3%

Year 2: 24.5%

Year 3: 17.5%

Year 4: 12.5%

Year 5: 8.9%

Year 6: 8.9%

Year 7: 4.5%

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[1] (Lawrence, 2013)

[2] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)

[3] (Murray State University)

At the state level, there is a property tax abatement of 55% for 20 years for hydro systems over 10 MW, hence qualifying this hypothetical facility[4].

COSTS: Construction and O&M cost data were derived via Marshall Goldberg of MRG Associates via an unpublished Oak Ridge National Laboratories database on hydroelectric plants that will be published as part of an upcoming version of the National Renewable Energy Laboratories (NREL) Jobs and Economic Development Impact (JEDI) model.

FIXED COST OF PLANT: This would cover the below:

Book Value Estimate of Plant and Transmission Lines $ 139,235,415

- Assumes 5 miles of transmission line to interconnection point

Plant Cost $ 137,414,965

Capital Replacement Annually $ 500,000

- Assumes that annual capital replacement funds are put into escrow in an interest-bearing account that is equal to the inflation rate.

Land Value (*land and water rights*) $ 1,500,000

- Assumes water rights cover water costs over 30 year period

Amount of Down Payment for Plant $ 41,770,624

- Assumes 30% down and the remainder is debt financed

Length of Loan (years) 20 years

Interest Rate on Plant Loan (%) 5 %

Any Government Loan Assistance $ 0

OTHER COSTS:

Annual Variable Costs (including labor) $ 2,605,143

- Includes production based O&M costs plus insurance

[4] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)

- Does not included property tax @ 45% of assessed value due to 55% abatement for first 20 years of operation

REFERENCES

Interstate Renewable Energy Council / North Carolina Solar Center. (2013). Federal Incentives / Policies for Renewables / Efficiency: Modified Accelerarated Cost Recovery System (MACRS) + Bonus Depreciation (2008-2015). (I. R. Center, Producer) Retrieved October 24, 2013, from Datebase of State Incentives for Renewables and Efficiency (DSIRE): http://www.dsireusa.org/incentives/incentive.cfm?Incetive_Code=US06F&re=1&ee=1

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Additional Note: Construction and O&M data was provided via Marshall Goldberg of MRG Associates. Data was derived from detailed system and cost data from Oak Ridge National Laboratory data sets that will soon be published as part of an updated NREL JEDI model for hydropower resources.

APPENDIX B
DATA for ECONOMIC IMPACT ANALYSIS

ENERGY SOURCE: **Pumped Storage Hydroelectric – 10 MW**

CONSTRUCTION COSTS:

(1) Estimated Total Construction Costs: **$ 139,235,415**

- Total Construction Costs includes land and labor expenditures

(2) Percentage of Total Construction Costs that is Labor
And Benefits **22.9%**

(3) Percentage of Labor and Benefits Costs that are
Benefits **28.8**%

(4) Number of Construction Employees **736 FTE**

(5) Percentage of Construction Employees that Live
In White Pine County **10**%

(6) Percentage of Construction Employees that Live
In the State of Nevada **90**%

- Does not include employees that live in White Pine County)

(7) Percentage of Construction Costs LESS Labor
And Benefits Spent in White Pine County **3.7**%

(8) Percentage of Construction Costs LESS Labor

And Benefits Spent in the State of Nevada **51.9**%

- (Does not include costs spent in White Pine County)

ANNUAL OPERATION COSTS:

- Data does not include debt or equity payments

1) Estimated Total Annual Operation Costs: **$2,605,143**

(2) Percentage of Total Operation Costs that is Labor

and Benefits **21.6**%

(3) Percentage of Labor and Benefits Costs that are

Benefits **28.8**%

(4) Number of Operation Employees **6.5 FTE**

(5) Percentage of Operation Employees that Live

In White Pine County **100**%

(6) Percentage of Operation Employees that Live

In the State of Nevada **0%**

- Does not include employees that live in White Pine County

(7) Percentage of Operation Costs LESS Labor

And Benefits Spent in White Pine County **0**%

(8) Percentage of Operation Costs LESS Labor

And Benefits Spent in the State of Nevada **78.4**%

- Does not include costs spent in White Pine County

References

The data provided in the support of the economic impact analysis was derived via Marshall Goldberg of MRG Asssociates from a Oak Ridge National Laboratories hydroelectric database that is currently unpublished. This database will be incorporated into an upcoming version of the National Renewable Energy Laboratories (NREL) Jobs and Economic Development Impact (JEDI) model for its new hydroelectric module.

Appendix F: Solar Photovoltaic Resource Assessment for White Pine County – Millennium Energy, LLC

MILLENNIUM ENERGY LLC

FINAL REPORT
Solar Photovoltaic Resource Assessment for White Pine County

Submitted to:
White Pine County
Community and Economic Development
957 Campton Street
Ely, NV 89301

In Support of:
Department of Energy Award Number DE-EE0003139
Renewable Energy Feasibility Study and Resources Assessment

Submitted by:
Joe Bourg, President
Millennium Energy LLC
Golden, Colorado 80402
Voice: (303) 526-2972
Email: jbourg@millenniumenergysolar.com
Date: December 2013

PHOTOVOLTAIC SOLAR

EXECUTIVE SUMMARY

White Pine County (County) is home to an abundant solar resource that provides opportunities for development of solar photovoltaic (PV) power plants, and associated economic development. For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they are unregulated and not subject to state RPS regulations, and sales outside of Nevada would likely be uncompetitive due to additional transmission service costs.
- **Anticipated market prices for energy sales:** Based on historical sales prices to NV Energy and current PV plant costs, PV-based energy sales prices were estimated to be in the eight to nine cent per kilowatt-hour (kWh) range, with a mid-point price of 8.5 cents per KWh.
- **Solar resource data and expected annual energy generation potential:** Based upon modeling of a 10 MW PV plant utilizing the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM), it was estimated that the first year's annual energy generation would be 20,075 MegaWatt-hours (MWh), and would decline 0.5% per year due to PV panel degradation.
- **PV construction and operations and maintenance (O&M) costs:** Utilizing the NREL Jobs and Economic Development Impact (JEDI) and SAM models, the PV construction cost was estimated to be $26.7 Million with annual O&M costs of $230,000.
- **Financing parameters and tax incentives:** Project financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, five-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the NREL JEDI model, it was estimated that 35 construction and one O&M full-time jobs would be supported by a 10 MW PV project.
- **Project Locations:** Potential project locations were limited to areas within a five-mile radius of NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines, and within the southern portion of the county due to the better solar resource. It should be noted that projects of larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a required substation for interconnection.

METHODOLOGY AND ASSUMPTIONS

The analysis of PV opportunities was based on a 10 Megawatt (MW) plant to provide a consistent comparison among the renewable resource technologies. In addition, 10 MW is typically of sufficient size to analyze, such that the results would scale up in a linear manner if larger system sizes were to be considered.

The first step in the analysis was to review and analyze the market opportunities for solar PV energy sales. Based on this review, it was determined that NV Energy would likely be the only plausible off-taker of the energy. This is due to the fact that the utility serving the entire County, Mt. Wheeler Power, is an unregulated rural electric cooperative. As such, Mt. Wheeler is not subject to the State of Nevada Renewable Portfolio Standard (RPS) requirements, and therefore would not be a candidate for renewable energy purchases from projects located in the County. In addition, selling to out-of-state utilities is not an economic option due to costs that would be incurred related to transmission wheeling and other transmission-related ancillary charges. Since PV plants compete in a highly competitive market, adding additional transaction costs to energy sales prices would make the overall sales price non-competitive in out-of-state markets. However, two high-voltage transmission lines owned by NV Energy intersect the County, one from east-to-west and one from north-to-south. As a result, PV projects in the County could potentially interconnect with one of these lines, and avoid transmission wheeling and ancillary costs if the energy were sold to NV Energy. Therefore, NV Energy was determined to be the only likely off-taker of energy from a PV project in the County, and this assumption served as the basis for the remainder of the analyses.

With NV Energy as the assumed off-taker of energy from the potential 10 MW PV plant, the next step was to research and determine expected sales prices for the energy. Currently, the market for large-scale PV energy sales to NV Energy is in a state of flux as regulatory considerations are sorted out. With NV Energy currently ahead of schedule with respect to its RPS requirements, the utility has not awarded a solar power purchase agreement (PPA) since 2011. PPA prices in 2011 were in the low nine-cent per kWh range. Since then, PV system costs have come down somewhat, as have PPA prices in neighboring states. Based on these facts, PV energy sales prices were estimated to be in the eight to nine-cent per kWh range, with the midpoint of 8.5 cents per kWh recommended as the sales price for the economic analysis. These sales prices were assumed to be without annual escalation factors, as NV Energy has historically required that all PPA bids be offered at a fixed price for the 20-year contract duration (although this may or may not change in the future).

The next step in the PV resource assessment for the County was to review and analyze the solar resource, develop a basic conceptual design of a 10 MW plant, and model the annual energy generation resulting from plant operations. For this assessment, Millennium utilized the National Renewable Energy Laboratory's (NREL) System Advisor Model (SAM), to incorporate the weather and resource data for the County, specify PV system components, and model the output. Based on weather and resource data for the Ely area, it was determined that a 10 MW single-axis tracking PV system would generate approximately 20,075 MWh annually.

Once the off-taker, sales price, and output values were ascertained, Millennium began collecting data on construction and O&M costs for a hypothetical 10 MW plant. Construction costs were tabulated based on information derived from NREL's JEDI and SAM models and included cost breakdowns for capital cost, labor, and land. Similarly, O&M costs were derived from the same models for fixed and variable costs, including materials, labor, insurance, and other costs. The 10 MW PV system assumed for this study was estimated to cost ~$26.7 Million including interconnection and transmission spur costs, with annual O&M costs estimated at $230,000. Complete breakdowns of construction and O&M costs are included in Appendices A and B, as part of the data request responses.

In an effort to support the economic and feasibility assessments of a hypothetical 10 MW PV project, Millennium provided input into the financing parameters (including loan terms, interest rates, and debt ratios), as well as the tax treatments of Federal and state incentives applicable to the project. Specifically, details were provided on Federal tax credits, five-year accelerated depreciation schedules and basis determination, and treatment of the 10-year 55% property tax exemption for 10 MW+ renewable energy systems in Nevada.

The final assessment performed for this project was to develop data to assist in the economic development analyses to be completed by UNR under this project. This data development effort was based on the NREL JEDI databases and resulted in the development of estimates of labor and benefits expenditures within the County and the state. This data assisted in determining the economic development impacts of 10 MW increments of solar PV projects in the County. Key findings from this assessment were that 35 full-time employment (FTE) construction jobs would be needed to build a 10 MW PV project; however, due to the low O&M requirements of a PV plant, only 1 FTE would be required for O&M. Additional economic development input data is provided in Appendix B.

Finally, Millennium provided input into the mapping studies in terms of defining screening criteria and project parameters to assist in identifying potential areas for project development based on identified markets, resource potential, and distance to transmission lines. The resulting map for the PV resource assessment indicates that areas within a 10-mile wide corridor of the NV Energy east-west or north-south transmission lines (i.e., five miles on either side of the transmission line) in the southern portion of the County have potential for PV development, that are also located with a 5-mile radius of an existing substation. While most areas in the southern portion of the County meet the minimum threshold for solar resource potential, the commercially developable areas are limited based on the properties' proximity to NV Energy transmission lines and substations. However, this proximity is based on a 10 MW sized project, and projects of a significantly larger scale could potentially by developed that interconnect directly with the NV Energy transmission lines – as larger projects could potentially absorb the cost of building a required substation for interconnection at the high voltage transmission level.

RESOURCE DESCRIPTION

White Pine County has an abundant solar resource to fuel potential PV projects. On a nation-wide basis, the County has some of the best solar resource potential. However, the market for solar energy sales in Nevada is NV Energy, and this market is statewide. As such, PV projects in the northern half of the state must compete with projects in the southern half of the state, in most cases. While the solar resource in the White Pine County is high, the solar resource in southern Nevada is higher. This is an important consideration since, all factors being equal for a PV plant (i.e., PV system components and cost), a PV plant in southern Nevada will produce energy more cheaply than an identical plant in the north. This is due to the fact that more solar insolation hits a square meter in southern Nevada than in northern Nevada, hence more power is generated per unit area in the south than in the north. This means that in order to compete statewide, a PV plant in the north would need to be built with lower capital costs and/or with more efficient equipment to minimize cost and maximize system performance.

The County's solar resource is comparable to most counties at similar latitudes in Nevada. The PV solar resource is typically evaluated based on its Global Tilt Irradiance (GTI) value. GTI is the amount of solar irradiation that reaches a tilted surface on the earth that is tilted at the location's latitude. Its value is measured in terms of $kWh/m^2/day$. For White Pine County, the GHI ranges from approximately 5.5 to 6.5. For project screening purposes, the higher the GHI value the better, since more energy will be generated per unit area in locations with higher GHI values. It should be noted that a GHI value of 6.0 was designated as the minimum threshold criteria for PV project consideration. The GHI gradually decreases as one moves north within the County, with the northern regions having the lowest DNI values. Therefore, screening for potential PV project sites in the county needs to consider the GHI values. While a GHI value of less than 6.0 in some areas of the country may be considered an excellent resource, it would likely not be enough to develop a competitive project in Nevada, or within the county given the higher GHI values in the southern portions of the County.

RESOURCE LOCATION

As mentioned previously, many areas in White Pine County meet the minimum threshold GTI value of 6.0. However, not all areas of the County are considered potential sites for PV development due to market factors and differences in the solar resource. These two factors limited the areas that were considered for PV development potential under this study. Firstly, since NV Energy was determined to be the most likely off-taker of the energy from any project in the County, any potential project sites must be located within a reasonable distance (i.e., five miles) of one of NV Energy's east-west or north-south transmission lines. Secondly, while all areas of the county have a good solar resource, the highest solar resource areas are in the southern portion of the County. Based on these two factors alone, it was determined that potential resource locations for PV plants would be located along a 10 mile corridor of NV Energy's transmission lines, within five miles of existing substations, and with a preference for locations within the corridors that are co-located in the southern portion of the County. Figure 1, below illustrates the resulting resource locations determined from this study.

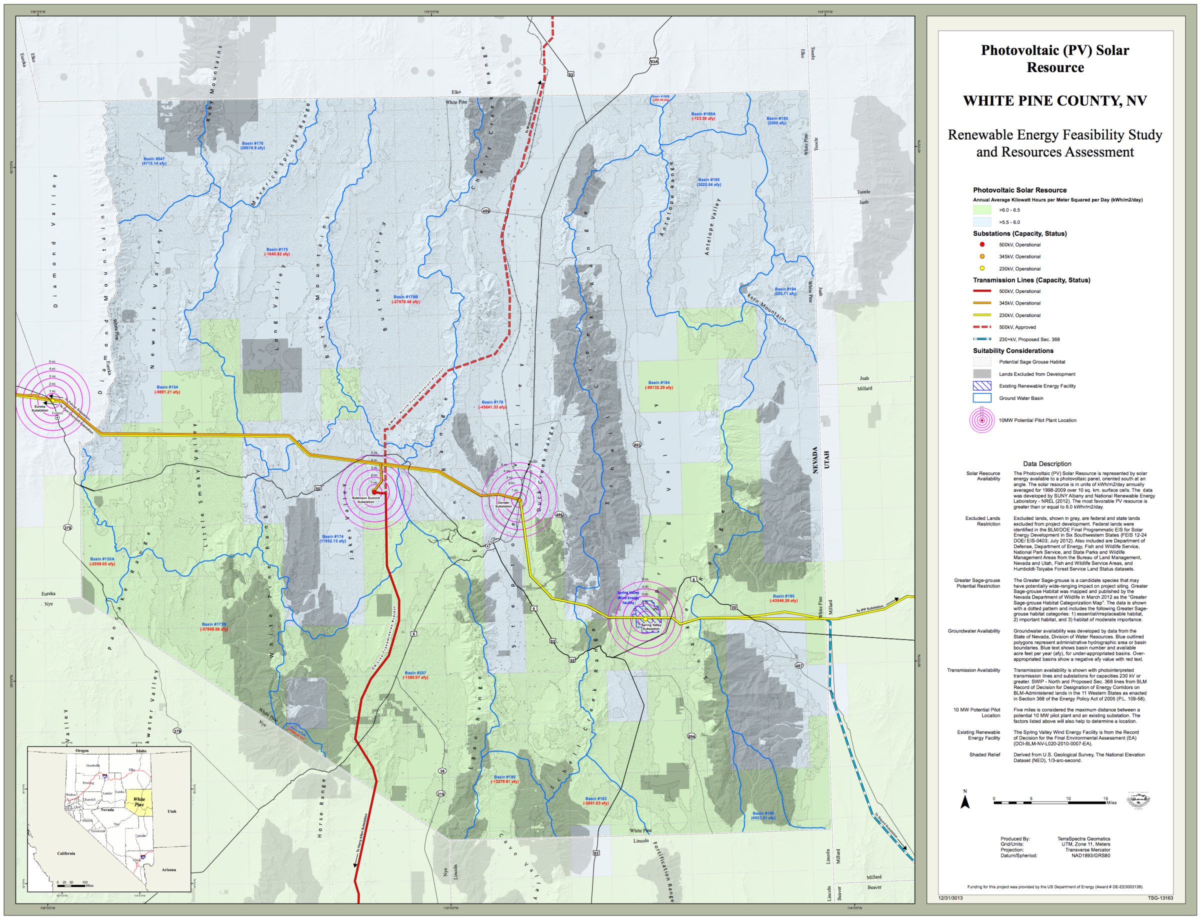

Figure 1 PV Resource Locations

INFRASTRUCTURE REQUIREMENTS

Compared to other renewable generation technologies, PV has minimal infrastructure requirements. The biggest and most expensive infrastructure requirement will be the interconnection equipment and spur line connecting to a substation interconnected with the NV Energy high-voltage transmission system. However, this requirement is common to all of the electricity producing renewable resources considered by this study. In addition, any project connecting directly to a high voltage transmission line would require a substation and large step-up transformers, and would likely have to be significantly larger in size in order to justify the additional cost.

Beyond the interconnection equipment, the infrastructure requirements are marginal. During the construction phase, passable dirt roads are required to deliver the PV system components and construction equipment, as well as to allow for water trucks to reach the site for dust control. Access to water at the site is desirable, but not critical as water can be trucked in. Fencing would also be required during construction, as well as on-site security personnel to prevent theft.

Once the plant is complete, in addition to the interconnection infrastructure, road access will be required to allow for water trucks (for panel washing) and maintenance vehicles. Onsite access to water is desirable, but not critical as it can be trucked in and is only needed a few times per year. Perimeter fencing will also will required at the site, as will some form of security protection (i.e., on-site personnel or electronic security systems).

ENVIRONMENTAL AND CULTURAL CONSIDERATIONS/IMPACTS

PV power plants have one of the lowest environmental and cultural impacts of all renewable energy technologies. PV plants emit zero pollutants, require minimal to no water requirements (non-water based panel cleaning solutions can be utilized), and have no long-term impacts on the land. During the construction phase of a PV project, some grading and land leveling may be required, but these impacts are typically minimal (although it is critical to have a dust control plan in place), given the best sites for project development tend to already be level and require a minimum of land disturbance. In addition, many development contracts for PV projects require the owner to return the land to its original state at the end of the project's life. In some instances, communities have raised concerns over the visual impacts of large PV arrays; however, due to the remoteness of the White Pine County area, this issue is not anticipated to be a concern – especially given the fact any potential projects would likely be developed within sight of NV Energy's large high voltage transmission lines.

As with any project development, environmental concerns would need to be assessed during the project planning phase. Few PV projects have been cancelled due to environmental issues. The most prevalent environmental issues associated with PV projects are the disturbance of land in threatened or endangered species habitat areas, and dust control during construction.

COMPARISON OF TECHNOLOGIES/SYSTEM REQUIREMENTS

PV systems are comprised of several main components, including PV modules, racking/mounting systems, inverters, and balance of system (BOS) equipment. For this study, Millennium compared various system configurations to arrive at the preferred system type, which balanced obtaining the highest system efficiency at the lowest cost. This balance was selected due to the fact that prospective solar PV plants in the County would likely need to compete with other plants in the state located in areas with a higher solar resource.

With respect to PV panels, poly-silicon panels were selected over thin film panels, as poly-silicon panels are higher efficiency with only minimally higher costs, and are well suited for utilization on tracking systems. Racking/Mounting systems come in a number of configurations, including fixed-tilt, single-axis tracking, and duel-axis tracking. The horizontal single-axis tracking configuration was selected, as it provided the best balance between maximizing system output while minimizing costs. Fixed tilt systems provide lower output at lower cost, while duel axis tracking systems offer higher output at higher costs. The single axis tracking system provided the best balance of system output with capital and O&M cost requirements. The final component compared was the inverter, which converts direct current to alternating current electricity for export to the grid. Inverter efficiencies typically range in the 95-98% range, with newer inverter technologies achieving efficiencies in the higher end of the range. Again, to maximize the efficiency of the system, an inverter in the 98% peak efficiency range was selected for this analysis. Inverters in this range are often liquid-cooled, which is an additional benefit in hot dry climates compared to more conventional air-cooled units.

REPRESENTATIVE PROJECT DESCRIPTION

Based on the research, analyses, and evaluations completed for this study, the following PV plant characteristics were specified for this study, and were used to the support evaluation of the economic and economic development opportunities for the County.

- 10 MW nameplate capacity PV plant
- Year 1 energy generation of 20,075 MWh, declining by 0.5% per year.
- PV system components
    - Poly-silicon panels (15.5%)
    - Horizontal single-axis tracking system
    - High efficiency inverters (97%+)
- Located within a five-mile radius of NV Energy transmission lines, within a five-mile radius of existing substations connected to NV Energy transmission lines, and within the southern portion of the County with a GTI value of greater than 6.0.

APPENDIX A
DATA REQUEST FEASIBILITY ANALYSIS
for
SOLAR PHOTOVOLTAIC

This completed data request form is for the stochastic feasibility analysis. This specific form is for the SOLAR PHOTOVOLTAIC (PV) technology. Below are some assumptions of the Power Plant:

Power Plant 10 Mega-Watts

- Assumes that at this level, larger capacity sizes are approximately linear in scale in terms of economies of scale and production values

Length of Feasibility Analysis 30 Years

- Typically, the lifecycle analysis is set to the expected system life (i.e., PV = 30 years)

Assumed Rate of Return by Investors 10-15%

- Due to the highly competitive nature of the renewable energy industry in the current market, ROIs in the 10-15% range are common.

REVENUE DATA:

POWER PRODUCTION: Typically, renewable energy studies look at the annual production value (MWH) that includes downtime. For this study, this value was calculated for a 10 MW PV plant in White Pine County (Ely TMY weather data) using the NREL System Advisor Model (SAM)[1]. Using the assumptions from the SAM, and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated at 20,075,482 kWh. This is a more accurate assessment than max power per day – as the max daily power fluctuates widely due the seasonality of the resource. The modeled annual energy output is equivalent to 55,001 kWh/day (average).

PRICES OF OUTPUT: The latest benchmark for NV Energy for Solar PPA prices is ~$0.09/kWh from the 2011 round of RPS bids. Since PV and CSP compete with one another, the sales prices would be the same for both resources. However, costs have come down for solar projects in the last

[1] (National Renewable Energy Laboratory, 2013)

couple of years and based on what the industry has experienced in adjacent states the output price range would be 8-9 cents per kWh – with 8.5 cents being the mid-point and zero annual escalation in PPA prices.

GOVERNMENT PAYMENTS or SUBSIDIES: PV Plants are subsidized with tax benefits via three mechanisms: two that are Federal and one that is from the State of Nevada. The first is a 30% Investment Tax Credit[2]; the plant owner would see 30% of the plant cost as a tax credit in Year 1. The second is the Modified Accelerated Cost Recovery Mechanism (MACRS). MACRS allows for solar plants to be depreciated over 5 1/2 years[3]. The first step is to calculate the net basis of depreciation. In this case, it is the total plant cost (including interconnection equipment and transmission lines) minus the one-half 30% ITC amount. For example, for a plant costing $1M, the net basis would be $1M – 0.5*(30%*1M) = $850,000. This net basis is then depreciated according to the following schedule[4]:

Year 1: 20%
Year 2: 32%
Year 3: 19.2%
Year 4: 11.52%
Year 5: 11.52%
Year 6: 5.76%

Thirdly, at the state level, there is a property tax abatement of 55% for 20 years for PV systems over 10 MW, hence qualifying this hypothetical facility[5].

COSTS: Construction and O&M cost data were derived from the default data set provide in the NREL System Advisor Model.

Fixed Cost of Plant: This would cover the below:

Book Value Estimate of Plant and Transmission Lines	$ 26,740,930
• Assumes 5 miles of transmission line to interconnection point	
Plant Cost	$ 24,920,480

[2] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)
[3] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)
[4] (Murray State University)
[5] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)

Capital Replacement Annually (Fixed O&M)	$ N/A

- An inverter replacement cost of $2,500,000 should be accounted for in Year 15.

Land Value	$ 100,000

- Assumptions of 40 acres X $2500/acre

Amount of Down Payment for Plant	$ 8,022,279

- Assumes 30% down and the remainder is debt financed

Length of Loan (years)	20 years
Interest Rate on Plant Loan (%)	5.5[6] %
Any Government Loan Assistance	$ 0

- The DOE Loan Guarantee Program is not accepting any new applications at this time.

OTHER COSTS:

Annual Variable Costs	$ 230,000

- Includes production based O&M costs plus insurance
- Does not included property tax @ 45% of assessed value due to 55% abatement for first 20 years of operation

REFERENCES

Interstate Renewable Energy Council / North Carolina Solar Center. (2013). *Federal Incentives / Policies for Renewables / Efficiency: Modified Accelerarated Cost Recovery System (MACRS) + Bonus Depreciation (2008-2015)*. (I. R. Center, Producer) Retrieved October 24, 2013, from Datebase of State Incentives for Renewables and Efficiency (DSIRE): http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06F&re=1&ee=1

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APPENDIX B
DATA for ECONOMIC IMPACT ANALYSIS

ENERGY SOURCE: **Solar Photovoltaic – 10 MW**

CONSTRUCTION COSTS:

(1) Estimated Total Construction Costs: **$26,840,930**

- Total Construction Costs includes land and labor expenditures

(2) Percentage of Total Construction Costs that is Labor And Benefits **12.6%**

(3) Percentage of Labor and Benefits Costs that are Benefits **28.8**%

(4) Number of Construction Employees **35 FTE**

(5) Percentage of Construction Employees that Live In White Pine County **10**%

(6) Percentage of Construction Employees that Live In the State of Nevada **90**%

- Does not include employees that live in White Pine County)

(7) Percentage of Construction Costs LESS Labor And Benefits Spent in White Pine County **2.1**%

(8) Percentage of Construction Costs LESS Labor

And Benefits Spent in the State of Nevada **26.3**%

- Does not include costs spent in White Pine County

ANNUAL OPERATION COSTS:

- Data does not include debt or equity payments

1) Estimated Total Annual Operation Costs: $**230,000**

(2) Percentage of Total Operation Costs that is Labor

and Benefits **58.2**%

(3) Percentage of Labor and Benefits Costs that are

Benefits **28.8**%

(4) Number of Operation Employees **1 FTE**

(5) Percentage of Operation Employees that Live

In White Pine County **100**%

(6) Percentage of Operation Employees that Live

In the State of Nevada **0**%

- Does not include employees that live in White Pine County

7) Percentage of Operation Costs LESS Labor

And Benefits Spent in White Pine County **0**%

(8) Percentage of Operation Costs LESS Labor

And Benefits Spent in the State of Nevada **38.8**%

- Does not include costs spent in White Pine County

References

The data provided in to support the economic impact analysis was derived from the National Renewable Energy Laboratory Jobs and Economic Development Impact (JEDI) model:

National Renewable Energy Laboratory. (2013). *JEDI: Jobs and Economic Development Impact Models*. (N. R. Laboratory, Producer) Retrieved November 2, 2013, from National Renewable Energy Laboratory: http://www.nrel.gov/analysis/jedi/about_jedi.html

Appendix G: Wind Power Resource Assessment – Millennium Energy, LLC.

MILLENNIUM ENERGY LLC

FINAL REPORT

Wind Power Resource Assessment for White Pine County

Submitted to:
White Pine County
Community and Economic Development
957 Campton Street
Ely, NV 89301

In Support of:
Department of Energy Award Number DE-EE0003139
Renewable Energy Feasibility Study and Resources Assessment

Submitted by:
Joe Bourg, President
Millennium Energy LLC
Golden, Colorado 80402
Voice: (303) 526-2972
Email: jbourg@millenniumenergysolar.com
Date: December 2013

WIND POWER

EXECUTIVE SUMMARY

White Pine County's (County) wind resource is widely varied, ranging from Class 2 (Fair) to Class 7 (Superb). Most the best areas (Class 5-7) are located on mountain ridge tops which are difficult and costly to develop, and in many cases are in excluded areas for development. However, there are some lands with Class 3 to 5 resources (Fair to Excellent) that may provide opportunities for development of wind power plants, and associated economic development. For this assessment, Millennium Energy (Millennium) provided support to the University of Nevada, Reno (UNR), University of Nevada Community Extension, and TerraSpectra Geomatics to develop strategies, screening criteria, and data to support subsequent economic analyses and completion of resource/site potential maps. Some of the key findings and data developed for this effort include:

- **Markets for energy sales:** The primary market for energy sales is a power purchase agreement (PPA) with NV Energy. Mt. Wheeler Power is not a likely candidate as they are unregulated and not subject to state RPS regulations, and sales outside of Nevada would likely be uncompetitive due to additional transmission service costs.
- **Anticipated market prices for energy sales:** Based on historical sales prices to NV Energy, and recent sales prices in the west, wind-based energy sales prices were estimated to be in the 8.4 to 9.5 cent per kilowatt-hour (kWh) range, with the current median price estimated at 8.7 cents per KWh.
- **Wind resource data and expected annual energy generation potential:** Based upon modeling of a 10 MW wind plant located in Spring Valley utilizing the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM), it was estimated that the annual energy generation would be 25,967 MegaWatt-hours (MWh).
- **Wind power construction and operations and maintenance (O&M) costs:** Utilizing the NREL Jobs and Economic Development Impact (JEDI) and SAM models, the wind power plant construction cost was estimated to be $21.3 Million with annual O&M costs of $230,000.
- **Financing parameters and tax incentives:** Project financing characteristics were assumed to include a 20-year loan term with a 5.5% interest rate. Tax incentives include a 30% Federal Income Tax Credit, five-year accelerated depreciation, and a ten-year 55% state tax property tax exemption.
- **Economic development potential:** Utilizing the NREL JEDI model, it was estimated that 29 construction and one O&M full-time jobs would be supported by a 10 MW wind project.
- **Project Locations:** Potential project locations were limited to areas within a five-mile radius of the NV Energy transmission lines, with preference given to areas within five miles of substations serving those lines, and within areas of Class 3 to 5 wind resource potential. It should be noted that projects of larger scale could potentially interconnect directly with NV Energy transmission lines, as they would be better able to absorb the costs of building a

required substation for interconnection. Based on these screening criteria, the sites that were identified as having development potential are in areas adjacent to the 151 MW Spring Valley Wind Farm and the substation that was built to support that project.

METHODOLOGY AND ASSUMPTIONS

The analysis of wind power opportunities was based on a 10 Megawatt (MW) plant to provide a consistent comparison among the renewable resource technologies. In addition, 10 MW is typically of sufficient size to analyze, such that the results would scale up in a linear manner if larger system sizes were to be considered.

The first step in the analysis was to review and analyze the market opportunities for wind energy sales. Based on this review, it was determined that NV Energy would likely be the only plausible off-taker of the power. This is due the fact that the utility serving the entire County, Mt. Wheeler Power, is an unregulated rural electric cooperative. As such, Mt. Wheeler is not subject the State of Nevada Renewable Portfolio Standard (RPS) requirements, and therefore would not be a candidate for renewable energy purchases from projects located in the County. In addition, selling to out-of-state utilities is not an economic option due to costs that would be incurred related to transmission wheeling and other transmission-related ancillary charges. Since the wind power market is highly competitive, adding additional transaction costs to energy sales prices would make the overall sales price non-competitive in out-of-state markets. However, two-high voltage transmission lines owned by NV Energy intersect the County, one from east-to-west and one from north-to-south. As a result, wind projects in the County could potentially interconnect with one of these lines, and avoid transmission wheeling and ancillary costs if the energy were sold to NV Energy. Therefore, NV Energy was determined to be the only likely off-taker of energy from a wind project in the County, and this assumption served as the basis for the remainder of the analyses.

With NV Energy as the assumed off-taker of energy from the potential 10 MW wind plant, the next step was to research and determine expected sales prices for the power. Currently, the market for large-scale wind energy sales to NV Energy is in a state of flux as regulatory considerations are sorted out. With NV Energy currently ahead of schedule with respect to its RPS requirements, the utility has not awarded a wind power purchase agreement (PPA) since 2010. The wind power PPA with NV Energy is the only wind power contract in the utility's RPS with a price of 9.8 cents per kWh. Since then wind energy PPA prices in neighboring states have fallen to 8.4 cents per kWh. Based on a simple ratio of historical prices in the west in 2010 and the Spring Valley PPA price to current prices in the west, wind energy sales prices to NV Energy were estimated to be 8.7 cents per kWh. These sales prices were assumed to be without annual escalation factors, as NV Energy has historically required that all PPA bids be offered at a fixed price for the 20-year contract duration (although this may or may not change in the future).

The next step in the wind resource assessment for the County was to review and analyze the wind resource, develop a basic conceptual design of a 10 MW plant, and model the annual energy generation resulting from plant operations. For this assessment, Millennium utilized the National Renewable Energy Laboratory's (NREL) System Advisor Model (SAM), to incorporate the weather and resource data for the identified potential project sites, specify wind system components, and model the output. Based on weather and resource data for the Spring Valley area, it was determined that a 10 MW wind plant would generate approximately 25,967 MWh annually.

Once the off-taker, sales price, and output values were ascertained, Millennium began collecting data on construction and O&M costs for the hypothetical 10 MW plant. Construction costs were tabulated based on information derived from NREL's JEDI and SAM models and included cost breakdowns for capital cost, labor, and land. Similarly, O&M costs were derived from the same models for fixed and variable costs, including materials, labor, insurance, and other costs. The 10 MW wind plant assumed for this study was estimated to cost ~$21.3 Million including interconnection and transmission spur costs, with annual O&M costs estimated at $230,000. Complete breakdowns of construction and O&M costs are included in Appendices A and B as part of the data request responses.

In an effort to support the economic and feasibility assessments of the hypothetical 10 MW wind project, Millennium provided input into the financing parameters (including loan terms, interest rates, and debt ratios), as well as the tax treatments of Federal and state incentives applicable to the project. Specifically, details were provided on Federal tax credits, five-year accelerated depreciation schedules and basis determination, and treatment of the 10-year 55% property tax exemption for 10 MW+ renewable energy systems in Nevada.

The final assessment performed for this project was to develop data to assist in the economic development analyses to be completed by UNR under this project. This data development effort was based on the NREL JEDI databases and resulted in the development of estimates of labor and benefits expenditures within White Pine County and the State of Nevada. This data assisted in determining the economic development impacts of 10 MW increments of wind projects in the County. Key findings from this assessment were that 29 full-time employment (FTE) construction jobs would be needed to build a 10 MW wind project; however, due to the low O&M requirements of a wind plant, only one FTE would be required for O&M. Additional economic development input data is provided in Appendix B.

Finally, Millennium provided input into the mapping studies in terms of defining screening criteria and project parameters to assist in identifying potential areas for project development based on identified markets, resource potential, and distance to transmission lines. The resulting map for the wind resource assessment indicates that areas with a Class 3 and above wind resource, and located within a 10-mile wide corridor of the NV Energy east-west or north-south transmission lines (i.e., five miles on either side of the transmission line) in the County have potential for wind development, that are also located with a 5-mile radius of an existing substation. While other areas in the County have similar or better wind resources, the commercially developable areas are limited based on the properties' proximity to NV Energy transmission lines and substations – and the cost, difficulty, and restrictions of building wind projects on the tops of mountain ridge lines. However, the identified locations are for a 10 MW sized project, and projects of a significantly larger scale could potentially by developed that interconnect directly with the NV Energy transmission lines – as larger projects could potentially absorb the cost of building a required substation for interconnection at the high voltage transmission level. This was the case with the 151 MW Spring Valley Wind Farm, which is adjacent to the potential sites identified via this analysis.

RESOURCE DESCRIPTION

White Pine County has a wide range of wind resource potential ranging from Class 2 (Marginal) to Class 7 (Superb). While the better wind resource areas are located along mountain ridgelines, which are more difficult and costly to develop, there are developable areas with Class 3 to 4 resource potential (Fair to Excellent). Wind resources are site specific, and potential project sites should be evaluated with wind anemometers for at least one year to verify the resource. On a statewide basis, areas within the County exhibit wind classes that are equivalent to some of the best wind resources in other parts of the state. The best wind resources in the County that have development potential based on commercially developable land are located in Spring Valley. These results are expected, as Spring Valley is the location of Nevada's only utility-scale wind farm that is selling energy to NV Energy. The wind resource in Spring Valley is classified as Class 3 and 4. For purposes of this evaluation, wind classifications of Class 3 and above were included in the project screening criteria. Again, it should be noted that the wind class data is based on publicly available data utilizing 50-meter hub height measurements, which is typically utilized for project screening analyses. Using 80 meter height data may yield higher wind classifications for certain areas, but would not likely alter the relative resource potential among areas within the County.

RESOURCE LOCATION

Unlike solar resources, which are relatively homogenous across the County, wind resources are extremely site specific. While many areas within the County meet the minimum threshold value of a Class 3 resource or above, most of the better resources are located in areas that are difficult and/or costly to develop, or are located too far from existing transmission lines and substations. The most developable areas within the County are located in Spring Valley. Not surprisingly, the best resource location identified which meets the project screening criteria is an area adjacent to the 151 MW Spring Valley Wind Farm. This areas is within a five-mile distance of both NV Energy transmission lines and a substation (built to support the Spring Valley Wind Farm) interconnecting to the line, and is an area with a Class 4 wind resource. This resource location was used to conduct the performance modeling and economic impact data developed for this project. Figure 1, below illustrates the resulting resource locations identified by this study.

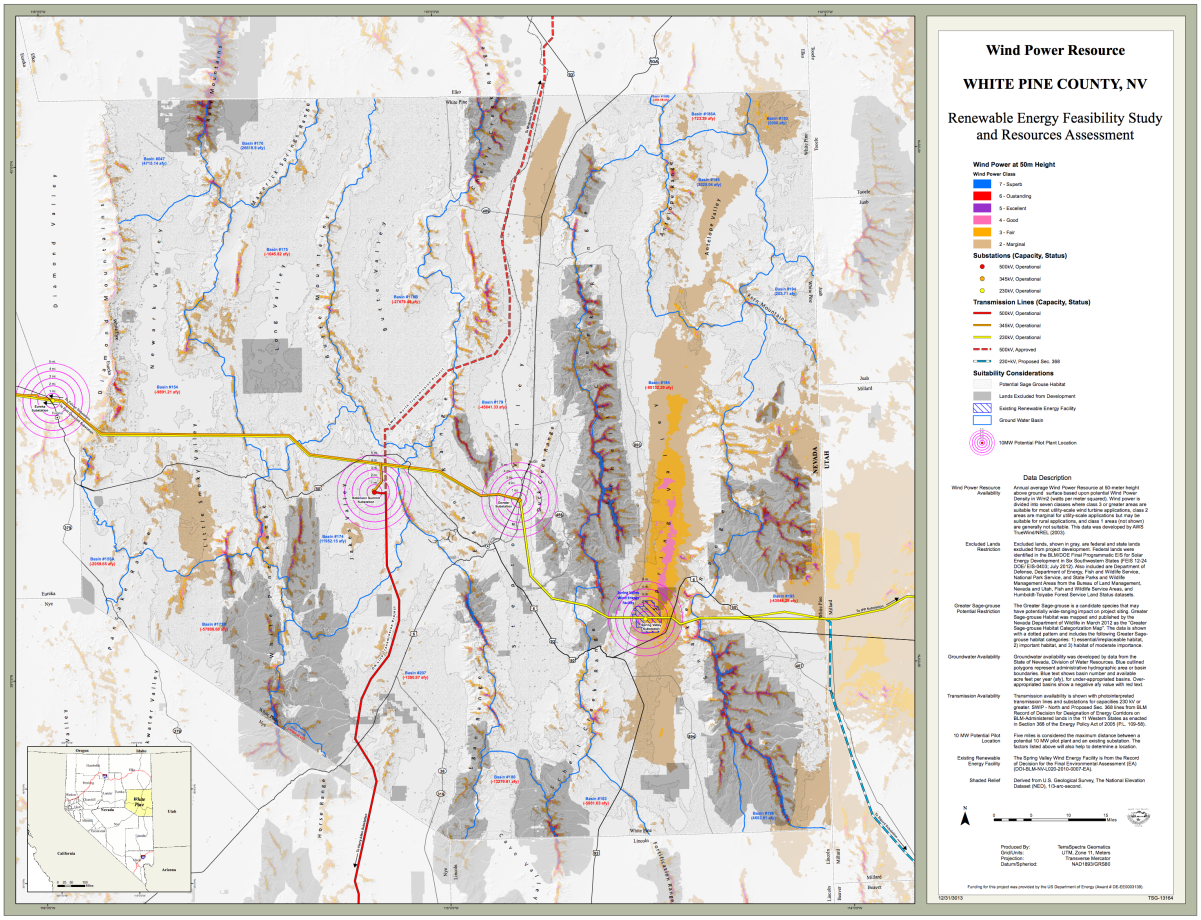


Figure 1 Wind Resource Locations

INFRASTRUCTURE REQUIREMENTS

The infrastructure requirements for a wind farm are minimal. The biggest and most expensive infrastructure requirement will be the interconnection equipment and a transmission spur to interconnect with the NV Energy high-voltage transmission system. However, this requirement is common to all of the electricity producing renewable resources considered by this study. In addition, any project connecting directly to a high voltage transmission line would require a substation and large step-up transformers, and would likely have to be significantly larger in size than 10 MW in order to justify the additional cost.

Beyond the interconnection equipment, the infrastructure requirements are marginal. During the construction phase, passable roads and possibly access to a nearby rail line would be required to deliver the large turbines and the balance of system components. Roads are also required for access by construction equipment and water trucks for dust control. Access to water at the site is not needed, as the footprint for a wind turbine is rather small and the dust control requirements are minimal compared to larger footprint projects such as solar projects.

Once the plant is complete, in addition to the interconnection infrastructure, road access will continue to be required to provide access for maintenance vehicles. No water is required for wind project operation or maintenance. Perimeter fencing may also will required for the project, as will some form of security protection (i.e., on-site personnel or electronic security systems) to prevent vandalism and for the safety of non-project personnel who may try and enter the area around the wind turbines.

ENVIRONMENTAL AND CULTURAL CONSIDERATIONS/IMPACTS

Wind farms typically have low environmental and cultural impacts. Individual wind turbines have a small land footprint, allowing for open areas around the turbine that can be utilized for other purposes or left in its natural state. Wind turbines emit zero pollutants, require no water, and have no long-term impacts on the land. During the construction phase of a wind project, some grading and land leveling may be required, but these impacts are typically minimal. The main environmental concern with wind projects is the potential for bird and bat kills by the rotating turbines. Development of a wind farm will require an environmental assessment of the impacts on flora and fauna in the area, but the main focus is typically on birds and bats. Wind farms are sited with migratory bird pathways taken into consideration as well site-specific impacts on birds and bats. Extensive evaluation can go into siting and placement of turbines to minimize the impacts of wind turbines on birds and bats. The frequency of bird and bat kills by wind turbines in the US has been dramatically reduced as a result of research and mitigation strategies employed over the last couple of decades.

Other potential environmental impacts associated with wind farms include sight and sound impacts to humans. In some instances, communities have raised concerns over the visual and sound impacts of wind turbines; however, due to the remoteness of the White Pine County area, these issues are anticipated to be only a minor concern.

The fact that there is already one large project in the County is a benefit to future wind development, as most of the potential environmental issues have likely already been identified. For example, the Spring Valley Wind Farm developers worked with the community to design a smaller land area footprint of the project, utilize soil and rock stain on restored areas reduce the visible color contrast between bare soil and vegetation, and implement robust monitoring and conservation measures to avoid, minimize and mitigate impacts to bats and avian species. Any new projects would need to address the potential for environmental issues, both identified and unidentified, and developers would need to work with the community and other stakeholders to resolve any potential issues.

COMPARISON OF TECHNOLOGIES/SYSTEM REQUIREMENTS

Wind generators are comprised of several main components, including the turbine, a gearbox, a tower, and balance of system (BOS) equipment. The components among different wind generators manufacturers are similar, with the main difference being whether the turbines are horizontal or vertical (i.e., “eggbeater type”) axis. For this study, Millennium reviewed the most common types of wind generator technologies specified in large wind farm projects in the current market. Based upon this review, it was verified that the most common wind generator on the market is a horizontal-axis three-blade configuration. This is the same type of configuration used at the Spring Valley Wind Farm located in the County.

REPRESENTATIVE PROJECT DESCRIPTION

Based on the research, analyses, and evaluations completed for this study, the following wind farm characteristics were specified for this study, and were used to the support evaluation of the economic and economic development opportunities for the County.

- 10 MW nameplate capacity wind farm
- Annual energy generation of 25,967 MWh
- Wind generator system components
  - Five 2.0 MW three-blade horizontal axis turbines with a 90 meter diameter
  - 80 meter hub height
  - Conventional towers and gearboxes
- Located within a five-mile radius of NV Energy transmission lines, within a five-mile radius of existing substations connected to NV Energy transmission lines, and with a minimum Wind Class of 3. The site utilized for the study's analysis is a Class 4 wind site located approximately four miles from the existing Spring Valley Wind Farm substation.

APPENDIX A
DATA REQUEST FEASIBILITY ANALYSIS
for
WIND POWER

This completed data request form is for the stochastic feasibility analysis. This specific form is for WIND POWER technology. Below are some assumptions of the Power Plant:

Power Plant 10 Mega-Watts

- Assumes that at this level, larger capacity sizes are approximately linear in scale in terms of economies of scale and production values

Length of Feasibility Analysis 25 Years

- Typically, the lifecycle analysis is set to the expected system life (i.e., Wind = 25 years)

Assumed rate of return by investors 10-15%

- Due to the highly competitive nature of the renewable energy industry in the current market, ROIs in the 10-15% range are common.

REVENUE DATA:

POWER PRODUCTION: Typically, renewable energy studies look at the annual production value (MWH) that includes downtime. For this study, this value was calculated for a 10 MW wind farm in White Pine County (Spring Valley weather data) using the NREL System Advisor Model (SAM)[1]. Using the assumptions from the SAM, and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated at 25,966,878 kWh. This is a more accurate assessment than max power per day – as the max daily power fluctuates widely due the seasonality of the resource. The modeled annual energy output is equivalent to 71,142 kWh/day (average).

PRICES OF OUTPUT: The latest and only benchmark in NV for Wind PPA prices is $0.098/kWh from the 2010 round of RPS bids[2]. It was determined that the best method for determining current

[1] (National Renewable Energy Laboratory, 2013)
[2] (Robison, 2010)

PPA prices was to benchmark the 2010 NV Energy PPA against the average of PPAs in the western region[3]. In 2010, the average wind PPA price in west was $0.095/kWh. In 2012 the average wind PPA price in the west dropped $0.084/kWh. Using the simple ratio of these prices, it is estimated that the current wind PPA price would be $0.087/kWh.

GOVERNMENT PAYMENTS or SUBSIDIES: Wind power plants are subsidized with tax benefits via three mechanisms: two that are Federal and one that is from the State of Nevada. The first is a 2.3 cents per kWh Production Tax Credit[4]; the plant owner would see a 2.3 cents per kWh tax credit for every kWh generated for the first 10 years of operation. The second is the Modified Accelerated Cost Recovery Mechanism (MACRS)[5]. MACRS allows for wind plants to be depreciated over 5 1/2 years. The first step is to calculate the net basis of depreciation. In this case, because production tax credits are used and not investment tax credits, the depreciation basis is the full capital cost of the plant. This net basis is then depreciated according to the following schedule:
Year 1: 20%
Year 2: 32%
Year 3: 19.2%
Year 4: 11.52%
Year 5: 11.52%
Year 6: 5.76%
Thirdly, at the state level, there is a property tax abatement of 55% for 20 years for wind systems over 10 MW, hence qualifying this hypothetical facility[6].

COSTS:

Fixed Cost of Plant: This would cover the below:

Book Value Estimate of Plant and Transmission Lines	$ 21,291,510
• Assumes 5 miles of transmission line to interconnection point	
Plant Cost	$ 19,466,510
Capital Replacement Annually (Fixed O&M)	$ N/A

[3] (Wiser, 2013)
[4] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)
[5] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)
[6] (Interstate Renewable Energy Council / North Carolina Solar Center, 2013)

- Any capital replacement costs are included in the production-based O&M costs

Land Value $ 12,500

- Assumptions of 5 acres X $2500/acre

Amount of Down Payment for Plant $ 6,387,453

- Assumes 30% down and the remainder is debt financed

Length of Loan (years) 20 years

Interest Rate on Plant Loan (%) 5.5 %

Any Government Loan Assistance $ 0

- The DOE Loan Guarantee Program is not accepting any new applications at this time.

OTHER COSTS:

Annual Variable Costs $ 230,000

- Includes production based O&M costs plus insurance
- Does not included property tax @ 45% of assessed value due to 55% abatement for first 20 years of operation

REFERENCES

Interstate Renewable Energy Council / North Carolina Solar Center. (2013). *Federal Incentives / Policies for Renewables / Efficiency: Modified Accelerated Cost Recovery System (MACRS) + Bonus Depreciation (2008-2015)*. (I. R. Center, Producer) Retrieved October 24, 2013, from Database of State Incentives for Renewables and Efficiency (DSIRE): http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06F&re=1&ee=1

Interstate Renewable Energy Council / North Carolina Solar Center. (2013). *Federal Incentives / Policies for Renewables & Efficiency: Renewable Electricity Production Tax Credit (PTC)*. (I. R. Center, Producer) Retrieved October 24, 2013, from Database of State Incentives for Renewables & Efficiency (DSIRE): http://www.dsireusa.org/incentives/index.cfm?Incentive_Code=US13F&re=1&ee=1

Interstate Renewable Energy Council / North Carolina Solar Center. (2013). *Nevada Incentives for Renewables/Efficiency: Large Scale Renewable Energy Property Tax Abatement (Nevada State Office of Energy)* . (I. R. Center, Producer) Retrieved October 24, 2013, from Database of State Incentives for Renewables and Efficiency: http://ww.dsireusa.org/incentives/incentives.cfm?Incentive_Code=NV01F&re=0&ee=0

Murray State University. (n.d.). *Modified Accelerated Cost Recovery System: the MACRS depreciation method*. (M. S. University, Producer) Retrieved October 24, 2013, from Murray State University: http://campus/murraystate.edu/academic/faculty/lguin/fin330/MACRS.htm

National Renewable Energy Laboratory. (2013). *JEDI :Jobs and Economic Development Impact Models*. (N. R. Laboratory, Producer) Retrieved November 2, 2013, from National Renewable Energy Laboratory: http://www.nrel.gov/analysis/jedi/about_jedi.html

National Renewable Energy Laboratory. (2013). *NREL System Advisor Model (SAM)* . (N. R. Laboratory, Producer, & National Renewable EnergyLaboratory) Retrieved Oct 18, 2013, from National Renewable Energy Laboratory : http://www.sam.nrel.gov

Robison, J. (2010, July 15). Going Green Not Cheap for NV Energy. *Las Vegas Review-Journal* .

Wiser, R. (2013, August). *2012 Wind Technologies Market Report* . Retrieved October 18, 2013, from Lawrence Berkeley National Laboratory Electricity Markets and Policy Group: emp.lbl.gov/publications/2012-wind-technologies-market-report

APPENDIX B
DATA for ECONOMIC IMPACT ANALYSIS

ENERGY SOURCE: **Wind Power – 10 MW**

CONSTRUCTION COSTS:

(1) Estimated Total Construction Costs: **$19,479,010**

- Total Construction Costs includes land and labor expenditures

(2) Percentage of Total Construction Costs that is Labor
And Benefits **16.5%**

(3) Percentage of Labor and Benefits Costs that are
Benefits **28.8**%

(4) Number of Construction Employees **29 FTE**

(5) Percentage of Construction Employees that Live
In White Pine County **1**%

(6) Percentage of Construction Employees that Live
In the State of Nevada **72**%

- Does not include employees that live in White Pine County)

(7) Percentage of Construction Costs LESS Labor
And Benefits Spent in White Pine County **0.6**%

(8) Percentage of Construction Costs LESS Labor

And Benefits Spent in the State of Nevada **22.1**%

- (Does not include costs spent in White Pine County)

ANNUAL OPERATION COSTS:

- Data does not include debt or equity payments

1) Estimated Total Annual Operation Costs: $**230,000**

(2) Percentage of Total Operation Costs that is Labor

and Benefits **36.2**%

(3) Percentage of Labor and Benefits Costs that are

Benefits **28.8**%

(4) Number of Operation Employees **1 FTE**

(5) Percentage of Operation Employees that Live

In White Pine County **100**%

(6) Percentage of Operation Employees that Live

In the State of Nevada **0%**

- Does not include employees that live in White Pine County

(7) Percentage of Operation Costs LESS Labor

And Benefits Spent in White Pine County **16.6**%

(8) Percentage of Operation Costs LESS Labor

And Benefits Spent in the State of Nevada **4.6**%

- Does not include costs spent in White Pine County

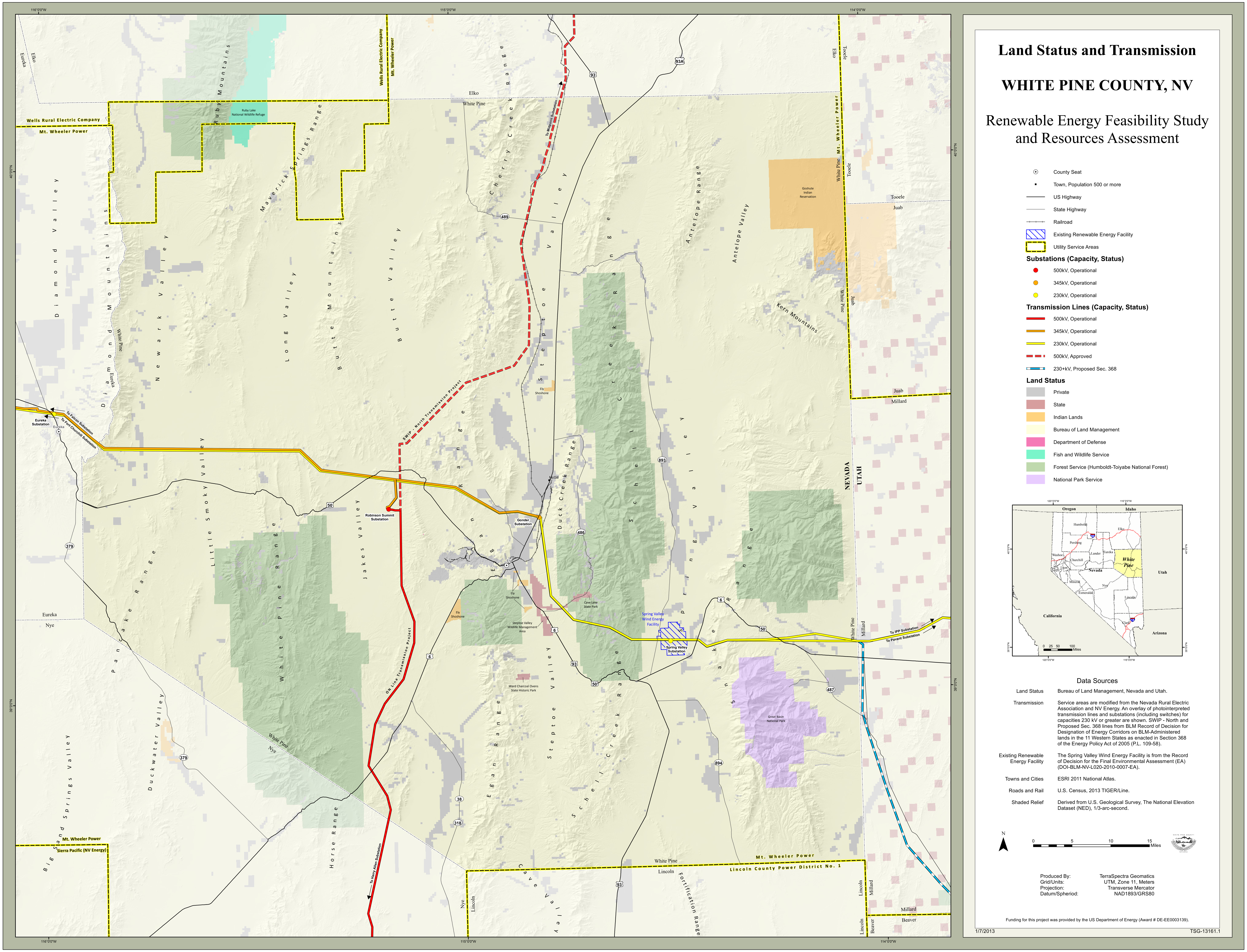
References

The data provided in to support the economic impact analysis was derived from the National Renewable Energy Laboratory Jobs and Economic Development Impact (JEDI) model:

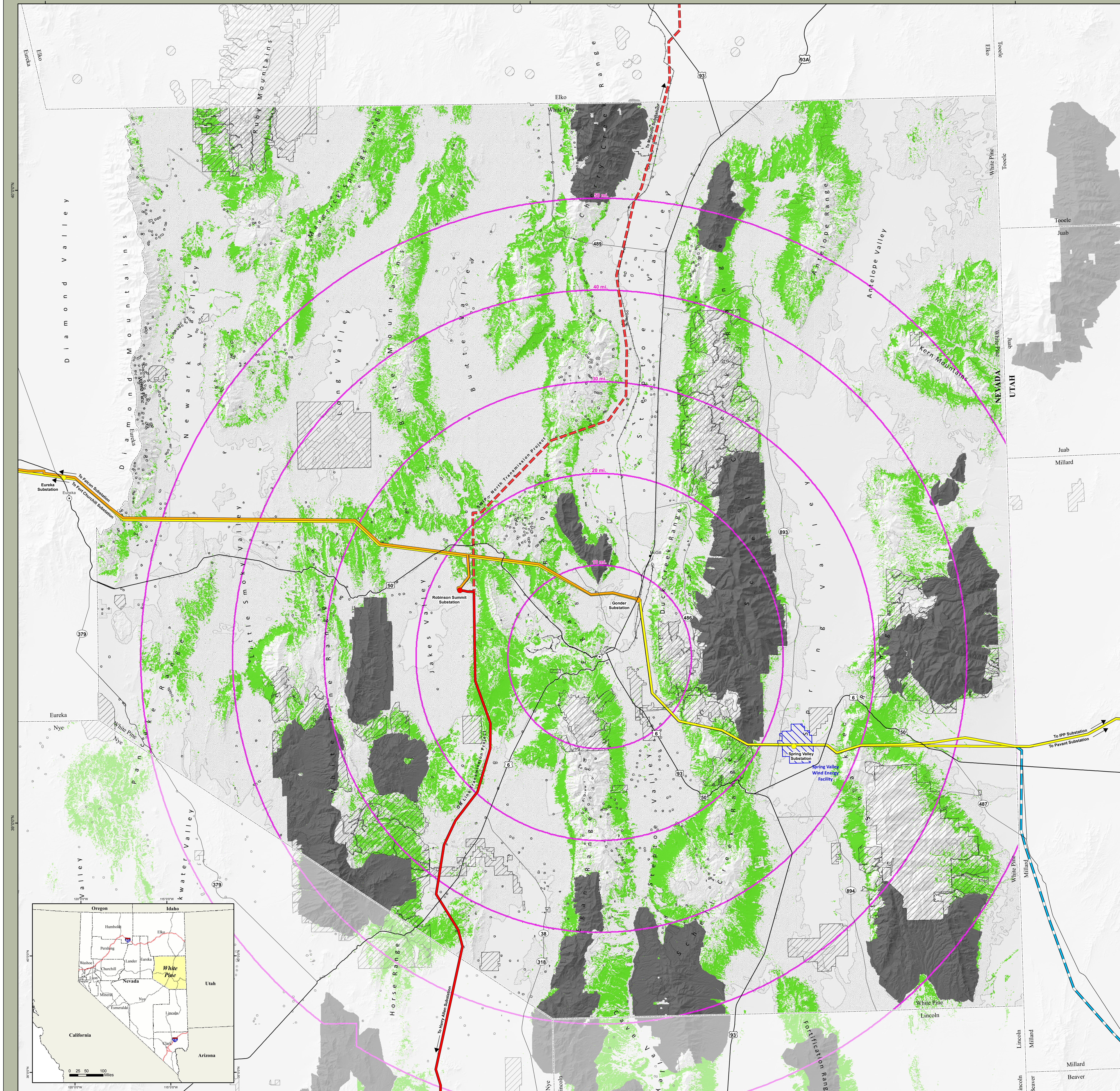
National Renewable Energy Laboratory. (2013). *JEDI :Jobs and Economic Development Impact Models*. (N. R. Laboratory, Producer) Retrieved November 2, 2013, from National Renewable Energy Laboratory: http://www.nrel.gov/analysis/jedi/about_jedi.html

Appendix H: Maps - Prepared by TerraSpectra Geomatics

1. Land Status and Transmission


Land Status and Transmission
WHITE PINE COUNTY, NV
Renewable Energy Feasibility Study and Resources Assessment
County Seat
Town, Population 500 or more
US Highway
State Highway
Railroad
Existing Renewable Energy Facility
Utility Service Areas
Substations (Capacity, Status)
500kV, Operational
345kV, Operational
230kV, Operational
Transmission Lines (Capacity, Status)
500kV, Operational
345kV, Operational
230kV, Operational
500kV, Approved
230+kV, Proposed Sec. 368
Land Status
Private
State
Indian Lands
Bureau of Land Management
Department of Defense
Fish and Wildlife Service
Forest Service (Humboldt-Toiyabe National Forest)
National Park Service
Data Sources
Land Status: Bureau of Land Management, Nevada and Utah.
Transmission: Service areas are modified from the Nevada Rural Electric Association and NV Energy. An overlay of photointerpreted transmission lines and substations (including switches) for capacities 230 kV or greater are shown. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).
Existing Renewable Energy Facility: The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).
Towns and Cities: ESRI 2011 National Atlas.
Roads and Rail: U.S. Census, 2013 TIGER/Line.
Shaded Relief: Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.
Produced By: TerraSpectra Geomatics
Grid/Units: UTM, Zone 11, Meters
Projection: Transverse Mercator
Datum/Spheroid: NAD1893/GRS80
Funding for this project was provided by the US Department of Energy (Award # DE-EE0003139).
1/7/2013
TSG-13161.1
Wells Rural Electric Company
Mt. Wheeler Power
Ruby Lake National Wildlife Refuge
Goshute Indian Reservation
Robinson Summit Substation
Gonder Substation
Eureka Substation
Spring Valley Wind Energy Facility
Spring Valley Substation
Cave Lake State Park
Great Basin National Park
Steptoe Valley Wildlife Management Area
Ward Charcoal Ovens State Historic Park
SWIP - North Transmission Project
On Line Transmission Project
To Falcon Substation
To Fort Churchill Substation
To IPP Substation
To Pavant Substation
To Harry Allen Substation
Sierra Pacific (NV Energy)
Lincoln County Power District No. 1
NEVADA
UTAH

2. Biomass



Biomass Resource

WHITE PINE COUNTY, NV

Renewable Energy Feasibility Study and Resources Assessment

Biomass Resource

Great Basin Pinyon Juniper Distribution

Potential Harvestable Great Basin Pinyon Juniper Zones (10 - 50 Miles)

Suitability Considerations

RCI Harvest Exclusion Areas

Areas with Potential Harvest Restrictions

Preliminary Priority and General Sage-grouse Habitat

Substations (Capacity, Status)

500kV, Operational

345kV, Operational

230kV, Operational

Transmission Lines (Capacity, Status)

500kV, Operational

345kV, Operational

230kV, Operational

500kV, Approved

230+kV, Proposed Sec. 368

Existing Renewable Energy Facility

Data Description

Biomass Resource Availability	Biomass Resource is represented by the distribution of potential harvestable Great Basin Pinyon-Juniper woodland. In an analysis by Resource Concepts, Inc. (RCI, 2013), unharvestable areas were eliminated from the Great Basin Pinyon-Juniper woodland mapped in the Southwest Regional GAP Landcover (SWReGAP, 2004) for Nevada and Utah. RCI eliminated areas of recent fires (Nevada Bureau of Land Management mapped fire distributions for 1981 - 2007), slopes greater than 30% (derived from 1/3-arc-second U.S. Geological Survey, National Elevation Dataset) and wilderness and wilderness study areas (shown in dark gray) from the Nevada BLM and the US Forest Service (USFS), Humboldt-Toiyabe National Forest.
Potential Harvestable Zones	RCI (2013) further indicated a 50 mile harvestable zone buffered around Ely, Nevada in 10-mile increments.
Areas with Potential Harvest Restrictions	Depicted with a hash pattern overlay are lands that may have potential Pinyon-Juniper harvest restrictions. These federal lands were identified in the BLM/DOE Final Programmatic EIS for Solar Energy Development in Six Southwestern States (FEIS 12-24 DOE/EIS-0403; July 2012), including BLM Areas of Critical Environmental Concern and No Surface Occupancy, USFS National Forest Inventoried Roadless Areas and Specially Designated Areas, and US Fish and Wildlife Service (USFWS) Critical Habitat for Threatened and Endangered Faunal Species. Also included are Department of Defense and National Park Service lands, State Parks, State Wildlife Management Areas, and USFWS Refuges mapped by the Nevada BLM, Utah BLM, USFWS, and USFS Land Status datasets.
Greater Sage-grouse Potential Restriction	The Greater Sage-grouse is a candidate species that may have potentially wide-ranging impact on siting of permanent facilities and infrastructure. While harvest and thinning of Pinyon-Juniper, primarily lop and scatter projects, has proven beneficial to Sage-grouse, it is unclear as to what restrictions may be placed on biomass mechanical harvest and associated temporary infrastructure (i.e. access roads, staging and handling areas, etc.). Greater Sage-grouse Habitat was mapped and published by the Nevada Department of Wildlife in March 2012 as the "Greater Sage-grouse Habitat Categorization Map". The data is shown with a dot pattern and includes the following Greater Sage-grouse habitat categories: 1) essential/irreplaceable habitat, 2) important habitat, and 3) habitat of moderate importance.
Transmission Availability	Transmission availability is shown with photointerpreted transmission lines and substations for capacities 230 kV or greater. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).
Existing Renewable Energy Facility	The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).
Shaded Relief	Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.

N

0 5 10 15 Miles

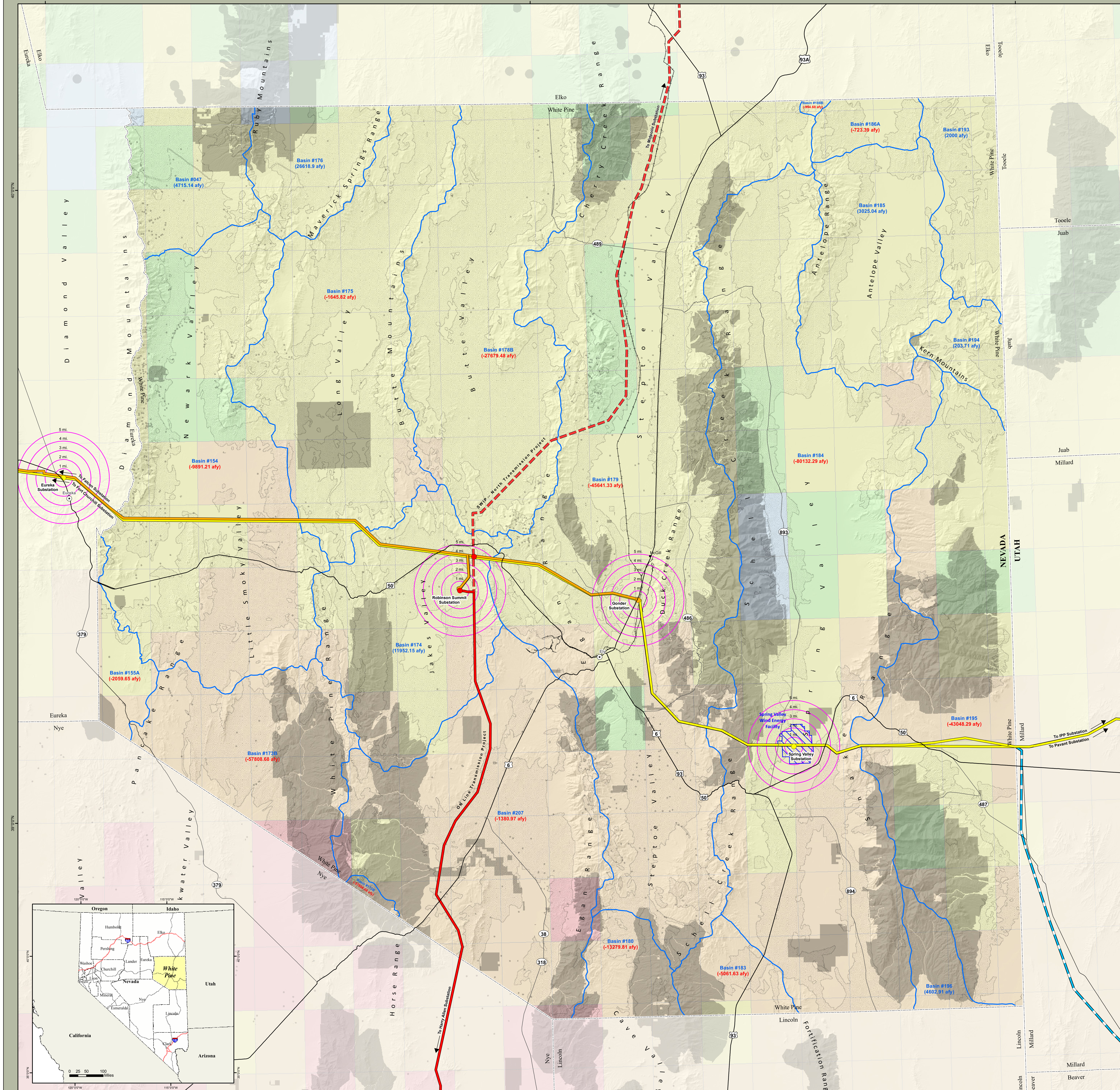
Produced By:	TerraSpectra Geomatics
Grid/Units:	UTM, Zone 11, Meters
Projection:	Transverse Mercator
Datum/Spheriod:	NAD1893/GRS80

Funding for this project was provided by the US Department of Energy (Award # DE-EE0003139).

1/7/2014

TSG-13165.1

3. Concentrating Solar Power



Concentrating Solar Power (CSP) Resource

WHITE PINE COUNTY, NV

Renewable Energy Feasibility Study and Resources Assessment

Concentrating Solar Power Resource

Annual Average Kilowatt Hours per Meter Squared per Day (kWh/m2/day)

- >7.5 - 8.0
- >7.0 - 7.5
- >6.5 - 7.0
- >6.0 - 6.5
- ≤ 6.0

Substations (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational

Transmission Lines (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational
- 500kV, Approved
- 230+kV, Proposed Sec. 368

Suitability Considerations

- Preliminary Priority and General Sage-grouse Habitat
- Lands Excluded from Development
- Existing Renewable Energy Facility
- Groundwater Availability by Basin
- 10MW Potential Pilot Plant Location

Data Description

Solar Resource Availability	Concentrating Solar Power (CSP) Resource is represented by Direct Normal Insolation (DNI) data. The solar resource is in units of kWh/m2/day annually averaged for 1998-2009 over 10 sq. km. surface cells. The data was developed by SUNY Albany and National Renewable Energy Laboratory - NREL (2012). The most favorable CSP resource is greater than or equal to 6.5 kWhr/m2/day.
Excluded Lands Restriction	Excluded lands, shown in gray, are federal and state lands excluded from project development. Federal lands were identified in the BLM/DOE Final Programmatic EIS for Solar Energy Development in Six Southwestern States (FEIS 12-24 DOE/ EIS-0403; July 2012). Also included are Department of Defense, Department of Energy, Fish and Wildlife Service, National Park Service, and State Parks and Wildlife Management Areas from the Bureau of Land Management, Nevada and Utah, Fish and Wildlife Service Areas, and Humboldt-Toiyabe Forest Service Land Status datasets.
Greater Sage-grouse Potential Restriction	The Greater Sage-grouse is a candidate species that may have potentially wide-ranging impact on siting of permanent facilities and infrastructure. Greater Sage-grouse Habitat was mapped and published by the Nevada Department of Wildlife in March 2012 as the “Greater Sage-grouse Habitat Categorization Map”. The data is shown with a dot pattern and includes the following Greater Sage-grouse habitat categories: 1) essential/irreplaceable habitat, 2) important habitat, and 3) habitat of moderate importance.
Groundwater Availability	Groundwater availability was developed by data from the State of Nevada, Division of Water Resources. Blue outlined polygons represent administrative hydrographic area or basin boundaries. Blue text shows basin number and available acre feet per year (afy), for under-appropriated basins. Over-appropriated basins show a negative afy value with red text.
Transmission Availability	Transmission availability is shown with photointerpreted transmission lines and substations for capacities 230 kV or greater. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).
10 MW Potential Pilot Location	Five miles is considered the maximum distance between a potential 10 MW pilot plant and an existing substation. The factors listed above will also help to determine a location.
Existing Renewable Energy Facility	The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).
Shaded Relief	Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.

N

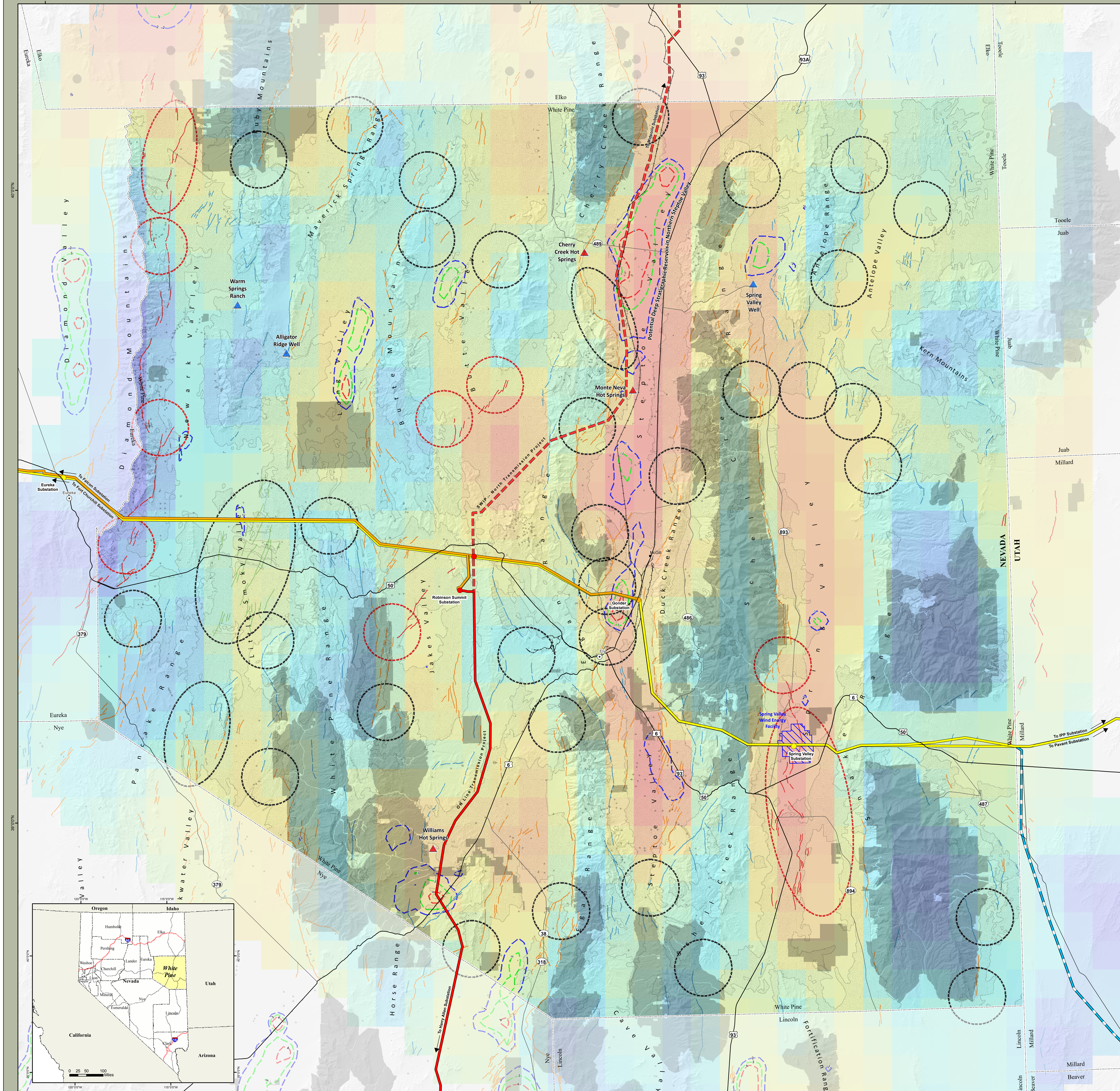
0 5 10 15 Miles

Produced By:	TerraSpectra Geomatics
Grid/Units:	UTM, Zone 11, Meters
Projection:	Transverse Mercator
Datum/Spheriod:	NAD1893/GRS80

Funding for this project was provided by the US Department of Energy (Award # DE-EE0003139).

1/7/2014 TSG-13162.1

4. Potential Geothermal



Potential Geothermal Resources

WHITE PINE COUNTY, NV

Renewable Energy Feasibility Study and Resources Assessment

Geothermal Resource

Known Geothermal Systems

Measured/Calculated Temperatures (°C)

- 86 - 123; More Favorable
- 42 - 85; Less Favorable

Quaternary Faults

Age (yrs)

- <15,000
- <130,000
- <750,000
- <1,600,000

Basin Depth Contours

- 2 km
- 3 km
- 4 km

Temperature Gradient

°C/km

High : 65

Low : 23

Potential Undiscovered Structurally Controlled Systems

- Higher Priority for Exploration
- Lower Priority for Exploration

Substations (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational

Transmission Lines (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational
- 500kV, Approved
- 230+kV, Proposed Sec. 368

Suitability Considerations

- Potential Sage Grouse Habitat
- Lands Excluded from Development
- Existing Renewable Energy Facility

Data Description

Geothermal Resource Availability	Geothermal Resource analysis was prepared by Hinz, Coolbaugh, and Faulds (2013) of the Nevada Bureau of Mines & Geology (NBMG). Their analysis indicates that the best potential for three of six known shallow geothermal systems (red, green, and blue triangles on map) for direct or indirect energy utilization are Monte Neva Hot Springs, Cherry Creek Hot Springs, and Williams Hot Springs. Quaternary faults, shown as red, orange, green, and blue fault lines, may indicate permeable fault zones that facilitate convective heat flow. Research by NBMG shows that specific fault patterns or structural settings may identify potential undiscovered structurally controlled systems (short dashed circular and oval areas indicated on the map). Those shown with red dashed outlines are considered to have a higher exploration priority based on Quaternary faults younger than 15,000 years that have a high slip and dilation tendency. The basin depth contours, shown as red (4 km), green (3 km), and blue (2 km) long dashed lines, indicate a potential for deep stratigraphic geothermal reservoirs in intermontane basins. The basin with the best potential is the northern part of Steptoe Valley in the area east of Cherry Creek Hot Spring, as indicated by the higher temperature gradients.
Excluded Lands Restriction	Excluded lands, shown in gray, are federal and state lands excluded from project development. Federal lands were identified in the BLM/DOE Final Programmatic EIS for Solar Energy Development in Six Southwestern States (FEIS 12-24 DOE/ EIS-0403; July 2012). Also included are Department of Defense, Department of Energy, Fish and Wildlife Service, National Park Service, and State Parks and Wildlife Management Areas from the Bureau of Land Management, Nevada and Utah, Fish and Wildlife Service Areas, and Humboldt-Toiyabe Forest Service Land Status datasets.
Greater Sage-grouse Potential Restriction	The Greater Sage-grouse is a candidate species that may have potentially wide-ranging impact on siting of permanent facilities and infrastructure. Greater Sage-grouse Habitat was mapped and published by the Nevada Department of Wildlife in March 2012 as the "Greater Sage-grouse Habitat Categorization Map". The data is shown with a dot pattern and includes the following Greater Sage-grouse habitat categories: 1) essential/irreplaceable habitat, 2) important habitat, and 3) habitat of moderate importance.
Transmission Availability	Transmission availability is shown with photointerpreted transmission lines and substations for capacities 230 kV or greater. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).
Existing Renewable Energy Facility	The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).
Shaded Relief	Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.

N

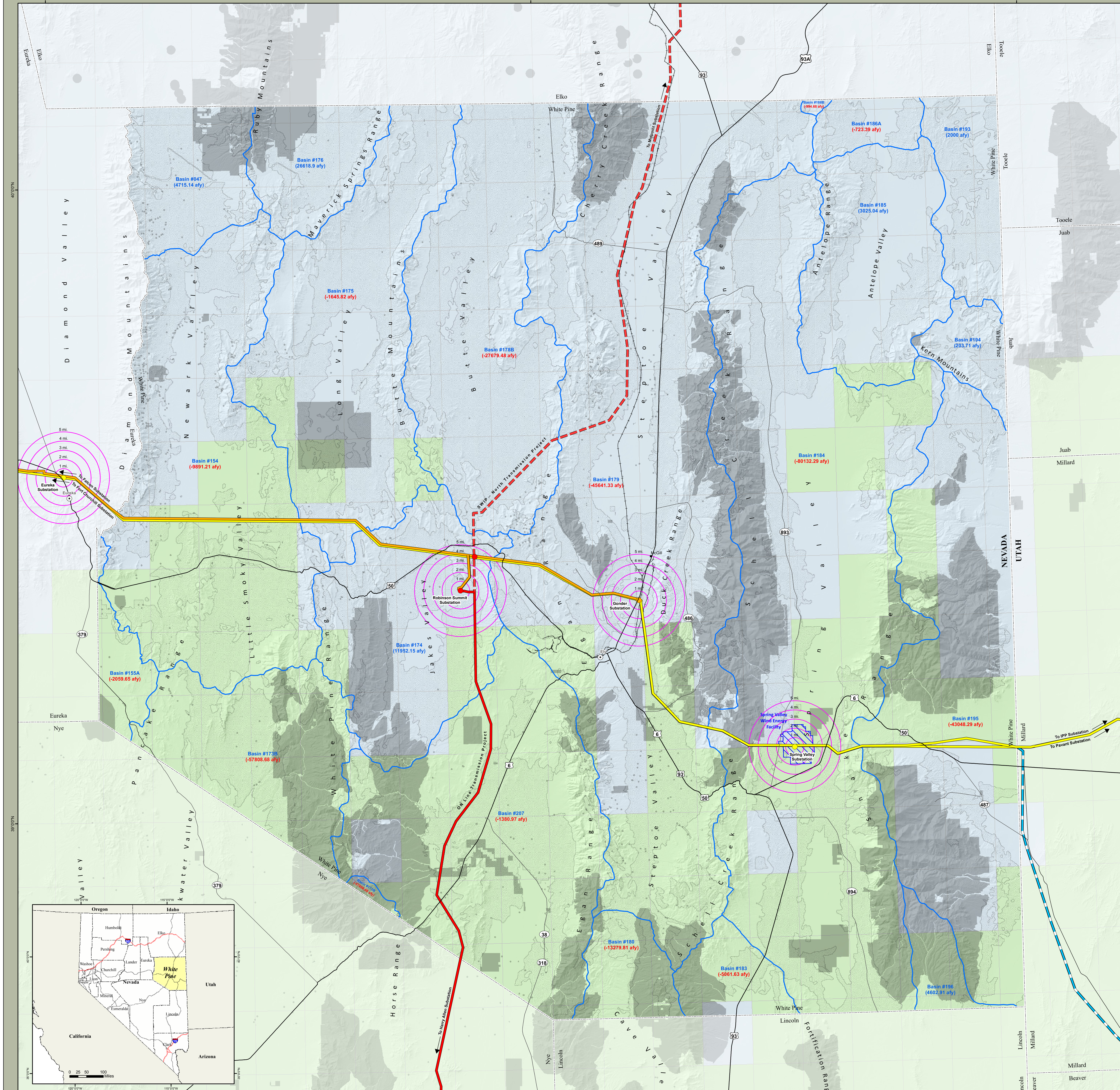
0 5 10 15 Miles

Produced By:	TerraSpectra Geomatics
Grid/Units:	UTM, Zone 11, Meters
Projection:	Transverse Mercator
Datum/Spheriod:	NAD1893/GRS80

Funding for this project was provided by the US Department of Energy (Award # DE-EE0003139).

1/7/2014 TSG-13166.1

5. Photovoltaic Solar



Photovoltaic (PV) Solar Resource

WHITE PINE COUNTY, NV

Renewable Energy Feasibility Study and Resources Assessment

Photovoltaic Solar Resource

Annual Average Kilowatt Hours per Meter Squared per Day (kWh/m2/day)

- >6.0 - 6.5
- >5.5 - 6.0

Substations (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational

Transmission Lines (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational
- 500kV, Approved
- 230+kV, Proposed Sec. 368

Suitability Considerations

- Preliminary Priority and General Sage-grouse Habitat
- Lands Excluded from Development
- Existing Renewable Energy Facility
- Groundwater Availability by Basin
- 10MW Potential Pilot Plant Location

Data Description

Solar Resource Availability	The Photovoltaic (PV) Solar Resource is represented by solar energy available to a photovoltaic panel, oriented south at an angle. The solar resource is in units of kWh/m2/day annually averaged for 1998-2009 over 10 sq. km. surface cells. The data was developed by SUNY Albany and National Renewable Energy Laboratory - NREL (2012). The most favorable PV resource is greater than or equal to 6.0 kWhr/m2/day.
Excluded Lands Restriction	Excluded lands, shown in gray, are federal and state lands excluded from project development. Federal lands were identified in the BLM/DOE Final Programmatic EIS for Solar Energy Development in Six Southwestern States (FEIS 12-24 DOE/ EIS-0403; July 2012). Also included are Department of Defense, Department of Energy, Fish and Wildlife Service, National Park Service, and State Parks and Wildlife Management Areas from the Bureau of Land Management, Nevada and Utah, Fish and Wildlife Service Areas, and Humboldt-Toiyabe Forest Service Land Status datasets.
Greater Sage-grouse Potential Restriction	The Greater Sage-grouse is a candidate species that may have potentially wide-ranging impact on siting of permanent facilities and infrastructure. Greater Sage-grouse Habitat was mapped and published by the Nevada Department of Wildlife in March 2012 as the "Greater Sage-grouse Habitat Categorization Map". The data is shown with a dot pattern and includes the following Greater Sage-grouse habitat categories: 1) essential/irreplaceable habitat, 2) important habitat, and 3) habitat of moderate importance.
Groundwater Availability	Groundwater availability was developed by data from the State of Nevada, Division of Water Resources. Blue outlined polygons represent administrative hydrographic area or basin boundaries. Blue text shows basin number and available acre feet per year (afy), for under-appropriated basins. Over-appropriated basins show a negative afy value with red text.
Transmission Availability	Transmission availability is shown with photointerpreted transmission lines and substations for capacities 230 kV or greater. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).
10 MW Potential Pilot Location	Five miles is considered the maximum distance between a potential 10 MW pilot plant and an existing substation. The factors listed above will also help to determine a location.
Existing Renewable Energy Facility	The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).
Shaded Relief	Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.

N

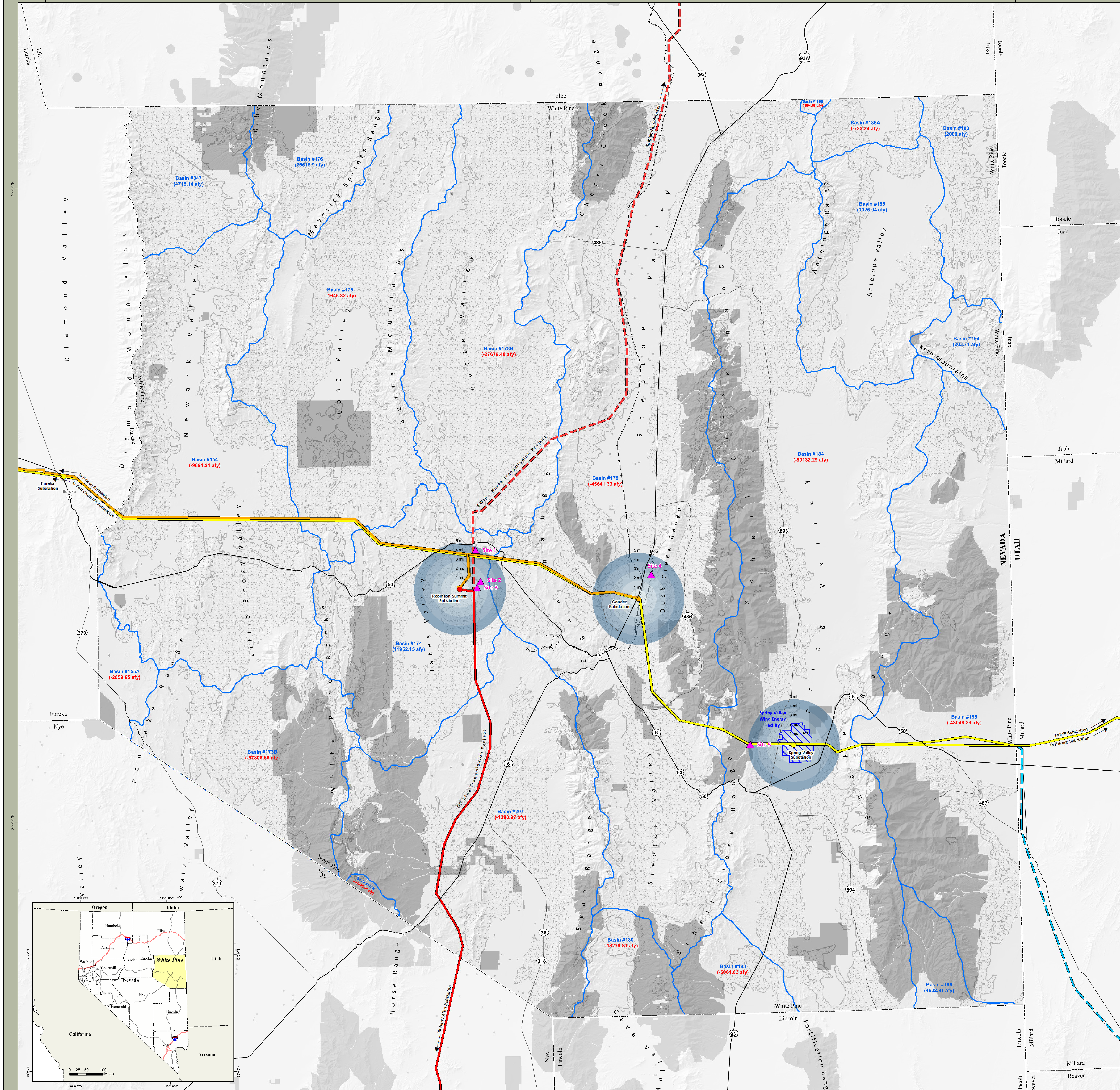
0 5 10 15 Miles

Produced By:	TerraSpectra Geomatics
Grid/Units:	UTM, Zone 11, Meters
Projection:	Transverse Mercator
Datum/Spheroid:	NAD1893/GRS80

Funding for this project was provided by the US Department of Energy (Award # DE-EE0003139).

1/7/2014 TSG-13163.1

6. Microhydro Resource



Microhydro Resource

WHITE PINE COUNTY, NV

Renewable Energy Feasibility Study and Resources Assessment

Microhydro Resource (Pumped Storage Hydro)

- Area Investigated for a Pilot 50MW Pumped Storage Hydro was within Five Miles of an Operational Substation
- Potential Site for a 50MW Pilot Pumped Storage Hydro

Substations (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational

Transmission Lines (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational
- 500kV, Approved
- 230+kV, Proposed Sec. 368

Suitability Considerations

- Preliminary Priority and General Sage-grouse Habitat
- Lands Excluded from Development
- Existing Renewable Energy Facility
- Groundwater Availability by Basin

Site ID	Upper Reservoir Site (acres)	Upper Reservoir Site Slope	Upper to Lower Reservoir Relief (Ft)	Upper to Lower Reservoir Horizontal Distance (Ft)
1	16.01	≤ 5°	79	712
2	16.01	≤ 5°	240	1,576
3	19.13	≤ 5°	62	559
4	24.02	≤ 5°	108	882
5	15.66	≤ 5°	18	2,561

Data Description

Microhydro Resource Availability
Microhydro Resource Analysis was defined by Millenium Energy, LLC and performed by TerraSpectra Geomatics. 50MW Pilot Pumped Storage Hydro site locations were modeled within five miles of each 230kV or larger capacity substation within White Pine County. The model was designed to find 15 acre or larger upper reservoir sites that had a maximum slope of 5 degrees, had a minimum 164 feet vertical relief above and a maximum 1000 feet horizontal distant from the the montane - intermontane valley interface where a lower reservoir could be sited. Shown on the map are potential pilot sites that were 15 acres or larger that had a maximum slope of 5 degrees. Magenta triangles with site ID numbers shown on the map indicate the location of potential upper and lower reservoir sites. The table above indicates by green which site criteria are met and by red which site criteria are not met. No upper reservoir - lower reservoir pair met both horizontal and vertical distance criteria for a 50MW Pilot Pumped Storage Hydro Project. This should not be taken to indicate that a larger utility-scale Pumped Storage Hydro Project is unfeasable given the abundant high relief available.

Excluded Lands Restriction
Excluded lands, shown in gray, are federal and state lands excluded from project development. Federal lands were identified in the BLM/DOE Final Programmatic EIS for Solar Energy Development in Six Southwestern States (FEIS 12-24 DOE/ EIS-0403; July 2012). Also included are Department of Defense, Department of Energy, Fish and Wildlife Service, National Park Service, and State Parks and Wildlife Management Areas from the Bureau of Land Management, Nevada and Utah, Fish and Wildlife Service Areas, and Humboldt-Toiyabe Forest Service Land Status datasets.

Greater Sage-grouse Potential Restriction
The Greater Sage-grouse is a candidate species that may have potentially wide-ranging impact on siting of permanent facilities and infrastructure. Greater Sage-grouse Habitat was mapped and published by the Nevada Department of Wildlife in March 2012 as the "Greater Sage-grouse Habitat Categorization Map". The data is shown with a dot pattern and includes the following Greater Sage-grouse habitat categories: 1) essential/irreplaceable habitat, 2) important habitat, and 3) habitat of moderate importance.

Groundwater Availability
Groundwater availability was developed by data from the State of Nevada, Division of Water Resources. Blue outlined polygons represent administrative hydrographic area or basin boundaries. Blue text shows basin number and available acre feet per year (afy), for under-appropriated basins. Over-appropriated basins show a negative afy value with red text.

Transmission Availability
Transmission availability is shown with photointerpreted transmission lines and substations for capacities 230 kV or greater. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).

50 MW Potential Pilot Location
Five miles is considered the maximum distance between a potential 50 MW pilot plant and an operational substation. The factors listed above will also help to determine a location.

Existing Renewable Energy Facility
The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).

Shaded Relief
Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.

N

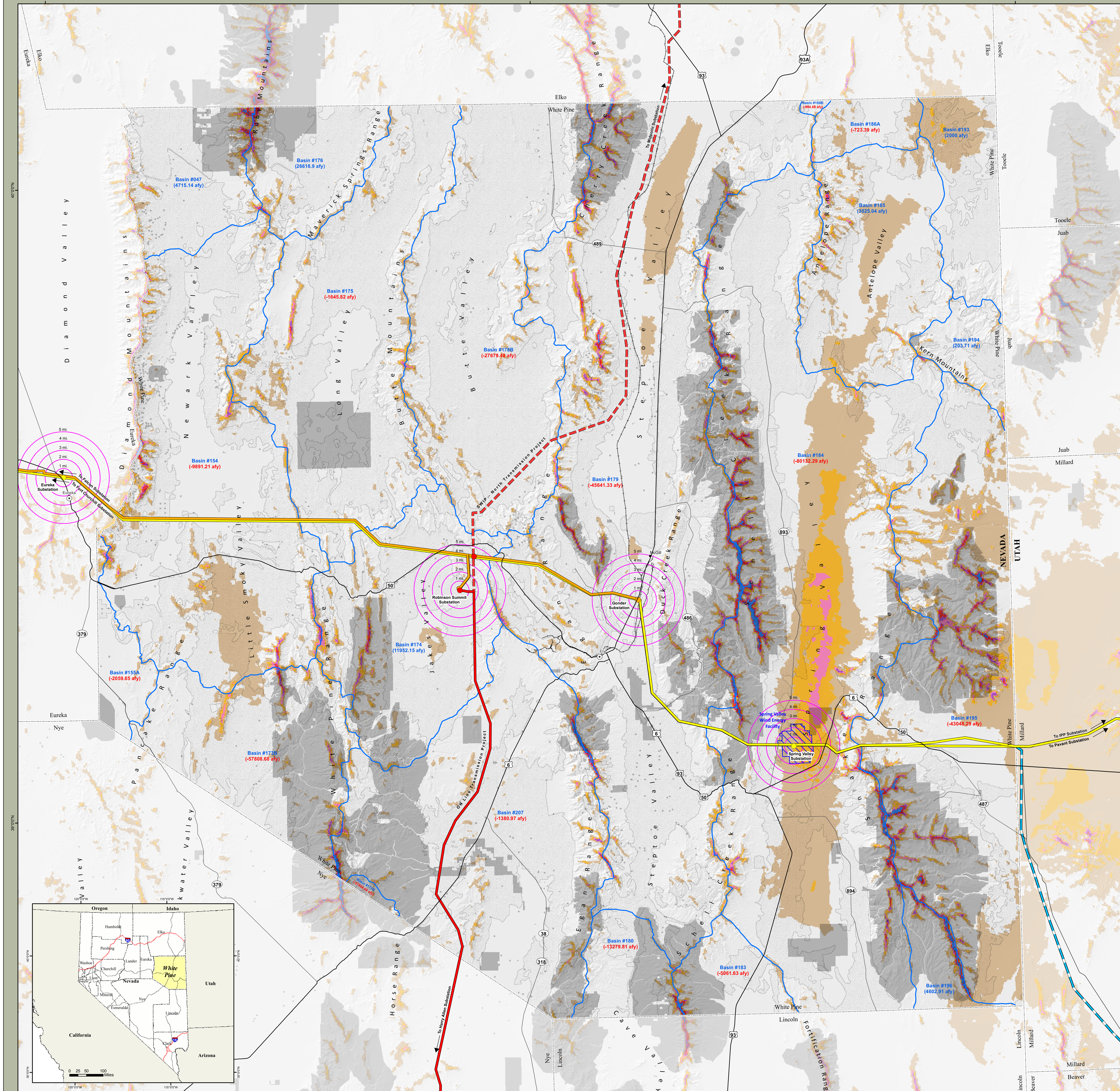
0 5 10 15 Miles

Produced By:	TerraSpectra Geomatics
Grid/Units:	UTM, Zone 11, Meters
Projection:	Transverse Mercator
Datum/Spheriod:	NAD1893/GRS80

Funding for this project was provided by the US Department of Energy (Award # DE-EE0003139).

1/7/2014 TSG-13167.1

7. Wind Power



Wind Power Resource

WHITE PINE COUNTY, NV

Renewable Energy Feasibility Study and Resources Assessment

Wind Power at 50m Height

Wind Power Class

- 7 - Superb
- 6 - Oustanding
- 5 - Excellent
- 4 - Good
- 3 - Fair
- 2 - Marginal

Substations (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational

Transmission Lines (Capacity, Status)

- 500kV, Operational
- 345kV, Operational
- 230kV, Operational
- 500kV, Approved
- 230+kV, Proposed Sec. 368

Suitability Considerations

- Preliminary Priority and General Sage-grouse Habitat
- Lands Excluded from Development
- Existing Renewable Energy Facility
- Groundwater Availability by Basin
- 10MW Potential Pilot Plant Location

Data Description

Wind Power Resource Availability	Annual average Wind Power Resource at 50-meter height above ground surface based upon potential Wind Power Density in W/m2 (watts per meter squared). Wind power is divided into seven classes where class 3 or greater areas are suitable for most utility-scale wind turbine applications, class 2 areas are marginal for utility-scale applications but may be suitable for rural applications, and class 1 areas (not shown) are generally not suitable. This data was developed by AWS TrueWind/NREL (2003).
Excluded Lands Restriction	Excluded lands, shown in gray, are federal and state lands excluded from project development. Federal lands were identified in the BLM/DOE Final Programmatic EIS for Solar Energy Development in Six Southwestern States (FEIS 12-24 DOE/ EIS-0403; July 2012). Also included are Department of Defense, Department of Energy, Fish and Wildlife Service, National Park Service, and State Parks and Wildlife Management Areas from the Bureau of Land Management, Nevada and Utah, Fish and Wildlife Service Areas, and Humboldt-Toiyabe Forest Service Land Status datasets.
Greater Sage-grouse Potential Restriction	The Greater Sage-grouse is a candidate species that may have potentially wide-ranging impact on siting of permanent facilities and infrastructure. Greater Sage-grouse Habitat was mapped and published by the Nevada Department of Wildlife in March 2012 as the "Greater Sage-grouse Habitat Categorization Map". The data is shown with a dot pattern and includes the following Greater Sage-grouse habitat categories: 1) essential/irreplaceable habitat, 2) important habitat, and 3) habitat of moderate importance.
Groundwater Availability	Groundwater availability was developed by data from the State of Nevada, Division of Water Resources. Blue outlined polygons represent administrative hydrographic area or basin boundaries. Blue text shows basin number and available acre feet per year (afy), for under-appropriated basins. Over-appropriated basins show a negative afy value with red text.
Transmission Availability	Transmission availability is shown with photointerpreted transmission lines and substations for capacities 230 kV or greater. SWIP - North and Proposed Sec. 368 lines from BLM Record of Decision for Designation of Energy Corridors on BLM-Administered lands in the 11 Western States as enacted in Section 368 of the Energy Policy Act of 2005 (P.L. 109-58).
10 MW Potential Pilot Location	Five miles is considered the maximum distance between a potential 10 MW pilot plant and an existing substation. The factors listed above will also help to determine a location.
Existing Renewable Energy Facility	The Spring Valley Wind Energy Facility is from the Record of Decision for the Final Environmental Assessment (EA) (DOI-BLM-NV-L020-2010-0007-EA).
Shaded Relief	Derived from U.S. Geological Survey, The National Elevation Dataset (NED), 1/3-arc-second.

N

0 5 10 15 Miles

Produced By:	TerraSpectra Geomatics
Grid/Units:	UTM, Zone 11, Meters
Projection:	Transverse Mercator
Datum/Spheriod:	NAD1893/GRS80

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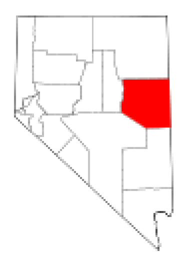
1/7/2014 TSG-13164.1

Appendix I: Financial Analysis and Incorporation of Risk in Clean Energy Projects for White Pine County – University of Nevada, Reno

TECHNICAL REPORT
UCED 2013/14 #4

Financial Analysis and Incorporation of Risk in Clean Energy Projects for White Pine County



University of Nevada, Reno
Center for Economic Development

Financial Analysis and Incorporation of Risk in Clean Energy Projects for White Pine County

Report Prepared by

Thomas R. Harris

Thomas R. Harris is a Professor in the Department of Economics and Director of the University Center for Economic Development, College of Business at the University of Nevada, Reno.

University Center for Economic Development
Department of Resource Economics
University of Nevada, Reno
Reno, Nevada
(775) 784-1681

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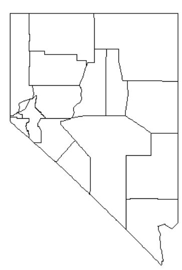
Thomas R. Harris, Director
University Center for Economic Development
University of Nevada, Reno
Department of Economics
Mail Stop 204
Reno, Nevada 89557



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

Financial Analysis and Incorporation of Risk in Clean Energy Project for White Pine County

Financial Analysis and Incorporation of Risk in Clean Energy Project for White Pine County

Executive Summary

The University Center for Economic development completed a feasibility analysis for five hypothetical clean energy projects in White Pine County, Nevada. These alternative energy projects are biomass, concentrated solar-hybrid, micro hydro, photovoltaic solar and wind. The results of these hypothetical clean energy studies can provide educational background to White Pine County decision makers as to financial considerations for actual clean energy projects. Also actual clean energy studies may have different assumptions that need to be considered that may not be addressed in these hypothetical studies.

Simulation Modeling for Feasibility Analysis

- Feasibility studies can be deterministic or stochastic in nature.
- Deterministic models do not have output, input price or output price variation. Feasibility analysis completed with average prices could be considered as a probability of 50% occurring.
- Stochastic models allow for output, input, output prices and input prices to vary. Stochastic simulation allows risk to be considered in feasibility analysis.
- The Monte Carlo or stochastic simulation results of this study aims to identify clean energy investments that not only have high positive net returns under average conditions but also yield the highest returns under unfavorable conditions.

Solar Photovoltaic Feasibility Analysis

- The Solar Photovoltaic (PV) system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 30 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- Usually renewable energy studies estimate annual production which includes downtime. Following a memo from Bourg (2013a), power production for a 10MW plant in White Pine County (Ely TMY weather data) using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM) was estimated using the assumptions from SAM and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated to be 20,075,482 kWh.
- For output prices, the latest benchmark in Nevada for Solar Purchase Price Agreement (PPA) price is $0.09/kWh from the 2011 round of Renewable Portfolio Standards (RPS) bids. Since Photovoltaic and Concentrated Solar Power (CSP) compete with one another, the sales price would be the same for both resources. However costs have declined for

solar projects in the last couple of years and based on what the industry has seen in adjacent states the output price ranges between $0.08/kWh to $0.09/kWh with $0.085/kWh as the mode and with zero annual escalation in PPA prices.

- For the deterministic analysis the mode output price will be used which is $0.085/kWh. For stochastic analysis, output prices are simulated using a GRKS probability distribution. The GRKS distribution is discussed in detail within the report.
- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.
- Results of the deterministic and stochastic feasibility analysis show that the estimated internal rate of return for investor's cash flow benefit is **greater** than the investor's required rate of return between 10% and 15%. Also results indicate that income tax credits and MCRS depreciation schedule impact the feasibility of this project.

Concentrating Solar with Hybrid Cooling Feasibility Analysis

- The Concentrating Solar with Hybrid Cooling system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 30 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- Usually renewable energy studies estimate annual production which includes downtime. Following a memo from Bourg (2013b), power production for a 10MW plant in White Pine County (Ely TMY weather data) using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM) was estimated using the assumptions from SAM and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated to be 25,385,765 kWh.
- For the deterministic analysis the mode output price will be used which is $0.085/kWh. For stochastic analysis, output prices are simulated using a GRKS probability distribution. The GRKS distribution is discussed in detail within the report.
- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.
- Results of the deterministic and stochastic feasibility analysis show that the estimated internal rate of return for investor's cash flow benefit is **less** than the investor's required rate of return between 10% and 15%. Also results indicate that income tax credits and MCRS depreciation schedule impact the feasibility of this project.

Wind Power Feasibility Analysis

- The Wind Power system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 25 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.

- Usually renewable energy studies estimate annual production which includes downtime. Following a memo from Bourg (2013c), power production for a 10MW plant in White Pine County (Ely TMY weather data) using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM) was estimated using the assumptions from SAM and a default downtime of 4% per year for scheduled maintenance and unscheduled outages. Therefore, the annual energy production is estimated to be 25,966,878 kWh.
- For the deterministic analysis the output price will be $0.084/kWh. For the feasibility of wind power, there will be no stochastic prices. Only deterministic simulation will be made.
- Results of the deterministic feasibility analysis show that the estimated internal rate of return for investor's cash flow benefit is **greater** than the investor's required rate of return between 10% and 15%. Also results indicate that income tax credits and MCRS depreciation schedule impact the feasibility of this project

Pumped Storage Hydro Plant Feasibility Analysis

- The pumped storage hydro system is assumed to be a 50 mega-watt (10MW) facility with the length of analysis being 30 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- From Bourg(2013d), similar to other resource assessments, renewable production estimates are typically derived by calculating the annual production estimate, including downtime for scheduled maintenance and unscheduled interruptions. For this analysis, annual production is estimated from recently Federal Energy Regulation Commission (FERC) approved 3,000 MW pumped hydro project near Ely, Nevada. Based on the estimated annual energy output from the Ely project, a similar, but smaller 50 MW project would generate an estimated 153,300,000 kWh per year.
- For the deterministic analysis the output price will be $0.05/kWh. For the feasibility of wind power, there will be no stochastic prices. Only deterministic simulation will be made.
- Results of the deterministic feasibility analysis show that the estimated internal rate of return for investor's cash flow benefit is **less** than the investor's required rate of return between 10% and 15%. Also results indicate that income tax credits and MCRS depreciation schedule impact the feasibility of this project.

Biomass Power Feasibility Analysis

- The Biomass Power system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 20 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- Correspondence with Don Henderson of Resource Concepts (2013) and a report The Beck Group (2011) provided information as to annual net production from the Biomass Power plant to be 82,000,000 kWh per year.

- For output prices, correspondence with Don Henderson of Resource Concepts (2013) and a report The Beck Group (2011) provided information as to output price being $0.095 kWh. Only deterministic simulation will be made.
- Results of the deterministic feasibility analysis show that the estimated internal rate of return for investor’s cash flow benefit is less than the investor’s required rate of return between 10% and 15%. Also results indicate that income tax credits and MCRS depreciation schedule impact the feasibility of this project.

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Financial Analysis and Incorporation of Risk in Clean Energy Project for White Pine County

Introduction

For this paper, feasibility analysis will be completed for five hypothetical alternative energy projects. These alternative energy projects are biomass, concentrated solar-hybrid, micro hydro, photovoltaic solar and wind. The purpose of the hypothetical feasibility analysis is to provide an understanding of potential financial considerations for actual clean energy investments. For actual clean energy projects, detailed feasibility analysis would require specific financial and physical information as to the proposed project. Also for this analysis, deterministic and stochastic feasibility analysis will be completed given price data availability. Stochastic or Monte Carlo simulation offers business analyst and investors an economical means of conducting risk-based economic feasibility studies of new investments such as alternative energy projects in White Pine County.

Simulation Modeling for Feasibility Analysis

For the purposes of this study, a Monte Carlo simulation was utilized to capture the variability in output prices and accompanying risk that needs to be considered in a feasibility analysis. Deterministic investment feasibility analysis ignores price and cost variability and does not incorporate risk. Deterministic models provide only a point estimate of key operating variables (KOV's) instead of estimating the probability distribution that incorporates risk of success and failure in a feasibility analysis (Pouliquen, 1970, Reutlinger, 1970; Hardaker et al., 2004). Pouliquen (1970) indicates the benefits of Monte Carlo simulations are that it provides decision-makers the extreme values of KOV's and their probabilities along with a weighted estimate of the relationships between unfavorable and favorable outcomes. In addition to the risk analysis and how it affects the feasibility of the project, Pouliquen (1970) suggests that the complete feasibility simulation can be used to analyze alternative management plan if the investment is undertaken. The Monte Carlo simulation results of this study aims to identify clean energy investments that not only have high positive net returns under average conditions but also yield the highest returns under unfavorable conditions.

Easy to use simulation add-ons for Excel, such as Semitar, @Risk, and Crystal Ball, are available to convert deterministic Excel spreadsheet model to Monte Carlo simulation models. For this paper, the add-on Excel Semitar package will be used (Richardson et al., 2006). The Semitar program allows investigators to ask "what if" questions for recyclable projects.

Richardson (2006) outlined steps in developing Monte Carlo simulation analysis of investment projects. First probability distributions for all risky variables must be defined, parameterized, simulated and validated. Second, the stochastic variables from the probability distributions are used in the accounting equations to calculate production, receipts, costs, cash flows, and balance sheet variables for the project. Stochastic values sampled from the probability distributions make the financial statement variables stochastic, Third, the completed stochastic model is simulated many times (i.e. 500 iterations) using random values for the risky variables. The results of the 500 samples provide the information to estimate empirical probability distributions for unobservable KOVs; such as; net present value, and annual cash flows, so investors can evaluate the probability of success for a proposed clean energy project. Fourth, the analysis uses the stochastic simulation model to analyze alternative management scenarios, and provides the results to the decision-maker in the form of probabilities and probabilistic forecasts for the KOV's.

Solar Photovoltaic Feasibility Analysis

The key assumptions for the feasibility analysis of the Solar Photovoltaic (PV) system are listed below:

- The Solar Photovoltaic (PV) system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 30 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- Usually renewable energy studies estimate annual production which includes downtime. Following a memo from Bourg (2013a), power production for a 10MW plant in White Pine County (Ely TMY weather data) using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM) was estimated using the assumptions from SAM and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated to be 20,075,482 kWh.
- For output prices, the latest benchmark in Nevada for Solar Purchase Price Agreement (PPA) price is $0.09/kWh from the 2011 round of Renewable Portfolio Standards (RPS) bids. Since Photovoltaic and Concentrated Solar Power (CSP) compete with one another, the sales price would be the same for both resources. However costs have declined for solar projects in the last couple of years and based on what the industry has seen in adjacent states the output price ranges between $0.08/kWh to $0.09/kWh with $0.085/kWh as the mode and with zero annual escalation in PPA prices.
- For the deterministic analysis the mode output price will be used which is $0.085/kWh. For stochastic analysis, output prices are simulated using a GRKS probability distribution. The GRKS distribution was named for its developers, **G**ray, **R**ichardson, **K**lose, and **S**chuman (Richardson, Herbst, Outlaw, and Gill, 2007). The distribution is used to simulate random variables with a minimum of information which are a minimum, a middle value, and a maximum value. The GRKS draws 2.28% of the values below the minimum and 2.28% of the value above the maximum. Random values drawn outside the minimum and maximum values account for low-frequency rare events that could significantly impact a business or

what are called Black Swans. The GRKS distribution does not force the minimum or maximum values to be equal distance from the middle so the GRKS can simulate a skewed distribution. For this paper the GRKS distribution will be employed to estimate random output prices with minimum price of $0.08/kWh, mode price of $0.085/kWh, and the maximum price of $0.09/kWh. The random prices for the model are simulated as a multivariate empirical probability distribution using procedures outlined by Richardson et al. (2000).

- The Solar PV Plants are subsidized with tax benefits via three mechanisms: two that are Federal and one that is from the State of Nevada. The first is a 30% Investment Tax Credit where the plant owner would realize 30% of the plant cost as a tax credit in Year 1. The second is the Modified Accelerated Cost Recovery Mechanism (MACRS). MACRS allows for solar plants to be depreciated over 5 1/2 years. The first step is to calculate the net basis of depreciation. For the Solar PV, it is the total plant cost (including interconnection equipment and transmission lines) minus the one-half times the 30% Investment Tax Credit. This net basis is then depreciated according to the following schedule:
  Year 1: 20%
  Year 2: 32%
  Year 3: 19.2%
  Year 4: 11.52%
  Year 5: 11.52%
  Year 6: 5.76%.
  The third mechanism is from the state of Nevada. This is a property tax abatement of 55% for twenty years for the Solar PV system. This property tax abatement will be employed because the hypothetical system is a 10 MW system and qualifies. However, there may be additional requirements for the property abatements under NRS 701A.360 that an actual project needs to consider.
- The estimated plant and transmission line cost is assumed to be $26,740,930. It is assumed for the hypothetical plant with a five mile transmission line to the interconnection point.
- An inverter replacement cost of $2,500,000 will be accounted for in year 15.
- It is assumed 40 acres of land purchased at $2,500 per acre, for land cost of $100,000.
- For plant investment, it is assumed 30% down or $8,022,279 with the remainder of the debt financed.
- The length of loan will be twenty (20) years with an interest rate of 5.5%.
- Annual variable cost which includes production based O&M cost plus insurance will be $230,000. Also assumed is an annual inflation rate of 2%.
- Federal taxes are included as 35% of income.

- The Corporate Owner/Tax Equity Partner was assumed to fully utilize tax credits, depreciation, and tax losses.
- For feasibility analysis, internal rate of return for the Solar PV system investments will be estimated. Internal rate of return estimates the rate of interest which equates the net present value of a projected series of cash flow payments to zero. Internal rate of return can be used to rank investments and accept or reject invests based on their internal rate of return. Acceptability of the Solar PVsystem investment depends upon comparison of its internal rate of return (IRR) with the investor's required rate of return (RRR). For this feasibility analysis, the required rate of return has to be between 10% to 15%. Acceptability is based on the following decision rules listed below:

  IRR exceeds RRR, investment is accepted

  IRR equals RRR, then investment is indifferent

  IRR less RRR, reject investment.

- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.

Pro Forma Income Statement for Solar Photovoltaic System

Table 1 show Year One Pro Forma Income Statement for the deterministic analysis where output price is held constant at $0.085/kWh for each year of the thirty year feasibility. The Solar Photovoltaic System generates the following revenues and cost for Year One.

As shown in Pro Forma Income Statement (Table 1), the project generates a Year One revenue stream of approximately $1,706.4 thousand, of which $384.7 thousand is used to pay operations, maintenance, and property taxes. This leaves net operating income of $1,321.7 thousand prior to application of depreciation, payment of long-term debt, and taxes. The total after tax cash flow benefit is $9,260.0 thousand in Year One. A thirty year pro forma scenario for the deterministic model is presented in Appendix A in Table 1.A. At a price of $0.085/kWh for each year of the thirty year feasibility, the project's internal rate of return was estimated to be 35.59% which exceeds the needed rate of return by investors of between 10% to 15%.

For the stochastic analysis, the GRKS distribution was employed with price ranging from $0.08/kWh at the minimum, $0.085kWh at the mode, and $0.09/kWh at the maximum. Figure 1 shows range of internal rates of return with an average rate of return of 39.59%, a minimum of

37.99%, and a maximum of 41.15%. For the investor, Figure 1 shows that for all output prices the minimum requirement rate of return of 10% to 15% is met and exceeded. Also results of the deterministic and stochastic feasibility analysis, show that the above internal rate of return for investor's cash flow benefit is influenced by income tax credits and MCRS depreciation schedule.

Table 1. Solar Photovoltaic Power Plant Deterministic Simulation for Year One Pro Forma Income Statement ($1,000)

REVENUE/EXPENSE LINE ITEM	**($1,000)**
Electric Sales	1,706.4
Other Sales	0.0
Total Revenues:	**1,706.4**
Variable Cost	230.0
Property Tax	154.7
Total Operating Expense:	**384.7**
OPERATING INCOME	**1,321.7**
-Interest	1,035.0
-Depreciation	4,546.0
PRE TAX INCOME:	**-4,259.3**
-Taxes	-9,513.0
Net Income (book)	**5,253.7**
PROJECT CASH FLOW & BENEFITS	
PRETAX INCOME:	-4,259.3
+Book Depreciation	4,546.0
-Loan Principal	539.7
PRETAX CASH FLOW	**-253.0**
TAXES/CREDITS	
Federal Taxes	-1,490.8
Less Federal Tax Credits	-8,022.3
NET TAXES	**9,513.0**
NET CASH FLOWS	
Operating Pretax Cash Flow	-253.0
State Credits/Grants	0.0
Federal Credits/Taxes	9,513.0
Total Cash Flow Benefit	**9,260.0**

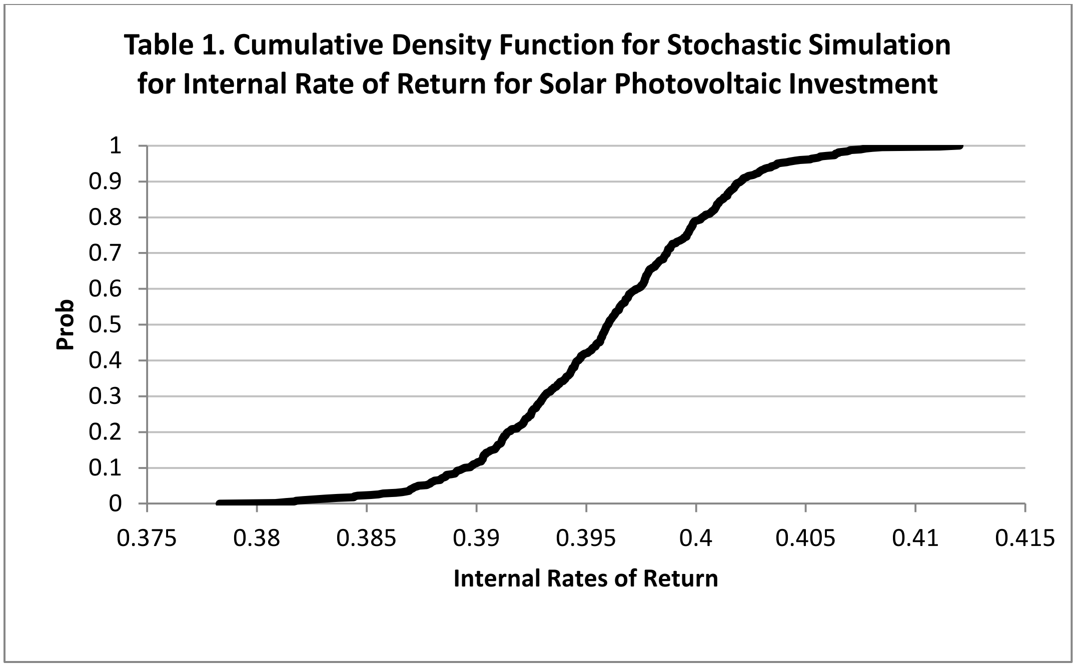


Table 1. Cumulative Density Function for Stochastic Simulation for Internal Rate of Return for Solar Photovoltaic Investment
Prob
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.375
0.38
0.385
0.39
0.395
0.4
0.405
0.41
0.415
Internal Rates of Return

Concentrating Solar with Hybrid Cooling Feasibility Analysis

The key assumptions for the feasibility analysis of the Concentrating Solar with Hybrid Cooling system are listed below:

- The Concentrating Solar with Hybrid Cooling system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 30 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.

- Usually renewable energy studies estimate annual production which includes downtime. Following a memo from Bourg (2013b), power production for a 10MW plant in White Pine County (Ely TMY weather data) using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM) was estimated using the assumptions from SAM and a default downtime of 4% per year for scheduled maintenance and unscheduled outages, the annual energy production is estimated to be 25,385,765 kWh.

- For output prices, the latest benchmark in Nevada for Solar Purchase Price Agreement (PPA) price is $0.09/kWh from the 2011 round of Renewable Portfolio Standards (RPS) bids. Since Photovoltaic and Concentrated Solar Power (CSP) compete with one another, the sales price would be the same for both resources. However costs have declined for solar projects in the last couple of years and based on what the industry has seen in adjacent states the output price ranges between $0.08/kWh to $0.09/kWh with $0.085/kWh as the mode and with zero annual escalation in PPA prices.

- For the deterministic analysis the mode output price will be used which is $0.085/kWh. For stochastic analysis, output prices are simulated using a GRKS probability distribution. The GRKS distribution was named for its developers, **G**ray, **R**ichardson, **K**lose, and **S**chuman (Richardson, Herbst, Outlaw, and Gill, 2007). The distribution is used to simulate random variables with a minimum of information which are a minimum, a middle value, and a maximum value. The GRKS draws 2.28% of the values below the minimum and 2.28% of the value above the maximum. Random values drawn outside the minimum and maximum values account for low-frequency rare events that could significantly impact a business or what are called Black Swans. The GRKS distribution does not force the minimum or maximum values to be equal distance from the middle so the GRKS can simulate a skewed distribution. For this paper the GRKS distribution will be employed to estimate random output prices with minimum price of $0.08/kWh, mode price of $0.085/kWh, and the maximum price of $0.09/kWh. The random prices for the model are simulated as a multivariate empirical probability distribution using procedures outlined by Richardson et al. (2000).

- The Concentrating Solar with Hybrid Cooling System plant are subsidized with tax benefits via three mechanisms: two that are Federal and one that is from the State of Nevada. The first is a 30% Investment Tax Credit where the plant owner would realize 30% of the plant cost as a tax credit in Year 1. The second is the Modified Accelerated Cost Recovery Mechanism (MACRS). MACRS allows for solar plants to be depreciated over 5 1/2 years. The first step is to calculate the net basis of depreciation. In this case, it is the total plant cost (including interconnection equipment and transmission lines) minus the one-half times the 30% Investment Tax Credit. This net basis is then depreciated according to the following schedule:

Year 1: 20%

Year 2: 32%

Year 3: 19.2%

Year 4: 11.52%

Year 5: 11.52%

Year 6: 5.76%.

The third mechanism is from the state of Nevada. This is a property tax abatement of 55% for twenty years for the Concentrating Solar with Hybrid Cooling System. This property tax abatement will be employed because the hypothetical system is a 10 MW system and qualifies. However, there may be additional requirements for the property abatements under NRS 701A.360 that an actual project needs to consider.

- A 30% Investment Tax Credit will be used by plant owner for the first year which would be 30% of the plant cost.
- A property tax abatement of 55% for twenty years for the Concentrating Solar with Hybrid Cooling System will be employed because the hypothetical system is a 10 MW system and qualifies. However, there may be additional requirements for the property abatements under NRS 701A.360 that an actual project needs to consider.
- The estimated plant and transmission line cost is assumed to be $71,497,738. It is assumed for the hypothetical plant with a five mile transmission line to the interconnection point.
- Capital replacement annually or Operations and Maintenance fixed costs if $643,500 with annual variable cost which includes operations and maintenance cost plus insurance is $434,671 (Bourg, 2013b).
- It is assumed 90 acres of land purchased at $2,500 per acre, for land cost of $225,000.
- For plant investment, it is assumed 30% down or $21,449,321 with the remainder of the debt financed.
- The length of loan will be twenty (20) years with an interest rate of 5.5%.

- Annual variable cost and annual capital replacement cost will be $1,078,171 annually. Also assumed is an annual inflation rate of 2%.
- Federal taxes are included as 35% of income.
- The Corporate Owner/Tax Equity Partner was assumed to fully utilize tax credits, depreciation, and tax losses.
- For feasibility analysis, internal rate of return for the Concentrating Solar with Hybrid Cooling System investments will be estimated. Internal rate of return estimates the rate of interest which equates the net present value of a projected series of cash flow payments to zero. Internal rate of return can be used to rank investments and accept or reject invests based on their internal rate of return. Acceptability of a Concentrating Solar with Hybrid Cooling System investment depends upon comparison of its internal rate of return (IRR) with the investor's required rate of return (RRR). For this feasibility analysis, the required rate of return has to be between 10% to 15%. Acceptability is based on the following decision rules listed below:

  IRR exceeds RRR, investment is accepted

  IRR equals RRR, then investment is indifferent

  IRR less RRR, reject investment.
- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.

Pro Forma Income Statement for Concentrating Solar with Hybrid Cooling

Table 2 show Year One Pro Forma Income Statement for the deterministic analysis where output price is held constant at $0.085/kWh for each year of the thirty year feasibility. The Concentrating Solar with Hybrid Cooling System generates the following revenues and cost for Year One.

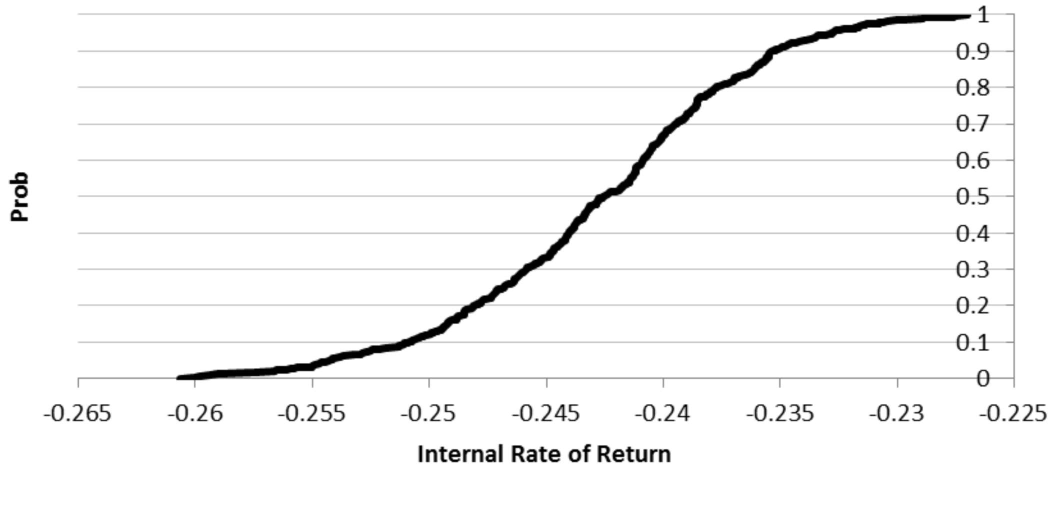
As shown in Pro Forma Income Statement (Table 1), the project generates a Year One revenue stream of approximately $2,157.8 thousand, of which $1,232.9 thousand is used to pay operations, maintenance, and property taxes. This leaves net operating income of $1,252.9 thousand prior to application of depreciation, payment of long-term debt, and taxes. The total after tax cash flow benefit is $23,065.5 thousand in Year One. A thirty year pro forma scenario for the deterministic model is presented in Appendix A in Table 2.A. At a price of $0.085/kWh for each year of the thirty year feasibility, the project's internal rate of return was estimated to be -24.25% which was **below** the needed rate of return by investors of between 10% to 15%.

For the stochastic analysis, the GRKS distribution was employed with price ranging from $0.08/kWh at the minimum, $0.085kWh at the mode, and $0.09/kWh at the maximum. Figure 2 shows range of internal rates of return with an average rate of return of -24.28%, a minimum of -26.07%, and a maximum of -22.70%. For the investor, Figure 2 shows that for stochastic output prices the minimum requirement of a 10% to 15% return is **not** met and exceeded. As in the Solar PV system investment, the internal rate of return for investors cash flow benefit is influenced by income tax credits and MCRS depreciation schedule.

Table 2. Concentrating Solar with Hybrid Cooling Plant Deterministic Simulation for One Year Pro Forma Income Statement ($1,000).

REVENUE/EXPENSE LINE ITEM	**($1,000)**
Electric Sales	2,157.8
Other Sales	0.0
Total Revenues:	**2,157.8**
Variable Cost	1,078.2
Property Tax	154.7
Total Operating Expense:	**1,253.9**
OPERATING INCOME	**924.9**
-Interest	2,765.0
-Depreciation	12,154.6
PRE TAX INCOME:	**-13,994.8**
-Taxes	-26,347.5
Net Income (book)	**12,352.7**
PROJECT CASH FLOW & BENEFITS	
PRETAX INCOME:	-13,994.8
+Book Depreciation	12,154.6
-Loan Principal	1,441.8
PRETAX CASH FLOW	**-3,282.0**
TAXES/CREDITS	
Federal Taxes	-4,898.2
Less Federal Tax Credits	21,449.3
NET TAXES	**26,347.5**
NET CASH FLOWS	
Operating Pretax Cash Flow	-3,282.0
State Credits/Grants	0.0
Federal Credits/Taxes	26,347.5
Total Cash Flow Benefit	**23,065.5**

Figure 2. Cumulative Density Function for Stochatic Simulation for Internal Rate of Return for Concentrating Solar with Hybrid Cooling Investement..



Wind Power Feasibility Analysis

The key assumptions for the feasibility analysis of the Wind Power system are listed below:

- The Wind Power system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 25 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- Usually renewable energy studies estimate annual production which includes downtime. Following a memo from Bourg (2013c), power production for a 10MW plant in White Pine County (Ely TMY weather data) using the National Renewable Energy Laboratory (NREL) System Advisor Model (SAM) was estimated using the assumptions from SAM and a default downtime of 4% per year for scheduled maintenance and unscheduled outages. Therefore, the annual energy production is estimated to be 25,966,878 kWh.
- For output prices, the latest and only benchmark Nevada for Wind 88 Purchase Price Agreement (PPA) is $0.098/kWh from 2010 round of Renewable Portfolio Standard (RPS) bids. From Bourg(2013c), it was determined that the best method for determining current PPA prices was to benchmark the 2010 NV Energy PPA against the average of PPA's in the Western Region. In 2010, the average wind PPA in the west was $0.9508/kWh. In 2012, the average wind PPA price in the west dropped to $0.084/kWh. Using the simple ratio of these prices, it was estimated that the current PPA price would be $0.0866/kWh. For the feasibility of wind power, there will be **no stochastic prices.** Only deterministic simulation will be made.

- For the deterministic analysis the output price will be $0.084/kWh.

- Wind Power plants are subsidized with tax benefits via three mechanisms which are two that are Federal and one that is from the state of Nevada (Bourg, 2013c). The first is a $0.023/kWh Production Tax Credit. The plant owner would realize a $0.023/kWh tax credit for every kWh generated for the first ten (10) years of operation. If there is no wind and no operation, there will be no production tax credit. The second federal mechanism is the Modified Accelerated Recovery System (MACRS) depreciation schedule which allows for wind plants to be depreciated over 5 ½ years. The initial step is to calculate the net basis of depreciation. In this case because the production tax credits are employed and not the investment tax credit, the depreciation basis is the full capital cost of the plant. The net basis is then depreciated according to the below schedule:
  Year 1: 20%
  Year 2: 32%
  Year 3: 19.2%
  Year 4: 11.52%
  Year 5: 11.52%

Year 6: 5.76%

Lastly, at the state level, there is a property tax abatement of 55% for 20 years for wind power plants over 10MW and hence this hypothetical plant qualifies. However, there may be additional requirements for the property abatements under NRS 701A.360 that an actual project may consider.

- The estimated plant and transmission line cost is assumed to be $21,291,510. It is assumed for the hypothetical plant a five mile transmission line to the interconnection point.
- It is assumed 5 acres of land purchased at $2,500 per acre, for land cost of $12,500.
- For plant investment, it is assumed 30% down or $6,387,453 with the remainder to be debt financed.
- The length of loan will be twenty (20) years with an interest rate of 5.5%.
- Annual variable cost which includes production based O&M cost plus insurance will be $230,000. Also assumed is an annual inflation rate of 2%.
- Federal taxes are included as 35% of income.
- The Corporate Owner/Tax Equity Partner was assumed to fully utilize tax credits, depreciation, and tax losses.
- For feasibility analysis, internal rate of return for the Wind Power investment will be estimated. Internal rate of return estimates the rate of interest which equates the net present value of a projected series of cash flow payments to zero. Internal rate of return can be used to rank investments and accept or reject invests based on their internal rate of return. Acceptability of a Wind Power investment depends upon comparison of its internal rate of return (IRR) with the investor's required rate of return (RRR). For this feasibility analysis, the required rate of return has to be between 10% to 15%. Acceptability is based on the following decision rules listed below:

  IRR exceeds RRR, investment is accepted
  IRR equals RRR, then investment is indifferent
  IRR less RRR, reject investment.
- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.

Pro Forma Income Statement for Wind Power System

Table 3 show Year One Pro Forma Income Statement for the deterministic analysis where output price is held consistent at $0.0866/kWh per year. The Wind Power System generates the following revenues and cost for Year One.

As shown in Pro Forma Income Statement (Table 3), the project generates a Year One revenue stream of approximately $2,248.7 thousand, of which $352.8 thousand is used to pay operations, maintenance, and property taxes. This leaves net operating income of $1,895.9 thousand prior to application of depreciation, payment of long-term debt, and taxes. The total after tax cash flow benefit is $2,359.8 thousand in Year One. A twenty year pro forma scenario for the deterministic model is presented in Appendix A in Table 3.A. At a price of $0.0866/kWh the project's internal rate of return was estimated to be 31.1% which exceeds the needed rate of return by investors of between 10% to 15%.

Since there was only one price used in this analysis of $0.0866/kWh, a stochastic feasibility simulation analysis was not performed for the Wind Power project. However as stated earlier, the deterministic results show that the internal rate of return for the total cash flow benefit that was greater than the required 10% to 15% required by investors.

Table 3. Wind Power Plant Deterministic Simulation for Year One Pro Forma Income Statement ($1,000)

REVENUE/EXPENSE LINE ITEM	($1,000)
Electric Sales	2,248.7
Other Sales	0.0
Total Revenues:	**2,248.7**
Variable Cost	230.0
Property Tax	122.8
Total Operating Expense:	**352.8**
OPERATING INCOME	**1,895.9**
-Interest	820.4
-Depreciation	4,260.8
PRE TAX INCOME:	**-3,185.3**
-Taxes	-1,712.1
Net Income (book)	**-1,473.2**
PROJECT CASH FLOW & BENEFITS	
PRETAX INCOME:	-3,185.2
+Book Depreciation	4,260.8
-Loan Principal	427.8
PRETAX CASH FLOW	**647.7**
TAXES/CREDITS	
Federal Taxes	-1,114.9
Less Federal Tax Credits	597.2
NET TAXES	**1,721.1**
NET CASH FLOWS	
Operating Pretax Cash Flow	647.7
State Credits/Grants	0.0
Federal Credits/Taxes	1,721.9
Total Cash Flow Benefit	**2,359.8**

Pumped Storage Hydro Plant Feasibility Analysis

The key assumptions for the feasibility analysis of the pumped storage hydro plant system are listed below:

- The pumped storage hydro system is assumed to be a 50 mega-watt (10MW) facility with the length of analysis being 30 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- From Bourg(2013d), similar to other resource assessments, renewable production estimates are typically derived by calculating the annual production estimate, including downtime for scheduled maintenance and unscheduled interruptions. For this analysis, annual production is estimated from recently Federal Energy Regulation Commission (FERC) approved 3,000 MW pumped hydro project near Ely, Nevada. Based on the estimated annual energy output from the Ely project, a similar, but smaller 50 MW project would generate an estimated 153,300,000 kWh per year.
- For output prices, the value of output from the pumped storage hydro facility is the value of its output, on a marginal basis, between the cost of power during the off-peak and on-peak periods (Bourg, 2013d). However, wholesale cost data is not available from NV Energy, as it is proprietary. In addition, there may be additional value from pumped storage hydro plant as a firming resource for co-located renewable energy projects, as well as from providing ancillary services to the transmission system. Currently, and for the foreseeable future as natural gas remains low, the marginal value of power between on-peak and off-peak is estimated to $0.05/kWh. This estimate is based on the current and forward prices of off-peak (coal) and on-peak (natural gas combined cycle combustion turbine) and some ancillary service value.

  With respect to calculating the value of the output of its pumped hydro storage plant, the methodology employed by Bourg (2013d) was not as simple as that for renewables, as it is not the output of the plant multiplied by the sales price. Pumped storage hydro requires the water to be pumped to a upper reservoir during the low cost off-peak hours and then power is generated during the higher cost on-peak hours In addition, the new pumped storage hydro systems are approximately 80% efficient which means that 80% of the power generated from then turbines is recovered from power required to pump the water to the upper reservoir. Therefore, in the case of this hypothetical 50 MW plant, the additional annual input costs would be 191,625,000kWh (times) off-peak power costs/kWh. This resulting dollar value of these input costs would then be subtracted from the gross revenues from the turbine generation output of 153,000,000 kWh (times) on-peak power costs/kWh. The important variable in this equation is the marginal cost of power between off-peak and on-peak power. Assuming that based on current and forecasted coal versus natural gas prices, that this difference is approximately $0.05/kWh over the next 30 years, it is recommended that off-peak power costs be valued at $0.03/kWh and that on-peak power be valued at $0.08/kWh. This yields a marginal cost of $0.05/kWh that is used for the deterministic analysis. Since no ranges of prices were estimated only the deterministic feasibility analysis will be employed for the pumped storage hydro plant.

- The pumped storage hydro plant qualifies for the Federal Modified Accelerated Recovery System (MACRS) depreciation schedule. MACRS allows for pumped storage plants to be depreciated over 7 years. Unlike other renewables, pumped storage hydro does not qualify for investment or production tax credits, therefore its depreciation basis is the total plant cost. This net basis is then depreciated according to the following schedule:
  Year 1: 14.3%
  Year 2: 24.5%
  Year 3: 17.5%
  Year 4: 12.5%
  Year 5: 8.9%
  Year 6: 8.9%
  Year 7: 4.5%
  At the state level, there is a property tax abatement of 55% for 20 years for hydro systems over 10 MW, hence qualifying this hypothetical facility. However, there may be additional requirements for the property abatements under NRS 701A.360 that an actual project may consider.
- The estimated plant and transmission line cost is assumed to be $139,235,415. It is assumed for the hypothetical plant a five mile transmission line to the interconnection point.
- It is assumed that land with water rights covering 30 years would cost $1,500,000.
- For plant investment, it is assumed 30% down or $41,779,624 with the remainder to be debt financed.
- The length of loan will be twenty (20) years with an interest rate of 5%.
- Annual variable cost which includes production based O&M cost plus insurance will be $3,105,143. Also assumed is an annual inflation rate of 2%.
- Federal taxes are included as 35% of income.
- The Corporate Owner/Tax Equity Partner was assumed to fully utilize tax credits, depreciation, and tax losses.
- For feasibility analysis, internal rate of return for the Pumped Storage Hydro Plant Facility investment will be estimated. Internal rate of return estimates the rate of interest which equates the net present value of a projected series of cash flow payments to zero. Internal rate of return can be used to rank investments and accept or reject invests based on their internal rate of return. Acceptability of the Pumped

Storage Hydro Plant Facility investment depends upon comparison of its internal rate of return (IRR) with the investor's required rate of return (RRR). For this feasibility analysis, the required rate of return has to be between 10% to 15%. Acceptability is based on the following decision rules listed below:
IRR exceeds RRR, investment is accepted
IRR equals RRR, then investment is indifferent
IRR less RRR, reject investment.

- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.

Pro Forma Income Statement for Pumped Storage Hydro System

Table 1 show Year One Pro Forma Income Statement for the deterministic analysis where output price is held consistent at $0.05/kWh per year. The Pumped Storage Hydro System generates the following revenues and cost for Year One.

As shown in Pro Forma Income Statement (Table 4), the project generates a Year One revenue stream of approximately $7,665.0 thousand, of which $3,227.9 thousand is used to pay operations, maintenance, and property taxes. This leaves net operating income of $4,437.1 thousand prior to application of depreciation, payment of long-term debt, and taxes. The total after tax cash flow benefit is $3,816.7 thousand in Year One. A thirty year pro forma scenario for the deterministic model is presented in Appendix A in Table 4.A. At a price of $0.05/kWh the project's internal rate of return was estimated to be -11.7% which is below the needed rate of return by investors of between10% to 15%.

Since there was only one price used in this analysis of $0.05/kWh, a stochastic feasibility simulation analysis for the pumped storage hydro system project was not attempted. However as stated earlier, the deterministic results show that the internal rate of return for the total cash flow benefit was **less** than the required 10% to 15% required by investors.

Table 4. Pumped Storage Hydro Plant Deterministic Simulation for Year One Pro Forma Income Statement ($1,000)

REVENUE/EXPENSE LINE ITEM	($1,000)
Electric Sales	7,665.0
Other Sales	0.0
Total Revenues:	**7,665.0**
Variable Cost	3,105.1
Property Tax	122.8
Total Operating Expense:	**3,227.9**
OPERATING INCOME	**4,437.1**
-Interest	5,443.1
-Depreciation	19,910.7
PRE TAX INCOME:	**-20,916.7**
-Taxes	-7,320.8
Net Income (book)	**-13,595.8**
PROJECT CASH FLOW & BENEFITS	
PRETAX INCOME:	-20,916.7
+Book Depreciation	19,910.7
-Loan Principal	2,498.1
PRETAX CASH FLOW	**-3,504.1**
TAXES/CREDITS	
Federal Taxes	-7,320.8
Less Federal Tax Credits	0.0
NET TAXES	**7,320.8**
NET CASH FLOWS	
Operating Pretax Cash Flow	-3,504.1
State Credits/Grants	0.0
Federal Credits/Taxes	7,320.8
Total Cash Flow Benefit	**3,816.7**

Biomass Power Feasibility Analysis

The key assumptions for the feasibility analysis of the Biomass Power system are listed below:

- The Biomass Power system is assumed to be a 10 mega-watt (10MW) facility with the length of analysis being 20 years. Also assumed is that rate of return for investors for the highly competitive energy industry is between 10% to 15%.
- Correspondence with Don Henderson of Resource Concepts (2013) and a report The Beck Group (2011) provided information as to annual net production from the Biomass Power plant to be 82,000,000 kWh per year.
- For output prices, correspondence with Don Henderson of Resource Concepts (2013) and a report The Beck Group (2011) provided information as to output price being $0.095 kWh. Only deterministic simulation will be made.
- For the deterministic analysis, the output price will be $0.095/kWh and the output price will escalate at 1.5% per year similar to THE Beck Group analysis (2011).
- Biomass Power plants are subsidized with tax benefits via three mechanisms which are two that are Federal and one that is from the state of Nevada (Henderson, 2014 and The Beck Group, 2011). The first is a $0.012/kWh Production Tax Credit with the tax credit escalating at 3% annually. The plant owner would realize a $0.012/kWh tax credit for every kWh generated for the first ten (10) years of operation. If there is no wind and no operation, there will be no production tax credit. The second federal mechanism is the Modified Accelerated Recovery System (MACRS) depreciation schedule which allows for wind plants to be depreciated over 5 ½ years. The initial step is to calculate the net basis of depreciation. In this case because the production tax credits are employed and not the investment tax credit, the depreciation basis is the full capital cost of the plant. The net basis is then depreciated according to the below schedule:

  Year 1: 20%

  Year 2: 32%

  Year 3: 19.2%

  Year 4: 11.52%

  Year 5: 11.52%

  Year 6: 5.76%

  Lastly, at the state level, there is a property tax abatement of 55% for 20 years for wind power plants over 10MW and hence this hypothetical plant qualifies.

However, there may be additional requirements for the property abatements under NRS 701A.360 that an actual project may consider.

- The estimated plant and transmission line cost is assumed to be $47,547,000.
- For plant investment, it is assumed 30% down or $14,264,100 with the remainder to be debt financed.
- The length of loan will be twenty (20) years with an interest rate of 4.0%.
- Annual variable cost includes operations and maintenance of $2,768,000, biomass fuel costs of $6,576,276, and ash disposal of $24,245. Also assumed is an annual inflation rate of 3%. (Henderson, 2013 and The Beck Group, 2011).
- Federal taxes are included as 35% of income.
- The Corporate Owner/Tax Equity Partner was assumed to fully utilize tax credits, depreciation, and tax losses.
- For feasibility analysis, internal rate of return for the Biomass Power investment will be estimated. Internal rate of return estimates the rate of interest which equates the net present value of a projected series of cash flow payments to zero. Internal rate of return can be used to rank investments and accept or reject invests based on their internal rate of return. Acceptability of a Biomass Power investment depends upon comparison of its internal rate of return (IRR) with the investor's required rate of return (RRR). For this feasibility analysis, the required rate of return has to be between 10% to 15%. Acceptability is based on the following decision rules listed below:
  IRR exceeds RRR, investment is accepted
  IRR equals RRR, then investment is indifferent
  IRR less RRR, reject investment.
- The owner is assumed to require a 10% to 15% rate of return from the project. Therefore, for this analysis, an investment will be considered acceptable if its internal rate of return is greater than 10% to 15%.

Pro Forma Income Statement for Biomass Power System

Table 5 show Year One Pro Forma Income Statement for the deterministic analysis where output price is held consistent at $0.095/kWh per year. The Biomass System generates the following revenues and cost for Year One.

As shown in Pro Forma Income Statement (Table 5), the project generates a Year One revenue stream of approximately $7,790.0 thousand with operations and maintenance, fuel, ash disposal, and property tax costs yields a net operating income loss of -$1,727.2 thousand prior to application of depreciation, payment of long-term debt, and taxes. The total after tax cash flow benefit is $1,206.5 thousand in Year One. A twenty year pro forma scenario for the deterministic model is presented in Appendix A in Table 5.A. At a price of $0.095/kWh the project's internal rate of return **does not** exceeds the needed rate of return by investors of between 10% to 15%. The fuel costs for the estimated hypothetical plant in White Pine County is significantly higher than the estimated fuel costs for the Lincoln County plant (The Beck Group, 2011). As stated in The Beck Report (2011), fuel costs greatly impact the financial feasibility of biomass plants.

Since there was only one price used in this analysis of $0.095/kWh, a stochastic feasibility simulation analysis was not performed for the Wind Power project. However as stated earlier, the deterministic results show that the internal rate of return for the total cash flow benefit that was less than the required 10% to 15% required by investors.

Table 5. Biomass Plant Deterministic Simulation for Year One Pro Forma Income Statement ($1,000)

REVENUE/EXPENSE LINE ITEM	**($1,000)**
Electric Sales	7,790.0
Other Sales	0.0
Total Revenues:	**7,790.0**
O&M	2,768.0
Fuel	6,570.3
Ash Disposal	24.2
Property Taxes	154.7
Total Operating Expense:	**9,517.2**
OPERATING INCOME	**-1,727.2**
-Interest	1,331.3
-Depreciation	9,509.4
PRE TAX INCOME:	**-12,568.0**
-Taxes	-5,412.3
Net Income (book)	**-7,155.7**
PROJECT CASH FLOW & BENEFITS	
PRETAX INCOME:	-12,568.0
+Book Depreciation	9,509.4
-Loan Principal	1,117.7
PRETAX CASH FLOW	**-4,176.3**
TAXES/CREDITS	
Federal Taxes	-4,398.8
Less Federal Tax Credits	0.0
NET TAXES	**4,398.8**
NET CASH FLOWS	
Operating Pretax Cash Flow	-4,176.3
State Credits/Grants	0.0
Federal Credits/Taxes	5,382.8
Total Cash Flow Benefit	**1,206.5**

SUMMARY

For this paper, feasibility analysis will be completed for five hypothetical alternative energy projects. These alternative energy projects are biomass, concentrated solar-hybrid, micro hydro, photovoltaic solar and wind. The purpose of the hypothetical feasibility analysis is to provide an initial understanding of potential financial considerations for actual clean energy investments. For actual clean energy projects, detailed feasibility analysis would require specific financial and physical information as to the proposed project. Also for this analysis, deterministic and stochastic feasibility analysis will be completed given price data availability. Stochastic or Monte Carlo simulation offers business analyst and investors an economical means of conducting risk-based economic feasibility studies of new investments such as alternative energy projects in White Pine County. Results of this study are outlined below:

- For the Solar Photovoltaic Power System, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project met the investor's required rate of return of between 10% to 15% for the deterministic analysis where output price remained constant at $0.085/kWh for 30 years and the stochastic prices ranged between $0.08/kWh and $0.09/kWh for 30 years.
- For the Concentrating Solar with Hybrid Cooling System, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does not meet the investor's required rate of return of between 10% to 15% for the deterministic analysis where output price remained constant at $0.085/kWh for 30 years and the stochastic prices ranged between $0.08/kWh and $0.09/kWh for 30 years.
- For the Wind Power System, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does meet the investor's required rate of return of between 10% to 15% for the deterministic analysis with output price remaining constant at $0.0866/kWh over 30 years. Since there were no output price ranges given for the Wind Power project, a stochastic simulation was not attempted.
- For the Pumped Storage Hydro Plant System, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does not meet the investor's required rate of return of between 10% to 15% for the deterministic analysis with output price remaining constant at $0.05/kWh over 30 years. Since there were no output price ranges given for the Wind Power project, a stochastic simulation was not attempted.
- For the Biomass Power Plant System, given the federal and state tax credits and Modified Accelerated Cost Recovery Mechanism, this potential hypothetical clean power project does not meet the investor's required rate of return of between 10% to 15% for the deterministic analysis with output price remaining constant at $0.095/kWh over 30 years.

Since there were no output price ranges given for the Wind Power project, a stochastic simulation was not attempted.

- It should be noted that these five hypothetical feasibility analyses are only for demonstration of financial possibilities of clean energy projects in White Pine County. Actual clean energy projects may differ as to fuel costs, investments, and etc and these should be considered in an actual feasibility analysis.

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Appendix A:

Pro Forma Income Statements

Table 1.A. Pro Forma Income Statement for Solar Photovotaic Power Plant

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
REVENUES:											
Electric Sales		1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4
Total Revenue		**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**
EXPENSES:											
Variable Costs		230.0	234.6	239.3	244.1	249.0	253.9	259.0	264.2	269.5	274.9
Property Taxes		154.7	131.5	111.8	95.0	80.8	68.7	58.4	49.6	42.2	35.8
Total Operating Expenses		384.7	366.1	351.1	339.1	329.7	322.6	317.4	313.8	311.6	310.7
OPERATING INCOME		**1,321.7**	**1,340.3**	**1,355.3**	**1,367.3**	**1,376.7**	**1,383.8**	**1,389.0**	**1,392.6**	**1,394.8**	**1,395.7**
-INTEREST		1,035.0	1,005.3	974.0	941.0	906.1	869.4	830.6	789.6	746.5	700.9
-DEPRECIATION		4,546.0	7,273.5	4,364.1	2,618.5	2,618.5	1,309.2	0.0	0.0	0.0	0.0
PRETAX INCOME		**-4,259.3**	**-6,938.6**	**-3,982.8**	**-2,192.1**	**-2,147.9**	**-794.8**	**558.5**	**603.0**	**648.3**	**694.8**
-TAXES		-9,513.0	-2,428.5	-1,394.0	-767.2	-751.8	-278.2	195.5	211.0	226.9	243.2
NET INCOME - BOOK		**5,253.7**	**-4,510.1**	**-2,588.8**	**-1,424.9**	**-1,396.1**	**-516.6**	**363.0**	**391.9**	**421.4**	**451.6**
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME		-4,259.3	-6,938.6	-3,982.8	-2,192.1	-2,147.9	-794.8	558.5	603.0	648.3	694.8
Plus: Book Depreciation		4,546.0	7,273.5	4,364.1	2,618.5	2,618.5	1,309.2	0.0	0.0	0.0	0.0
Less: Loan Principal		539.7	569.4	600.7	633.7	668.6	705.4	744.2	785.1	828.3	873.8
PRETAX CASH FLOW		**-253.0**	**-234.4**	**-219.4**	**-207.4**	**-198.0**	**-190.9**	**-185.7**	**-182.1**	**-180.0**	**-179.0**
TAXES/CREDITS:											
FEDERAL TAXES		-1,490.8	-2,081.6	-1,194.8	-657.6	-644.4	-238.4	167.5	180.9	194.5	208.4
Less: FEDERAL TAX CREDITS		8,022.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES		**9,513.0**	**2,081.6**	**1,194.8**	**657.6**	**644.4**	**238.4**	**-167.5**	**-180.9**	**-194.5**	**-208.4**
NET CASH FLOW:											
CAPITAL INVESTMENT	-26,840.9										
AMOUNT TO FINANCE	18,818.7										
OPERATING PRETAX CASH FLOW		-253.0	-234.4	-219.4	-207.4	-198.0	-190.9	-185.7	-182.1	-180.0	-179.0
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	0.0	9,513.0	2,081.6	1,194.8	657.6	644.4	238.4	-167.5	-180.9	-194.5	-208.4
TOTAL CASH FLOW BENEFIT	-8,022.3	9,260.0	1,847.1	975.4	450.2	446.3	47.5	-353.2	-363.0	-374.5	-387.5
Cumulative Pretax Cash Flow		-253.0	-487.5	-706.9	-914.3	-1,112.3	-1,303.2	-1,485.3	-1,667.5	-1,847.4	-2,026.4
Cumulative After Tax		9,260.0	11,107.1	12,082.6	12,532.8	12,979.1	13,026.7	12,673.4	12,310.4	11,936.0	11,548.5

Table 1.A. continued

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
REVENUES:										
Electric Sales	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4
Total Revenue	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**
EXPENSES:										
Variable Costs	280.4	286.0	291.7	297.5	303.5	309.5	315.7	322.1	328.5	335.1
Property Taxes	30.5	25.9	22.0	18.7	15.9	13.5	11.5	9.8	8.3	7.1
Total Operating Expenses	310.8	311.9	313.7	316.2	319.4	323.1	327.2	331.8	336.8	342.1
OPERATING INCOME	**1,395.6**	**1,394.5**	**1,392.7**	**1,390.2**	**1,387.0**	**1,383.4**	**1,379.2**	**1,374.6**	**1,369.6**	**1,364.3**
-INTEREST	652.8	602.1	548.6	492.2	432.7	369.9	303.6	233.7	159.9	82.1
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRETAX INCOME	**742.8**	**792.4**	**844.1**	**898.0**	**954.4**	**1,013.5**	**1,075.6**	**1,140.9**	**1,209.7**	**1,282.2**
-TAXES	260.0	277.3	295.4	314.3	334.0	354.7	376.5	399.3	423.4	448.8
NET INCOME - BOOK	**482.8**	**515.1**	**548.6**	**583.7**	**620.3**	**658.8**	**699.1**	**741.6**	**786.3**	**833.4**
PROJECT CASH FLOW and BENEFITS										
PRETAX INCOME	742.8	792.4	844.1	898.0	954.4	1,013.5	1,075.6	1,140.9	1,209.7	1,282.2
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less: Loan Principal	921.9	972.6	1,026.1	1,082.5	1,142.1	1,204.9	1,271.2	1,341.1	1,414.8	1,492.6
PRETAX CASH FLOW	**-179.1**	**-180.2**	**-182.0**	**-184.6**	**-187.7**	**-191.4**	**-195.5**	**-200.1**	**-205.1**	**-210.4**
TAXES/CREDITS:										
FEDERAL TAXES	222.8	237.7	253.2	269.4	286.3	304.0	322.7	342.3	362.9	384.7
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES	**-222.8**	**-237.7**	**-253.2**	**-269.4**	**-286.3**	**-304.0**	**-322.7**	**-342.3**	**-362.9**	**-384.7**
NET CASH FLOW:										
CAPITAL INVESTMENT										
AMOUNT TO FINANCE										
OPERATING PRETAX CASH FLOW	-179.1	-180.2	-182.0	-184.6	-187.7	-191.4	-195.5	-200.1	-205.1	-210.4
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-222.8	-237.7	-253.2	-269.4	-286.3	-304.0	-322.7	-342.3	-362.9	-384.7
TOTAL CASH FLOW BENEFIT	-402.0	-417.9	-435.2	-453.9	-474.0	-495.4	-518.2	-542.4	-568.0	-595.1
Cumulative Pretax Cash Flow	-2,205.6	-2,385.8	-2,567.8	-2,752.3	-2,940.0	-3,131.4	-3,327.0	-3,527.1	-3,732.2	-3,942.7
Cumulative After Tax	11,146.5	10,728.6	10,293.4	9,839.4	9,365.4	8,870.0	8,351.8	7,809.3	7,241.3	6,646.2

Table 1.A. continued

	Year 21	Year 22	Year 23	Year 24	Year 25	Yaer 26	Year 27	Year 28	Year 29	Year 30	Total
REVENUES:											
Electric Sales	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	1,706.4	51,192.5
Total Revenue	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	**1,706.4**	51,192.5
EXPENSES:											
Variable Costs	341.8	348.6	355.6	362.7	369.9	377.3	384.9	392.6	400.4	408.4	9,330.7
Property Taxes	13.3	11.3	9.6	8.2	7.0	5.9	5.0	4.3	3.6	3.1	1,062.9
Total Operating Expenses	355.1	359.9	365.2	370.9	376.9	383.3	389.9	396.9	404.1	411.5	10,393.5
OPERATING INCOME	**1,351.3**	**1,346.5**	**1,341.2**	**1,335.5**	**1,329.5**	**1,323.2**	**1,316.5**	**1,309.6**	**1,302.3**	**1,294.9**	40,799.0
-INTEREST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12,676.0
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22,729.8
PRETAX INCOME	**1,351.3**	**1,346.5**	**1,341.2**	**1,335.5**	**1,329.5**	**1,323.2**	**1,316.5**	**1,309.6**	**1,302.3**	**1,294.9**	5,393.2
-TAXES	473.0	471.3	469.4	467.4	465.3	463.1	460.8	458.3	455.8	453.2	-6,134.7
NET INCOME - BOOK	**878.4**	**875.2**	**871.8**	**868.1**	**864.2**	**860.1**	**855.7**	**851.2**	**846.5**	**841.7**	11,527.8
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME	1,351.3	1,346.5	1,341.2	1,335.5	1,329.5	1,323.2	1,316.5	1,309.6	1,302.3	1,294.9	5,393.2
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22,729.8
Less: Loan Principal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18,818.7
PRETAX CASH FLOW	**1,351.3**	**1,346.5**	**1,341.2**	**1,335.5**	**1,329.5**	**1,323.2**	**1,316.5**	**1,309.6**	**1,302.3**	**1,294.9**	9,304.3
TAXES/CREDITS:											
FEDERAL TAXES	405.4	403.9	402.4	400.7	398.9	396.9	395.0	392.9	390.7	388.5	1,405.0
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8,022.3
NET TAXES	**-405.4**	**-403.9**	**-402.4**	**-400.7**	**-398.9**	**-396.9**	**-395.0**	**-392.9**	**-390.7**	**-388.5**	6,617.3
NET CASH FLOW:											
CAPITAL INVESTMENT											
AMOUNT TO FINANCE											
OPERATING PRETAX CASH FLOW	1,351.3	1,346.5	1,341.2	1,335.5	1,329.5	1,323.2	1,316.5	1,309.6	1,302.3	1,294.9	9,304.3
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-405.4	-403.9	-402.4	-400.7	-398.9	-396.9	-395.0	-392.9	-390.7	-388.5	6,617.3
TOTAL CASH FLOW BENEFIT	945.9	942.5	938.8	934.9	930.7	926.2	921.6	916.7	911.6	906.4	7,899.3
Cumulative Pretax Cash Flow	-2,591.3	-1,244.9	96.4	1,431.9	2,761.4	4,084.6	5,401.1	6,710.6	8,013.0	9,307.9	
Cumulative After Tax	7,592.1	8,534.7	9,473.5	10,408.4	11,339.1	12,265.3	13,186.8	14,103.5	15,015.2	15,921.6	

Table 2.A. Pro Forma Income Statement for Concentrating Solar with Hybrid Cooling Plant

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
REVENUES:											
Electric Sales		2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8
Total Revenue		**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**
EXPENSES:											
Variable Costs		1,078.2	1,099.7	1,121.7	1,144.2	1,167.0	1,190.4	1,214.2	1,238.5	1,263.2	1,288.5
Property Taxes		154.7	131.5	111.8	95.0	80.8	68.7	58.4	49.6	42.2	35.8
Total Operating Expenses		1,232.9	1,231.3	1,233.5	1,239.2	1,247.8	1,259.0	1,272.5	1,288.1	1,305.4	1,324.4
OPERATING INCOME		**924.9**	**926.5**	**924.3**	**918.6**	**910.0**	**898.8**	**885.2**	**869.7**	**852.4**	**833.4**
-INTEREST		2,765.0	2,685.7	2,602.1	2,513.8	2,420.7	2,322.5	2,218.8	2,109.5	1,994.1	1,872.4
-DEPRECIATION		12,154.6	19,447.4	11,668.4	7,001.1	7,001.1	3,500.5	0.0	0.0	0.0	0.0
PRETAX INCOME		**-13,994.8**	**-21,206.6**	**-13,346.2**	**-8,596.3**	**-8,511.8**	**-4,924.2**	**-1,333.6**	**-1,239.8**	**-1,141.7**	**-1,039.0**
-TAXES		-26,347.5	-7,422.3	-4,671.2	-3,008.7	-2,979.1	-1,723.5	-466.8	-433.9	-399.6	-363.6
NET INCOME - BOOK		**12,352.7**	**-13,784.3**	**-8,675.1**	**-5,587.6**	**-5,532.7**	**-3,200.8**	**-866.8**	**-805.8**	**-742.1**	**-675.3**
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME		-13,994.8	-21,206.6	-13,346.2	-8,596.3	-8,511.8	-4,924.2	-1,333.6	-1,239.8	-1,141.7	-1,039.0
Plus: Book Depreciation		12,154.6	19,447.4	11,668.4	7,001.1	7,001.1	3,500.5	0.0	0.0	0.0	0.0
Less: Loan Principal		1,441.8	1,521.1	1,604.8	1,693.0	1,786.1	1,884.4	1,988.0	2,097.4	2,212.7	2,334.4
PRETAX CASH FLOW		**-3,282.0**	**-3,280.3**	**-3,282.6**	**-3,288.2**	**-3,296.9**	**-3,308.1**	**-3,321.6**	**-3,337.1**	**-3,354.5**	**-3,373.4**
TAXES/CREDITS:											
FEDERAL TAXES		-4,898.2	-6,362.0	-4,003.9	-2,578.9	-2,553.5	-1,477.3	-400.1	-371.9	-342.5	-311.7
Less: FEDERAL TAX CREDITS		21,449.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES		**26,347.5**	**6,362.0**	**4,003.9**	**2,578.9**	**2,553.5**	**1,477.3**	**400.1**	**371.9**	**342.5**	**311.7**
NET CASH FLOW:											
CAPITAL INVESTMENT	-71,722.7										
AMOUNT TO FINANCE	50,273.4										
OPERATING PRETAX CASH FLOW		-3,282.0	-3,280.3	-3,282.6	-3,288.2	-3,296.9	-3,308.1	-3,321.6	-3,337.1	-3,354.5	-3,373.4
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	0.0	26,347.5	6,362.0	4,003.9	2,578.9	2,553.5	1,477.3	400.1	371.9	342.5	311.7
TOTAL CASH FLOW BENEFIT	-21,449.3	23,065.5	3,081.7	721.3	-709.4	-743.3	-1,830.8	-2,921.5	-2,965.2	-3,011.9	-3,061.7
Cumulative Pretax Cash Flow		-3,282.0	-6,562.3	-9,844.8	-13,133.1	-16,429.9	-19,738.0	-23,075.2	-26,412.3	-29,766.8	-33,140.2
Cumulative After Tax		23,065.5	26,147.2	26,868.5	26,159.1	25,415.8	23,585.0	20,663.5	17,698.2	14,686.3	11,624.6

Table 2.A. continued

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
REVENUES:										
Electric Sales	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8
Total Revenue	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**
EXPENSES:										
Variable Costs	1,314.3	1,340.6	1,367.4	1,394.7	1,422.6	1,451.1	1,480.1	1,509.7	1,539.9	1,570.7
Property Taxes	30.5	25.9	22.0	18.7	15.9	13.5	11.5	9.8	8.3	7.1
Total Operating Expenses	1,344.7	1,366.5	1,389.4	1,413.4	1,438.5	1,464.6	1,491.6	1,519.5	1,548.2	1,577.7
OPERATING INCOME	**813.0**	**791.3**	**768.4**	**744.4**	**719.3**	**693.2**	**666.2**	**638.3**	**609.6**	**580.0**
-INTEREST	1,744.0	1,608.6	1,465.7	1,314.9	1,155.8	988.0	811.0	624.2	427.2	219.3
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRETAX INCOME	**-931.0**	**-817.2**	**-697.3**	**-570.6**	**-436.6**	**-294.8**	**-144.8**	**14.1**	**182.4**	**360.7**
-TAXES	-325.8	-286.0	-244.0	-199.7	-152.8	-103.2	-50.7	4.9	63.8	126.3
NET INCOME - BOOK	**-605.1**	**-531.2**	**-453.2**	**-370.9**	**-283.8**	**-191.6**	**-94.1**	**9.2**	**118.6**	**234.5**
PROJECT CASH FLOW and BENEFITS										
PRETAX INCOME	-931.0	-817.2	-697.3	-570.6	-436.6	-294.8	-144.8	14.1	182.4	360.7
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less: Loan Principal	2,462.8	2,598.3	2,741.2	2,891.9	3,051.0	3,218.8	3,395.8	3,582.6	3,779.7	3,987.5
PRETAX CASH FLOW	**-3,393.8**	**-3,415.5**	**-3,438.4**	**-3,462.5**	**-3,487.6**	**-3,513.6**	**-3,540.6**	**-3,568.5**	**-3,597.2**	**-3,626.8**
TAXES/CREDITS:										
FEDERAL TAXES	-279.3	-245.2	-209.2	-171.2	-131.0	-88.5	-43.4	4.2	54.7	108.2
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES	**279.3**	**245.2**	**209.2**	**171.2**	**131.0**	**88.5**	**43.4**	**-4.2**	**-54.7**	**-108.2**
NET CASH FLOW:										
CAPITAL INVESTMENT										
AMOUNT TO FINANCE										
OPERATING PRETAX CASH FLOW	-3,393.8	-3,415.5	-3,438.4	-3,462.5	-3,487.6	-3,513.6	-3,540.6	-3,568.5	-3,597.2	-3,626.8
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	279.3	245.2	209.2	171.2	131.0	88.5	43.4	-4.2	-54.7	-108.2
TOTAL CASH FLOW BENEFIT	-3,114.5	-3,170.3	-3,229.3	-3,291.3	-3,356.6	-3,425.2	-3,497.2	-3,572.7	-3,652.0	-3,735.0
Cumulative Pretax Cash Flow	-36,534.0	-39,949.5	-43,387.9	-46,850.4	-50,338.0	-53,851.7	-57,392.3	-60,960.8	-64,558.1	-68,184.9
Cumulative After Tax	8,510.1	5,339.7	2,110.5	-1,180.9	-4,537.5	-7,962.7	-11,459.9	-15,032.6	-18,684.6	-22,419.6

Table 2.A. continued

	Year 21	Year 22	Year 23	Year 24	Year 25	Yaer 26	Year 27	Year 28	Year 29	Year 30	Total
REVENUES:											
Electric Sales	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	2,157.8	64,733.7
Total Revenue	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	**2,157.8**	64,733.7
EXPENSES:											
Variable Costs	1,602.1	1,634.1	1,666.8	1,700.2	1,734.2	1,768.9	1,804.2	1,840.3	1,877.1	1,914.7	43,739.3
Property Taxes	13.3	11.3	9.6	8.2	7.0	5.9	5.0	4.3	3.6	3.1	1,062.9
Total Operating Expenses	1,615.4	1,645.5	1,676.5	1,708.4	1,741.1	1,774.8	1,809.3	1,844.6	1,880.8	1,917.8	44,802.2
OPERATING INCOME	**542.4**	**512.3**	**481.3**	**449.4**	**416.7**	**383.0**	**348.5**	**313.2**	**277.0**	**240.0**	19,931.5
-INTEREST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33,863.5
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60,773.1
PRETAX INCOME	**542.4**	**512.3**	**481.3**	**449.4**	**416.7**	**383.0**	**348.5**	**313.2**	**277.0**	**240.0**	-74,705.1
-TAXES	189.8	179.3	168.5	157.3	145.8	134.1	122.0	109.6	97.0	84.0	-47,596.1
NET INCOME - BOOK	**352.5**	**333.0**	**312.9**	**292.1**	**270.8**	**249.0**	**226.5**	**203.6**	**180.1**	**156.0**	-27,109.0
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME	542.4	512.3	481.3	449.4	416.7	383.0	348.5	313.2	277.0	240.0	-74,705.1
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60,773.1
Less: Loan Principal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50,273.4
PRETAX CASH FLOW	**542.4**	**512.3**	**481.3**	**449.4**	**416.7**	**383.0**	**348.5**	**313.2**	**277.0**	**240.0**	-64,205.4
TAXES/CREDITS:											
FEDERAL TAXES	162.7	153.7	144.4	134.8	125.0	114.9	104.6	94.0	83.1	72.0	-23,111.3
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21,449.3
NET TAXES	**-162.7**	**-153.7**	**-144.4**	**-134.8**	**-125.0**	**-114.9**	**-104.6**	**-94.0**	**-83.1**	**-72.0**	44,560.6
NET CASH FLOW:											
CAPITAL INVESTMENT											
AMOUNT TO FINANCE											
OPERATING PRETAX CASH FLOW	542.4	512.3	481.3	449.4	416.7	383.0	348.5	313.2	277.0	240.0	-64,205.4
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-162.7	-153.7	-144.4	-134.8	-125.0	-114.9	-104.6	-94.0	-83.1	-72.0	44,560.6
TOTAL CASH FLOW BENEFIT	379.7	358.6	336.9	314.6	291.7	268.1	244.0	219.2	193.9	168.0	-41,094.2
Cumulative Pretax Cash Flow	-67,642.5	-67,130.2	-66,648.9	-66,199.4	-65,782.8	-65,399.8	-65,051.2	-64,738.0	-64,461.0	-64,220.9	
Cumulative After Tax	-22,039.9	-21,681.3	-21,344.4	-21,029.8	-20,738.1	-20,470.0	-20,226.0	-20,006.8	-19,812.9	-19,644.8	

Table 3.A. Pro Forma Income Statement for Wind Power Plant

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
REVENUES:											
Electric Sales		2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7
Total Revenue		**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**
EXPENSES:											
Variable Costs		230.0	234.6	239.3	244.1	249.0	253.9	259.0	264.2	269.5	274.9
Property Taxes		122.8	104.4	88.7	75.4	64.1	54.5	46.3	39.4	33.5	28.4
Total Operating Expenses		352.8	339.0	328.0	319.5	313.1	308.4	305.3	303.6	302.9	303.3
OPERATING INCOME		**1,895.9**	**1,909.7**	**1,920.7**	**1,929.2**	**1,935.7**	**1,940.3**	**1,943.4**	**1,945.2**	**1,945.8**	**1,945.4**
-INTEREST		820.4	796.9	772.1	745.9	718.2	689.1	658.3	625.9	591.7	555.6
-DEPRECIATION		4,260.8	6,817.3	4,090.4	2,454.2	2,454.2	1,227.1	0.0	0.0	0.0	0.0
PRETAX INCOME		**-3,185.3**	**-5,704.4**	**-2,941.7**	**-1,270.9**	**-1,236.8**	**24.1**	**1,285.1**	**1,319.3**	**1,354.1**	**1,389.9**
-TAXES		-1,712.1	-2,593.8	-1,626.8	-1,042.0	-1,030.1	-588.8	-147.5	-135.5	-123.3	-110.8
NET INCOME - BOOK		**-1,473.2**	**-3,110.6**	**-1,314.9**	**-228.8**	**-206.7**	**612.9**	**1,432.5**	**1,454.8**	**1,477.4**	**1,500.6**
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME		-3,185.3	-5,704.4	-2,941.7	-1,270.9	-1,236.8	24.1	1,285.1	1,319.3	1,354.1	1,389.9
Plus: Book Depreciation		4,260.8	6,817.3	4,090.4	2,454.2	2,454.2	1,227.1	0.0	0.0	0.0	0.0
Less: Loan Principal		427.8	451.3	476.1	502.3	530.0	559.1	589.9	622.3	656.5	692.6
PRETAX CASH FLOW		**647.7**	**661.5**	**672.5**	**681.0**	**687.5**	**692.1**	**695.2**	**697.0**	**697.6**	**697.2**
TAXES/CREDITS:											
FEDERAL TAXES		-1,114.9	-1,996.5	-1,029.6	-444.8	-432.9	8.4	449.8	461.7	473.9	486.4
Less: FEDERAL TAX CREDITS		597.2	597.2	597.2	597.2	597.2	597.2	597.2	597.2	597.2	597.2
NET TAXES		**1,712.1**	**2,593.8**	**1,626.8**	**1,042.0**	**1,030.1**	**588.8**	**147.5**	**135.5**	**123.3**	**110.8**
NET CASH FLOW:											
CAPITAL INVESTMENT	-21,304.0										
AMOUNT TO FINANCE	14,916.6										
OPERATING PRETAX CASH FLOW		647.7	661.5	672.5	681.0	687.5	692.1	695.2	697.0	697.6	697.2
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	0.0	1,712.1	2,593.8	1,626.8	1,042.0	1,030.1	588.8	147.5	135.5	123.3	110.8
TOTAL CASH FLOW BENEFIT	-6,387.5	2,359.8	3,255.3	2,299.3	1,723.1	1,717.6	1,280.9	842.7	832.5	820.9	808.0
Cumulative Pretax Cash Flow		647.7	1,309.3	1,981.8	2,662.8	3,350.2	4,042.3	4,739.3	5,436.3	6,133.8	6,831.0
Cumulative After Tax		2,359.8	5,615.1	7,914.5	9,637.5	11,355.1	12,636.0	13,478.7	14,311.1	15,132.0	15,940.0

Table 3.A. continued

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
REVENUES:										
Electric Sales	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7
Total Revenue	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**
EXPENSES:										
Variable Costs	280.4	286.0	291.7	297.5	303.5	309.5	315.7	322.1	328.5	335.1
Property Taxes	24.2	20.6	17.5	14.8	12.6	10.7	9.1	7.8	6.6	5.6
Total Operating Expenses	304.5	306.5	309.2	312.4	316.1	320.3	324.9	329.8	335.1	340.7
OPERATING INCOME	**1,944.2**	**1,942.2**	**1,939.6**	**1,936.4**	**1,932.6**	**1,928.5**	**1,923.9**	**1,918.9**	**1,913.6**	**1,908.1**
-INTEREST	517.5	477.3	434.9	390.1	343.0	293.2	240.6	185.2	126.8	65.1
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRETAX INCOME	**1,426.7**	**1,464.9**	**1,504.7**	**1,546.2**	**1,589.7**	**1,635.3**	**1,683.2**	**1,733.7**	**1,786.9**	**1,843.0**
-TAXES	499.4	512.7	526.6	541.2	556.4	572.4	589.1	606.8	625.4	645.0
NET INCOME - BOOK	**927.4**	**952.2**	**978.0**	**1,005.0**	**1,033.3**	**1,062.9**	**1,094.1**	**1,126.9**	**1,161.5**	**1,197.9**
PROJECT CASH FLOW and BENEFITS										
PRETAX INCOME	1,426.7	1,464.9	1,504.7	1,546.2	1,589.7	1,635.3	1,683.2	1,733.7	1,786.9	1,843.0
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less: Loan Principal	730.7	770.9	813.3	858.1	905.3	955.0	1,007.6	1,063.0	1,121.5	1,183.1
PRETAX CASH FLOW	**696.0**	**694.0**	**691.4**	**688.1**	**684.4**	**680.2**	**675.7**	**670.7**	**665.4**	**659.9**
TAXES/CREDITS:										
FEDERAL TAXES	499.4	512.7	526.6	541.2	556.4	572.4	589.1	606.8	625.4	645.0
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES	**-499.4**	**-512.7**	**-526.6**	**-541.2**	**-556.4**	**-572.4**	**-589.1**	**-606.8**	**-625.4**	**-645.0**
NET CASH FLOW:										
CAPITAL INVESTMENT										
AMOUNT TO FINANCE										
OPERATING PRETAX CASH FLOW	696.0	694.0	691.4	688.1	684.4	680.2	675.7	670.7	665.4	659.9
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-499.4	-512.7	-526.6	-541.2	-556.4	-572.4	-589.1	-606.8	-625.4	-645.0
TOTAL CASH FLOW BENEFIT	196.6	181.3	164.7	147.0	128.0	107.9	86.5	63.9	40.0	14.8
Cumulative Pretax Cash Flow	7,527.0	8,221.0	8,912.4	9,600.5	10,284.9	10,965.2	11,640.9	12,311.6	12,977.0	13,636.9
Cumulative After Tax	16,136.6	16,317.9	16,482.6	16,629.6	16,757.6	16,865.5	16,952.1	17,016.0	17,056.0	17,070.8

Table 3.A. continued

	Year 21	Year 22	Year 23	Year 24	Year 25	TOTAL
REVENUES:						
Electric Sales	2,248.7	2,248.7	2,248.7	2,248.7	2,248.7	56,218.3
Total Revenue	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	**2,248.7**	56,218.3
EXPENSES:						0.0
Variable Costs	341.8	348.6	355.6	362.7	369.9	7,367.0
Property Taxes	10.6	9.0	7.6	6.5	5.5	826.2
Total Operating Expenses	352.3	357.6	363.2	369.2	375.5	8,193.2
						0.0
OPERATING INCOME	**1,896.4**	**1,891.1**	**1,885.5**	**1,879.5**	**1,873.3**	48,025.1
-INTEREST	0.0	0.0	0.0	0.0	0.0	10,047.6
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	21,304.0
PRETAX INCOME	**1,896.4**	**1,891.1**	**1,885.5**	**1,879.5**	**1,873.3**	16,673.5
-TAXES	663.7	661.9	659.9	657.8	655.6	-136.7
NET INCOME - BOOK	**1,232.7**	**1,229.2**	**1,225.6**	**1,221.7**	**1,217.6**	16,810.2
PROJECT CASH FLOW and BENEFITS						0.0
PRETAX INCOME	1,896.4	1,891.1	1,885.5	1,879.5	1,873.3	16,673.5
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	21,304.0
Less: Loan Principal	0.0	0.0	0.0	0.0	0.0	14,916.6
PRETAX CASH FLOW	**1,896.4**	**1,891.1**	**1,885.5**	**1,879.5**	**1,873.3**	23,061.0
						0.0
TAXES/CREDITS:						0.0
FEDERAL TAXES	663.7	661.9	659.9	657.8	655.6	5,835.7
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	5,972.4
NET TAXES	**-663.7**	**-661.9**	**-659.9**	**-657.8**	**-655.6**	136.7
						0.0
NET CASH FLOW:						0.0
CAPITAL INVESTMENT						-21,304.0
AMOUNT TO FINANCE						14,916.6
OPERATING PRETAX CASH FLOW	1,896.4	1,891.1	1,885.5	1,879.5	1,873.3	23,061.0
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-663.7	-661.9	-659.9	-657.8	-655.6	136.7
TOTAL CASH FLOW BENEFIT	1,232.7	1,229.2	1,225.6	1,221.7	1,217.6	16,810.2
Cumulative Pretax Cash Flow	15,533.3	17,424.4	19,309.9	21,189.5	23,062.7	
Cumulative After Tax	18,303.5	19,532.7	20,758.3	21,980.0	23,197.6	

Table 4.A. Pro Forma Income Statement for Pumped Storage Hydro Plant

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
REVENUES:											
Electric Sales		7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0
Total Revenue		**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**
EXPENSES:											
Variable Costs		3,105.1	3,167.2	3,230.6	3,295.2	3,361.1	3,428.3	3,496.9	3,566.8	3,638.2	3,710.9
Property Taxes		122.8	104.4	88.7	75.4	64.1	54.5	46.3	39.4	33.5	28.4
Total Operating Expenses		3,227.9	3,271.6	3,319.3	3,370.6	3,425.2	3,482.8	3,543.2	3,606.2	3,671.6	3,739.4
OPERATING INCOME		**4,437.1**	**4,393.4**	**4,345.7**	**4,294.4**	**4,239.8**	**4,182.2**	**4,121.8**	**4,058.8**	**3,993.4**	**3,925.6**
-INTEREST		5,443.1	5,305.7	5,160.7	5,007.8	4,846.4	4,676.2	4,496.7	4,307.2	4,107.3	3,896.5
-DEPRECIATION		19,910.7	34,112.7	24,366.2	17,404.4	12,392.0	12,392.0	6,265.6	0.0	0.0	0.0
PRETAX INCOME		**-20,916.7**	**-35,025.0**	**-25,181.2**	**-18,117.8**	**-12,998.6**	**-12,886.0**	**-6,640.5**	**-248.4**	**-114.0**	**29.1**
-TAXES		-7,320.8	-12,258.7	-8,813.4	-6,341.2	-4,549.5	-4,510.1	-2,324.2	-86.9	-39.9	10.2
NET INCOME - BOOK		**-13,595.8**	**-22,766.2**	**-16,367.8**	**-11,776.6**	**-8,449.1**	**-8,375.9**	**-4,316.3**	**-161.5**	**-74.1**	**18.9**
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME		-20,916.7	-35,025.0	-25,181.2	-18,117.8	-12,998.6	-12,886.0	-6,640.5	-248.4	-114.0	29.1
Plus: Book Depreciation		19,910.7	34,112.7	24,366.2	17,404.4	12,392.0	12,392.0	6,265.6	0.0	0.0	0.0
Less: Loan Principal		2,498.1	2,635.5	2,780.5	2,933.4	3,094.7	3,265.0	3,444.5	3,634.0	3,833.8	4,044.7
PRETAX CASH FLOW		**-3,504.1**	**-3,547.8**	**-3,595.5**	**-3,646.8**	**-3,701.4**	**-3,759.0**	**-3,819.4**	**-3,882.4**	**-3,947.8**	**-4,015.6**
TAXES/CREDITS:											
FEDERAL TAXES		-7,320.8	-12,258.7	-8,813.4	-6,341.2	-4,549.5	-4,510.1	-2,324.2	-86.9	-39.9	10.2
Less: FEDERAL TAX CREDITS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES		**7,320.8**	**12,258.7**	**8,813.4**	**6,341.2**	**4,549.5**	**4,510.1**	**2,324.2**	**86.9**	**39.9**	**-10.2**
NET CASH FLOW:											
CAPITAL INVESTMENT	-140,735.4										
AMOUNT TO FINANCE	98,964.8										
OPERATING PRETAX CASH FLOW		-3,504.1	-3,547.8	-3,595.5	-3,646.8	-3,701.4	-3,759.0	-3,819.4	-3,882.4	-3,947.8	-4,015.6
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	0.0	7,320.8	12,258.7	8,813.4	6,341.2	4,549.5	4,510.1	2,324.2	86.9	39.9	-10.2
TOTAL CASH FLOW BENEFIT	-41,770.6	3,816.7	8,710.9	5,217.9	2,694.4	848.1	751.1	-1,495.2	-3,795.4	-3,907.9	-4,025.8
Cumulative Pretax Cash Flow		-3,504.1	-7,052.0	-10,647.5	-14,294.3	-17,995.7	-21,754.7	-25,637.1	-29,519.5	-33,467.3	-37,482.9
Cumulative After Tax		3,816.7	12,527.6	17,745.5	20,440.0	21,288.1	22,039.2	20,543.9	16,748.5	12,840.6	8,814.8

Table 4.A. continued

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
REVENUES:										
Electric Sales	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0
Total Revenue	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**
EXPENSES:										
Variable Costs	3,785.2	3,860.9	3,938.1	4,016.8	4,097.2	4,179.1	4,262.7	4,347.9	4,434.9	4,523.6
Property Taxes	24.2	20.6	17.5	14.8	12.6	10.7	9.1	7.8	6.6	5.6
Total Operating Expenses	3,809.3	3,881.4	3,955.5	4,031.7	4,109.8	4,189.8	4,271.8	4,355.7	4,441.5	4,529.2
OPERATING INCOME	**3,855.7**	**3,783.6**	**3,709.5**	**3,633.3**	**3,555.2**	**3,475.2**	**3,393.2**	**3,309.3**	**3,223.5**	**3,135.8**
-INTEREST	3,674.0	3,439.3	3,191.7	2,930.5	2,654.9	2,364.2	2,057.4	1,733.8	1,392.4	1,032.3
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRETAX INCOME	**181.6**	**344.3**	**517.7**	**702.8**	**900.3**	**1,111.0**	**1,335.7**	**1,575.5**	**1,831.1**	**2,103.5**
-TAXES	63.6	120.5	181.2	246.0	315.1	388.8	467.5	551.4	640.9	736.2
NET INCOME - BOOK	**118.1**	**223.8**	**336.5**	**456.8**	**585.2**	**722.1**	**868.2**	**1,024.0**	**1,190.2**	**1,367.3**
PROJECT CASH FLOW and BENEFITS										
PRETAX INCOME	181.6	344.3	517.7	702.8	900.3	1,111.0	1,335.7	1,575.5	1,831.1	2,103.5
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less: Loan Principal	4,267.2	4,501.9	4,749.5	5,010.7	5,286.3	5,577.0	5,883.7	6,207.4	6,548.8	6,908.9
PRETAX CASH FLOW	**-4,085.5**	**-4,157.6**	**-4,231.7**	**-4,307.9**	**-4,386.0**	**-4,466.0**	**-4,548.0**	**-4,631.9**	**-4,717.7**	**-4,805.4**
TAXES/CREDITS:										
FEDERAL TAXES	63.6	120.5	181.2	246.0	315.1	388.8	467.5	551.4	640.9	736.2
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES	**-63.6**	**-120.5**	**-181.2**	**-246.0**	**-315.1**	**-388.8**	**-467.5**	**-551.4**	**-640.9**	**-736.2**
NET CASH FLOW:										
CAPITAL INVESTMENT										
AMOUNT TO FINANCE										
OPERATING PRETAX CASH FLOW	-4,085.5	-4,157.6	-4,231.7	-4,307.9	-4,386.0	-4,466.0	-4,548.0	-4,631.9	-4,717.7	-4,805.4
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-63.6	-120.5	-181.2	-246.0	-315.1	-388.8	-467.5	-551.4	-640.9	-736.2
TOTAL CASH FLOW BENEFIT	-4,149.1	-4,278.1	-4,412.9	-4,553.9	-4,701.1	-4,854.9	-5,015.5	-5,183.3	-5,358.6	-5,541.6
Cumulative Pretax Cash Flow	-41,568.4	-45,726.0	-49,957.7	-54,265.6	-58,651.6	-63,117.6	-67,665.6	-72,297.5	-77,015.2	-81,820.6
Cumulative After Tax	4,665.7	387.6	-4,025.3	-8,579.2	-13,280.3	-18,135.1	-23,150.7	-28,334.0	-33,692.5	-39,234.2

Table 4.A. continued

	Year 21	Year 22	Year 23	Year 24	Year 25	Yaer 26	Year 27	Year 28	Year 29	Year 30	Total
REVENUES:											
Electric Sales	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	7,665.0	229,950.0
Total Revenue	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	**7,665.0**	229,950.0
EXPENSES:											
Variable Costs	4,614.1	4,706.4	4,800.5	4,896.5	4,994.4	5,094.3	5,196.2	5,300.1	5,406.1	5,514.3	125,969.7
Property Taxes	10.6	9.0	7.6	6.5	5.5	4.7	4.0	3.4	2.9	2.4	843.6
Total Operating Expenses	4,624.7	4,715.4	4,808.1	4,903.0	4,999.9	5,099.0	5,200.2	5,303.5	5,409.0	5,516.7	126,813.3
OPERATING INCOME	**3,040.3**	**2,949.6**	**2,856.9**	**2,762.0**	**2,665.1**	**2,566.0**	**2,464.8**	**2,361.5**	**2,256.0**	**2,148.3**	103,136.7
-INTEREST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71,718.3
-DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	126,843.5
PRETAX INCOME	**3,040.3**	**2,949.6**	**2,856.9**	**2,762.0**	**2,665.1**	**2,566.0**	**2,464.8**	**2,361.5**	**2,256.0**	**2,148.3**	-95,425.1
-TAXES	1,064.1	1,032.4	999.9	966.7	932.8	898.1	862.7	826.5	789.6	751.9	-33,398.8
NET INCOME - BOOK	**1,976.2**	**1,917.3**	**1,857.0**	**1,795.3**	**1,732.3**	**1,667.9**	**1,602.1**	**1,535.0**	**1,466.4**	**1,396.4**	-62,026.3
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME	3,040.3	2,949.6	2,856.9	2,762.0	2,665.1	2,566.0	2,464.8	2,361.5	2,256.0	2,148.3	-95,425.1
Plus: Book Depreciation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	126,843.5
Less: Loan Principal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87,105.5
PRETAX CASH FLOW	**3,040.3**	**2,949.6**	**2,856.9**	**2,762.0**	**2,665.1**	**2,566.0**	**2,464.8**	**2,361.5**	**2,256.0**	**2,148.3**	-55,687.1
TAXES/CREDITS:											
FEDERAL TAXES	1,064.1	1,032.4	999.9	966.7	932.8	898.1	862.7	826.5	789.6	751.9	-33,398.8
Less: FEDERAL TAX CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET TAXES	**-1,064.1**	**-1,032.4**	**-999.9**	**-966.7**	**-932.8**	**-898.1**	**-862.7**	**-826.5**	**-789.6**	**-751.9**	33,398.8
NET CASH FLOW:											
CAPITAL INVESTMENT											
AMOUNT TO FINANCE											
OPERATING PRETAX CASH FLOW	3,040.3	2,949.6	2,856.9	2,762.0	2,665.1	2,566.0	2,464.8	2,361.5	2,256.0	2,148.3	-55,687.1
STATE CREDITS/GRANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDRAL CREDITS/TAXES	-1,064.1	-1,032.4	-999.9	-966.7	-932.8	-898.1	-862.7	-826.5	-789.6	-751.9	33,398.8
TOTAL CASH FLOW BENEFIT	1,976.2	1,917.3	1,857.0	1,795.3	1,732.3	1,667.9	1,602.1	1,535.0	1,466.4	1,396.4	-64,059.0
Cumulative Pretax Cash Flow	-78,780.3	-75,830.6	-72,973.7	-70,211.7	-67,546.7	-64,980.7	-62,515.9	-60,154.4	-57,898.4	-55,750.1	
Cumulative After Tax	-37,257.9	-35,340.7	-33,483.7	-31,688.4	-29,956.1	-28,288.2	-26,686.1	-25,151.1	-23,684.7	-22,288.3	

Table 5.A. Pro Forma Income Statement for Biomas Power Plant

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
REVENUES:											
Electric Sales		7790	7906.85	8025.4528	8145.8345	8268.0221	8392.0424	8517.923	8645.6919	8775.3772	8907.0079
Total Revenue		**7790**	**7906.85**	**8025.4528**	**8145.8345**	**8268.0221**	**8392.0424**	**8517.923**	**8645.6919**	**8775.3772**	**8907.0079**
EXPENSES:											
O&M		2768	2851.04	2936.5712	3024.6683	3115.4084	3208.8706	3305.1368	3404.2909	3506.4196	3611.6122
Fuel		6570.276	6767.3843	6970.4058	7179.518	7394.9035	7616.7506	7845.2531	8080.6107	8323.0291	8572.7199
Ash Disposal		24.245	24.97235	25.721521	26.493166	27.287961	28.1066	28.949798	29.818292	30.712841	31.634226
Property Taxes		154.72454	131.51586	111.78848	95.020209	80.767177	68.652101	58.354286	49.601143	42.160971	35.836826
Total Operating Expenses		9517.2455	9774.9125	10044.487	10325.7	10618.367	10922.38	11237.694	11564.321	11902.322	12251.803
OPERATING INCOME		**-1727.2455**	**-1868.0625**	**-2019.0343**	**-2179.8652**	**-2350.345**	**-2530.3376**	**-2719.771**	**-2918.6292**	**-3126.9452**	**-3344.7953**
-INTEREST		1331.316	1286.6081	1240.1118	1191.7558	1141.4654	1089.1635	1034.7695	978.19967	919.36709	858.18122
-DEPRECIATION		9509.4	15215.04	9129.024	5477.4144	5477.4144	2738.7072	0	0	0	0
PRETAX INCOME		**-12567.962**	**-18369.711**	**-12388.17**	**-8849.0353**	**-8969.2248**	**-6358.2083**	**-3754.5404**	**-3896.8288**	**-4046.3123**	**-4202.9765**
-TAXES		-5412.3065	-6429.3987	-4335.8595	-3097.1624	-3139.2287	-2225.3729	-1314.0891	-1363.8901	-1416.2093	-1471.0418
NET INCOME - BOOK		**-7155.655**	**-11940.312**	**-8052.3106**	**-5751.8729**	**-5829.9961**	**-4132.8354**	**-2440.4513**	**-2532.9387**	**-2630.103**	**-2731.9347**
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME		-12567.962	-18369.711	-12388.17	-8849.0353	-8969.2248	-6358.2083	-3754.5404	-3896.8288	-4046.3123	-4202.9765
Plus: Book Depreciation		9509.4	15215.04	9129.024	5477.4144	5477.4144	2738.7072	0	0	0	0
Less: Loan Principal		1117.698	1162.406	1208.9022	1257.2583	1307.5486	1359.8506	1414.2446	1470.8144	1529.6469	1590.8328
PRETAX CASH FLOW		**-4176.2596**	**-4317.0765**	**-4468.0483**	**-4628.8792**	**-4799.359**	**-4979.3516**	**-5168.785**	**-5367.6432**	**-5575.9593**	**-5793.8093**
TAXES/CREDITS:											
FEDERAL TAXES		-4398.7865	-5510.9132	-3716.451	-2654.7106	-2690.7674	-1907.4625	-1126.3621	-1169.0486	-1213.8937	-1260.8929
Less: FEDERAL TAX CREDITS		984	1013.52	1043.9256	1075.2434	1107.5007	1140.7257	1174.9475	1210.1959	1246.5018	1283.8968
NET TAXES		**5382.7865**	**6524.4332**	**4760.3766**	**3729.954**	**3798.2681**	**3048.1882**	**2301.3096**	**2379.2445**	**2460.3955**	**2544.7898**
NET CASH FLOW:											
CAPITAL INVESTMENT	-47547										
AMOUNT TO FINANCE	33282.9										
OPERATING PRETAX CASH FLOW		-4176.2596	-4317.0765	-4468.0483	-4628.8792	-4799.359	-4979.3516	-5168.785	-5367.6432	-5575.9593	-5793.8093
STATE CREDITS/GRANTS	0	0	0	0	0	0	0	0	0	0	0
FEDRAL CREDITS/TAXES	0	5382.7865	6524.4332	4760.3766	3729.954	3798.2681	3048.1882	2301.3096	2379.2445	2460.3955	2544.7898
TOTAL CASH FLOW BENEFIT	-14264.1	1206.527	2207.3566	292.32833	-898.92523	-1001.0909	-1931.1635	-2867.4754	-2988.3987	-3115.5638	-3249.0195
Cumulative Pretax Cash Flow		-4176.2596	-8493.3361	-12961.384	-17590.264	-22389.623	-27368.974	-32736.617	-38104.261	-43680.22	-49474.029
Cumulative After Tax		1206.527	3413.8836	3706.2119	2807.2867	1806.1958	-124.96767	-2992.4431	-5980.8418	-9096.4056	-12345.425

Table 5.A. continued

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
REVENUES:										
Electric Sales	9040.613	9176.2222	9313.8656	9453.5735	9595.3771	9739.3078	9885.3974	10033.678	10184.184	10336.946
Total Revenue	**9040.613**	**9176.2222**	**9313.8656**	**9453.5735**	**9595.3771**	**9739.3078**	**9885.3974**	**10033.678**	**10184.184**	**10336.946**
EXPENSES:										
O&M	3719.9605	3831.5594	3946.5061	4064.9013	4186.8484	4312.4538	4441.8274	4575.0822	4712.3347	4853.7048
Fuel	8829.9015	9094.7986	9367.6425	9648.6718	9938.132	10236.276	10543.364	10859.665	11185.455	11521.019
Ash Disposal	32.583253	33.56075	34.567573	35.6046	36.672738	37.77292	38.906108	40.073291	41.27549	42.513754
Property Taxes	30.461302	25.892107	22.008291	18.707047	15.90099	13.515841	11.488465	9.7651955	8.3004161	7.0553537
Total Operating Expenses	12612.907	12985.811	13370.725	13767.885	14177.554	14600.018	15035.586	15484.586	15947.366	16424.293
OPERATING INCOME	**-3572.2936**	**-3809.5886**	**-4056.859**	**-4314.3112**	**-4582.1769**	**-4860.7107**	**-5150.1888**	**-5450.9075**	**-5763.1821**	**-6087.3463**
-INTEREST	794.5479	728.36926	659.54347	587.96464	513.52267	436.10301	355.58657	271.84947	184.76289	94.192845
-DEPRECIATION	0	0	0	0	0	0	0	0	0	0
PRETAX INCOME	**-4366.8415**	**-4537.9578**	**-4716.4024**	**-4902.2759**	**-5095.6996**	**-5296.8137**	**-5505.7754**	**-5722.757**	**-5947.945**	**-6181.5391**
-TAXES	-1528.3945	-1588.2852	-1650.7409	-1715.7966	-1783.4949	-1853.8848	-1927.0214	-2002.9649	-2081.7808	-2163.5387
NET INCOME - BOOK	**-2838.447**	**-2949.6726**	**-3065.6616**	**-3186.4793**	**-3312.2047**	**-3442.9289**	**-3578.754**	**-3719.792**	**-3866.1643**	**-4018.0004**
PROJECT CASH FLOW and BENEFITS										
PRETAX INCOME	-4366.8415	-4537.9578	-4716.4024	-4902.2759	-5095.6996	-5296.8137	-5505.7754	-5722.757	-5947.945	-6181.5391
Plus: Book Depreciation	0	0	0	0	0	0	0	0	0	0
Less: Loan Principal	1654.4661	1720.6448	1789.4706	1861.0494	1935.4914	2012.911	2093.4275	2177.1646	2264.2511	2354.8212
PRETAX CASH FLOW	**-6021.3076**	**-6258.6026**	**-6505.873**	**-6763.3253**	**-7031.191**	**-7309.7247**	**-7599.2028**	**-7899.9215**	**-8212.1962**	**-8536.3603**
TAXES/CREDITS:										
FEDERAL TAXES	-1310.0525	-1361.3873	-1414.9207	-1470.6828	-1528.7099	-1589.0441	-1651.7326	-1716.8271	-1784.3835	-1854.4617
Less: FEDERAL TAX CREDITS	0	0	0	0	0	0	0	0	0	0
NET TAXES	**1310.0525**	**1361.3873**	**1414.9207**	**1470.6828**	**1528.7099**	**1589.0441**	**1651.7326**	**1716.8271**	**1784.3835**	**1854.4617**
NET CASH FLOW:										
CAPITAL INVESTMENT										
AMOUNT TO FINANCE										
OPERATING PRETAX CASH FLOW	-6021.3076	-6258.6026	-6505.873	-6763.3253	-7031.191	-7309.7247	-7599.2028	-7899.9215	-8212.1962	-8536.3603
STATE CREDITS/GRANTS	0	0	0	0	0	0	0	0	0	0
FEDRAL CREDITS/TAXES	1310.0525	1361.3873	1414.9207	1470.6828	1528.7099	1589.0441	1651.7326	1716.8271	1784.3835	1854.4617
TOTAL CASH FLOW BENEFIT	-4711.2552	-4897.2153	-5090.9523	-5292.6425	-5502.4811	-5720.6806	-5947.4702	-6183.0944	-6427.8127	-6681.8986
Cumulative Pretax Cash Flow	-55495.337	-61753.939	-68259.812	-75023.138	-82054.329	-89364.053	-96963.256	-104863.18	-113075.37	-121611.73
Cumulative After Tax	-17056.68	-21953.896	-27044.848	-32337.49	-37839.971	-43560.652	-49508.122	-55691.217	-62119.029	-68800.928

Table 5.A continued

	Year 21	Year 22	Year 23	Year 24	Year 25	Yaer 26	Year 27	Year 28	Year 29	Year 30	Total
REVENUES:											
Electric Sales	10492.001	10649.381	10809.121	10971.258	11135.827	11302.864	11472.407	11644.493	11819.161	11996.448	292426.33
Total Revenue	10492.001	10649.381	10809.121	10971.258	11135.827	11302.864	11472.407	11644.493	11819.161	11996.448	292426.33
EXPENSES:											
O&M	4999.3159	5149.2954	5303.7742	5462.8875	5626.7741	5795.5773	5969.4446	6148.528	6332.9838	6522.9733	131688.75
Fuel	11866.649	12222.649	12589.328	12967.008	13356.018	13756.699	14169.4	14594.482	15032.316	15483.286	
Ash Disposal	43.789167	45.102842	46.455927	47.849605	49.285093	50.763646	52.286555	53.855152	55.470806	57.134931	
Property Taxes	13.326779	11.327762	9.628598	8.1843083	6.9566621	5.9131627	5.0261883	4.2722601	3.6314211	3.0867079	1062.8705
Total Operating Expenses	16923.081	17428.375	17949.187	18485.929	19039.034	19608.953	20196.157	20801.137	21424.402	22066.481	446488.7
OPERATING INCOME	-6431.0806	-6778.9942	-7140.0658	-7514.6714	-7903.2073	-8306.0887	-8723.7499	-9156.6438	-9605.2415	-10070.033	-154062.37
-INTEREST	0	0	0	0	0	0	0	0	0	0	15697.381
-DEPRECIATION	0	0	0	0	0	0	0	0	0	0	47547
PRETAX INCOME	-6431.0806	-6778.9942	-7140.0658	-7514.6714	-7903.2073	-8306.0887	-8723.7499	-9156.6438	-9605.2415	-10070.033	-217306.75
-TAXES	-2250.8782	-2372.648	-2499.023	-2630.135	-2766.1225	-2907.131	-3053.3125	-3204.8253	-3361.8345	-3524.5114	-77070.883
NET INCOME - BOOK	-4180.2024	-4406.3463	-4641.0428	-4884.5364	-5137.0847	-5398.9576	-5670.4375	-5951.8185	-6243.407	-6545.5212	-140235.87
PROJECT CASH FLOW and BENEFITS											
PRETAX INCOME	-6431.0806	-6778.9942	-7140.0658	-7514.6714	-7903.2073	-8306.0887	-8723.7499	-9156.6438	-9605.2415	-10070.033	-217306.75
Plus: Book Depreciation	0	0	0	0	0	0	0	0	0	0	47547
Less: Loan Principal	0	0	0	0	0	0	0	0	0	0	33282.9
PRETAX CASH FLOW	-6431.0806	-6778.9942	-7140.0658	-7514.6714	-7903.2073	-8306.0887	-8723.7499	-9156.6438	-9605.2415	-10070.033	-203042.65
TAXES/CREDITS:											
FEDERAL TAXES	-1929.3242	-2033.6983	-2142.0197	-2254.4014	-2370.9622	-2491.8266	-2617.125	-2746.9932	-2881.5725	-3021.0098	-65820.424
Less: FEDERAL TAX CREDITS	0	0	0	0	0	0	0	0	0	0	11280.457
NET TAXES	1929.3242	2033.6983	2142.0197	2254.4014	2370.9622	2491.8266	2617.125	2746.9932	2881.5725	3021.0098	77100.881
NET CASH FLOW:											
CAPITAL INVESTMENT											
AMOUNT TO FINANCE											
OPERATING PRETAX CASH FLOW	-6431.0806	-6778.9942	-7140.0658	-7514.6714	-7903.2073	-8306.0887	-8723.7499	-9156.6438	-9605.2415	-10070.033	-203042.65
STATE CREDITS/GRANTS	0	0	0	0	0	0	0	0	0	0	0
FEDRAL CREDITS/TAXES	1929.3242	2033.6983	2142.0197	2254.4014	2370.9622	2491.8266	2617.125	2746.9932	2881.5725	3021.0098	77100.881
TOTAL CASH FLOW BENEFIT	-4501.7564	-4745.296	-4998.046	-5260.27	-5532.2451	-5814.2621	-6106.625	-6409.6507	-6723.6691	-7049.0228	-140205.87
Cumulative Pretax Cash Flow	-128042.81	-134821.81	-141961.87	-149476.55	-157379.75	-165685.84	-174409.59	-183566.24	-193171.48	-203241.51	
Cumulative After Tax	-73302.684	-78047.98	-83046.026	-88306.296	-93838.542	-99652.804	-105759.43	-112169.08	-118892.75	-125941.77	

Appendix J: Economic Impact Assessment– University of Nevada Cooperative Extension

White Pine County Renewable Energy Feasibility and Resource Assessment

Economic Impact Assessment

Prepared for:
White Pine County

Prepared by:
University of Nevada Cooperative Extension
University Center for Economic Development
University of Nevada, Reno

January 2014

White Pine County Renewable Energy Feasibility and Resource Assessment

ECONOMIC IMPACT ASSESSMENT

Prepared by:

Buddy Borden
Tom Harris

Buddy Borden is an Area Extension Specialist in Community and Economic Development, University of Nevada Cooperative Extension, University of Nevada, Reno

Tom Harris is Professor & Director, University Center for Economic Development, University of Nevada, Reno.

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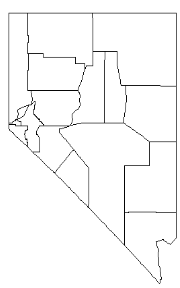
Thomas R. Harris, Director
University Center for Economic Development
University of Nevada, Reno
Department of Applied Economics and Statistics
Mail Stop 204
Reno, Nevada 89557-0105



UCED
University of Nevada, Reno
Nevada Cooperative Extension

The following report was prepared for White Pine County in accordance with Tasks 1 and 2 of the White Pine County Department of Energy Award Number DE-EE0003139, Renewable Energy Feasibility Study and Resources Assessment. Under the direction of White Pine County, the following resource team and subject matter specialists contributed to the overall study. Specific construction and annual operating primary data presented in this report was supplied by subject matter specialists.

S&B Christ, LLC.	Transmission and Distribution Assessment
Resource Concepts, Inc.	Biomass
Millennium Energy, LLC	Concentrated Solar, Photovoltaic Solar, and Wind
Nevada Bureau of Mines and Geology University of Nevada, Reno	Geothermal
TerraSpectra Geomatics	Resource Maps
UCED University of Nevada Reno	Feasibility Analysis
UNCE University of Nevada, Reno	Economic Impact Analysis

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EXECUTIVE SUMMARY

White Pine County, Nevada is currently focusing its economic development efforts on exploring innovative industries that achieve economic diversification that provide job stability and has the ability to grow community services. Renewable energy initiatives at the national and state levels have increased the interest of White Pine County to further study alternative renewable energy technologies, economic feasibility, and economic impacts on constructing a facility to generate and sell renewable power as a viable economic development strategy.

This study only considers the economic impacts of alternative renewable energy facility construction and annual facility operations for photovoltaic solar (PVSP), concentrated solar (CSP), wind, pumped storage hydro and biomass. In addition, economic impacts are estimated for the construction of 5 miles of transmission lines to support 10 Megawatt (MW) and 50MW facilities.

This study has three main objectives:

1. Provide a basic demographic, social and economic profile for White Pine County.
2. Measure economic impacts of the construction of alternative renewable energy facilities on White Pine County and State of Nevada.
3. Measure the economic impacts of the annual operations of alternative renewable energy facilities on White Pine County and State of Nevada.

Economic impacts for renewable energy development were estimated using a White Pine County and State of Nevada IMPLAN economic impact model. The IMPLAN model is an input-output based model that describes the inter-industry relationship between industries and commodity purchases within a local economy. Economic impacts are measured as total expenditures, personal income and employment. This includes direct impacts, indirect impacts (industry purchases), induced impacts (household purchases) and total impacts (direct + indirect + induced).

Demographic, social and economic characteristics of a community are one of the first steps in understanding the overall dynamics and development opportunities. Key characteristics for White Pine County include:

- Population is estimated at 10,300 residents (56% male and 44% female)
- Approximately 44.5% of population is 45 years and older with a median age of 41.
- High percentage of population is institutionalized because of state prison (121.3%).
- Nearly 37% of residents have graduated from high school and 33.4% have some college of AA degree.
- Government employment accounts for nearly 29% of total employed 16 years and older.
- Household income less than $35,000 accounts for nearly 40% of total households.
- Households income $75,000 and greater account for approximately 25% of total households.
- Over one-third of household income is derived through social security.
- 30% of households are collecting retirement income.
- Approximately 21% of total jobs are in agriculture, forestry, fishing & hunting and mining industries.

Phase one of alternative renewable energy development includes the construction of a power facility. Construction is considered as short-term and temporary increases in economic activity, personal income, and employment (12-15 months).

Estimated Total Construction Impacts on White Pine County.

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW	10MW	10MW	50MW	10MW
Economic Activity*	$1,041	$3,321	$342	$9,069	$6,726
Personal Income*	$393	$1,172	$129	$3,683	$1,665
Employment	5	13.6	1.7	90.3	29

*Thousands

Estimated Total Transmission Lines Construction Impacts on White Pine County.

	10WM Transmission	50MW Transmission
Size	5 Miles	5 Miles
Economic Activity*	$1,690	$2,304
Personal Income*	$892	$1,181
Employment	12.5	16.5

*Thousands

Estimated Total Construction Impacts on State of Nevada.

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW		10MW	50MW	10MW
Economic Activity*	$16,505	$39,417	$10,461	$151,322	$17,306
Personal Income*	$5,784	$16,134	$4,016	$54,069	$4,880
Employment	85.2	208.3	55.2	1,200.7	81.9

*Thousands

Estimated Total Transmission Lines Construction Impacts on State of Nevada.

	10WM Transmission	50MW Transmission
Size	5 Miles	5 Miles
Economic Activity*	$10,302	$13,834
Personal Income*	$3,495	$4,644
Employment	53.6	71.3

*Thousands

Phase two of alternative renewable energy development includes the annual operations of a power facility. Annual operations are considered as levels of long-term sustainable or reoccurring economic activity, personal income and employment.

Estimated Total Annual Impacts on White Pine County.

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW	10MW	10MW	50MW	10MW
Economic Activity*	$149	$1,215	$153	$850	$6,537
Personal Income*	$104	$962	$91	$613	$977
Employment	1.4	23.6	1.3	8.2	15.6

*Thousands

Estimated Total Annual Impacts on State of Nevada.

	PVSP	CSP	Wind	Hydro	Biomass
Size	10MW	10MW	10MW	50MW	10MW
Economic Activity*	$208	$1,278	$208	$2,778	$12,881
Personal Income*	$108	$1,150	$110	$777	$1,424
Employment	1.6	27.2	1.7	11.3	23.8

*Thousands

This study provides the basic framework for White Pine County to evaluate the economic impacts of alternative renewable energy facility construction and annual operations. This is just one component that White Pine County needs to consider when deciding if one or more of the renewable energy resources makes sense for full scale facility development.

INTRODUCTION

Rural counties throughout Nevada continue to be challenged with attracting viable industries that provide stable sources of income and employment. These challenges often are the result of underdeveloped or access to land, long distances from urban centers and relatively small population bases. With this in mind, rural counties are now exploring nontraditional industries that use their natural resources to provide viable economic development opportunities.

White Pine County, Nevada has focused its economic development efforts on exploring industries that can achieve economic diversification that provide job stability and has the ability to grow community services. Renewable Energy initiatives at the National and State levels have increased the interest among rural communities to further assess the technology and economic feasibility of generating and selling power as an economic development strategy.

This report estimates the potential economic impacts generated from the development and operations of five renewable energy sources that currently exist in White Pine County. They include photovoltaic solar (PVSP), concentrated solar (CSP), wind, pumped storage hydro and biomass.

Specific Objective of the study includes:

1. To present a socio-economic trend analysis comparing White Pine County, Nevada and United States;
2. To discuss community economics and input-output modeling;
3. To estimate the direct construction inputs to build a 10MW solar facility (PVSP & CSP), 10MW wind facility, 50MW pumped storage hydro facility, and 10MW biomass facility. Inputs include direct expenditures, direct personal income, and direct employment.
4. To estimate the direct annual operating inputs to operate a 10MW solar facility (PVSP & CSP), 10MW wind facility, 50MW pumped storage hydro facility, and 10MW biomass facility. Inputs include direct expenditures, direct personal income, and direct employment.
5. To estimate the construction of five miles of transmission delivery lines to support a 10MW solar facility (PVSP & CSP), 10MW wind facility, 50MW hydroelectric facility, and 10MW biomass facility.
6. To estimate the economic, employment and household income impacts of Renewable Energy development on White Pine County and Nevada's economy.

The following report is divided into five sections to assist county and community leaders in White Pine County and State of Nevada better understand the social and economic contributions of each renewable resource:

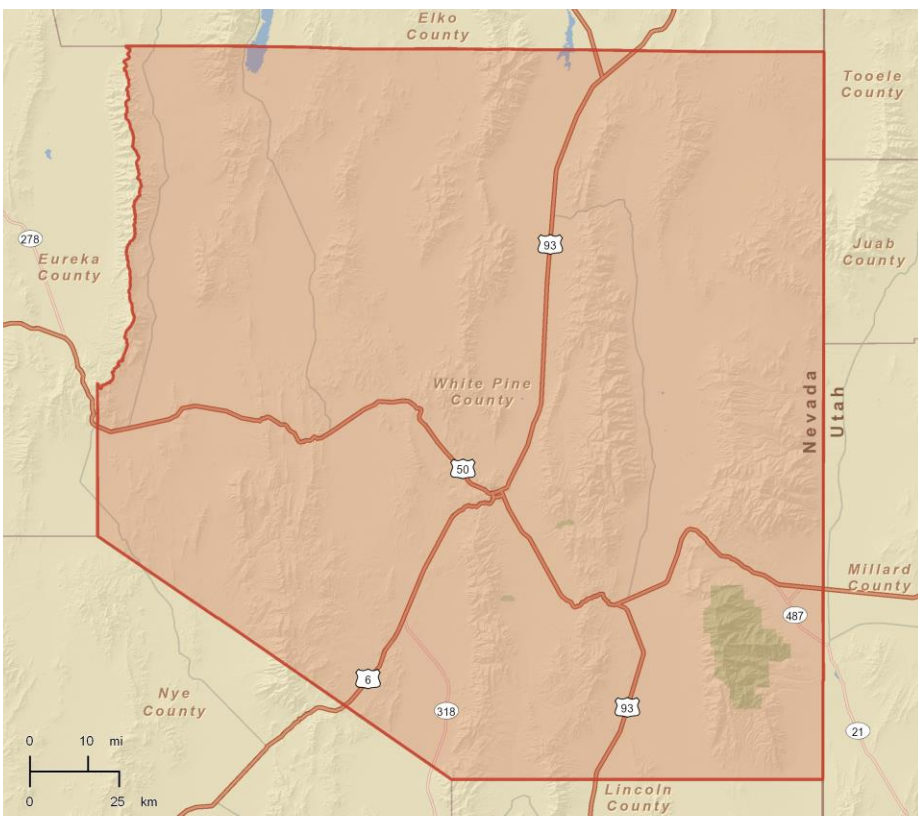
1. White Pine County, State of Nevada, and United States Demographic, Social and Economic Characteristics
2. White Pine County Conceptual Economic Model
3. White Pine County Economic Impact Model
4. White Pine County Economic Impact Estimates, Phase One – Construction Activity
5. White Pine County Economic Impact Estimates, Phase Two – Annual Operation Activity

DEMOGRAPHIC, SOCIAL AND ECONOMIC CHARACTERISITCS

Demographic, social and economic characteristics of a community are one of the first steps in understanding the overall dynamics of a community. This is especially important when a community is looking at economic development opportunities because it provides key information for planning and development purposes. This is the case in White Pine County where growth has been stagnant over the last several years. However, current exploration of developing alternative renewable energy facilities could have implications on the overall population make-up and economic conditions.

This analysis is divided into three types of characteristic areas; demographic, social and economic. Demographic characteristics include population, age, race and households. Social characteristics include education and marital status. Economic characteristics include labor force, occupation, income and employment. Each variable is analyzed using the most recent data and is compared to Nevada and the United States.

White Pine County



Source: Environmental System Research Institute (ESRI)

White Pine County Demographic Characteristics

Table 1 presents the demographic characteristics for White Pine County, Nevada and United States. Key indicators show:

- White Pine County population is estimated at 10,300
- White Pine County has a higher percentage of males (56.6%) when compared to Nevada (50.5%) and United States (49.2%).
- Approximately 44.5% of White Pine County population is 45 years and older, compared to Nevada at 37.6% and United States at 39.4%. This also explains the median age in White Pine County is 41 years compared to 36 in Nevada and 37 for the United States.
- White Pine County is predominantly white non-Hispanic representing 76.3% of the population.
- White Pine County has a proportionately high distribution of reported population institutionalized because of the State prison (12.3%).

Table 1. Demographic Data Characteristics – White Pine County, Nevada, & United States

	White Pine County		Nevada		United States	
	2010 Census	Percent	2010 Census	Percent	2010 Census	Percent
Population	10,300		2,700,551		308,745,538	
Male	5,681	56.6%	1,363,616	50.5%	151,781,326	49.2%
Female	4,349	43.4%	1,336,935	49.5%	156,964,212	50.8%
Age						
Under 5 Years Old	634	6.3%	187,478	6.9%	20,201,362	6.5%
5 to 9 Years Old	558	5.6%	183,077	6.8%	20,348,657	6.6%
10 to 14 Years Old	576	5.7%	183,173	6.8%	20,677,194	6.7%
15 to 19 Years Old	579	5.8%	182,600	6.8%	22,040,343	7.1%
20 to 24 Years Old	598	6.0%	177,509	6.6%	21,585,999	7.0%
25 to 34 Years Old	1,373	13.7%	387,286	14.3%	41,063,948	13.3%
35 to 44 Years Old	1,255	12.5%	383,043	14.2%	41,070,606	13.3%
45 to 54 Years Old	1,560	15.6%	376,527	13.9%	45,006,716	14.6%
55 to 59 Years Old	780	7.8%	164,575	6.1%	19,644,805	6.4%
60 to 64 Years Old	623	6.2%	150,924	5.6%	16,817,924	5.4%
65 to 74 Years Old	862	8.6%	197,781	7.3%	21,713,429	7.0%
75 to 84 Years Old	464	4.6%	96,391	3.6%	13,061,122	4.2%
85+ Years Old	168	1.7%	30,187	1.1%	5,493,433	1.8%
Median Age	41.0		36.0		37.0	

Table 1. Demographic Characteristics – White Pine County, Nevada, & United States (cont.…)

	White Pine County		Nevada		United States	
	2010 Census	Percent	2010 Census	Percent	2010 Census	Percent
Race						
White Non-Hispanic	7,652	76.3%	1,462,081	54.1%	196,817,552	63.7%
Hispanic	1,326	13.2%	716,501	26.5%	50,477,594	16.3%
African American	388	3.9%	208,058	7.7%	37,685,848	12.2%
American Indian	384	3.8%	23,536	0.9%	2,247,098	0.7%
Asian	96	1.0%	191,047	7.1%	14,465,124	4.7%
Native Hawaiian	9	0.1%	15,456	0.6%	481,576	0.2%
Other Race	6	0.1%	4,740	0.2%	604,265	0.2%
Two or More Race	169	1.7%	79,132	2.9%	5,966,481	1.9%
Institutionalized	1,224	12.2%	25,835	1.0%	3,993,659	1.3%
Households						
Living in Households	8,801	87.7%	2,664,397	98.7	300,758,215	97.4%
Living in Group Quarters	1,229	12.3%	36,154	1.3	7,987,323	2.6%
Institutionalized	1,224	12.2%	25,835	1.0	3,993,659	1.3%
Household Relationship						
Total Households	3,707		1,006,250		116,716,292	
Family	2,344	63.2%	656,621	65.3%	77,538,296	66.4%
Married Family	1,787	48.2%	462,509	46.0%	56,510,377	48.4%
Female-Headed	325	8.8%	127,587	12.7%	15,250,349	13.1%
Female-Headed with Children under 18	183	4.9%	70,909	7.0%	8,365,912	7.2%
Non-Family	1,363	36.8%	349,629	34.7%	39,177,996	33.6%
Non-Family living alone	1,120	30.2%	258,409	25.7%	31,204,909	26.7%
Av. Household Size	2.0		3.0		3.0	
Av. Family Size	3.0		3.0		3.0	

Source: The Rural Data Portal, Housing Assistance Council (HAC).

White Pine County Social Characteristics

Table 2 presents the social characteristics for White Pine County, Nevada and United States. Key indicators show:

- Nearly 37% of White Pine County residents have graduated from high school and 33.4% has some college or AA degree. This is slightly better than Nevada and United State percentages.
- White Pine County has a slightly higher divorce rate of 19.2% of the population when compared to Nevada (13.5%) and United States (10.5%).

Table 2. Social Characteristics – White Pine County, Nevada, & United States

	White Pine County		Nevada		United States	
	2010 Census	Percent	2010 Census	Percent	2010 Census	Percent
Educational Attainment, 25 Years and Older						
Population 25+ Years	6,317		1,733,764		199,726,659	
Less Than High School Graduate	1,024	16.2%	272,581	15.7%	29,898,483	15.0%
High School Graduate	2,334	36.9%	514,350	29.7%	57,903,353	29.0%
Some College or AA Degree	2,111	33.4%	568,041	32.8%	56,197,824	28.1%
BA Degree	609	9.6%	250,126	14.4%	35,148,428	17.6%
Graduate or Professional Degree	239	3.8%	128,666	7.4%	20,578,571	10.3%
High School Graduate or More Education	5,293	83.8	1,461,183	84.3%	169,828,176	85.0%
BA Degree or More Education	848	13.4	378,792	21.8%	55,726,999	27.9%
Marital Status 15 Years and Older						
Population 15+ Years	7,805		2,086,369		243,073,468	
Never Married	2,272	29.1%	624,834	29.9%	75,318,217	31.0%
Married but Separated	3,399	43.5%	1,026,007	49.2%	122,089,343	50.2%
Separated	120	1.5%	46,619	2.2%	5,262,846	2.2%
Widowed	514	6.6%	107,862	5.2%	14,902,524	6.1%
Divorced	1,500	19.2%	281,047	13.5%	25,500,538	10.5%
Female Population 15+	3,731		1,034,887		124,809,173	
Female Widowed	317	8.5%	82,192	7.9%	11,925,452	9.6%
Female Divorced	773	20.7%	151,294	14.6%	14,558,295	11.7%

Source: The Rural Data Portal, Housing Assistance Council (HAC).

White Pine County Economic Characteristics

Table 3 presents the economic characteristics for White Pine County, Nevada and United States. Key indicators show:

- White Pine County unemployment rate is 6.5% which is lower than Nevada at 9% and United States at 7.9%
- White Pine County Natural Resource, Construction & Maintenance occupations reports approximately 18 % of total 16+ years old employed, compared to 10.9% for Nevada and 9.8% for United States.
- Government employment is significant in White Pine County accounting for 28.9% of total employment16 years and older.
- White Pine County household income less than $35,000 accounts for nearly 40% of total households, compared to nearly 30% in Nevada and 34% in the United States.
- White Pine County household income $75,000 and above accounts for approximately 25% of households compared to nearly 35% in Nevada and 33% in the United States.
- Similar to age distribution in White Pine County, over one-third of household income is derived through social security compared to 25% in Nevada and 37% in the United States. In addition 30% of White Pine County residents are collecting retirement income compared to 16% in Nevada and 17% in the United States.
- White Pine County largest employment industry is Agriculture, Forestry, Fishing & Hunting and Mining accounting for approximately 21% of total jobs. Public Administration and Educational Services, Health Care and Social Services also account for approximately 18% and 17% or total jobs, respectively.

Table 3. Economic Characteristics – White Pine County, Nevada, & United States.

	White Pine County		Nevada		United States	
	2010 Census	Percent	2010 Census	Percent	2010 Census	Percent
CIVILIAN LABOR FORCE 16 and OLDER						
Labor Force	4,409		1,377,921		154,037,474	
Employed	4,122	93.5%	1,254,163	91.0%	141,833,331	92.1%
Unemployed	287	6.5%	123,758	9.0%	12,204,143	7.9%

Table 3. Economic Characteristics – White Pine County, Nevada, & United States (cont.…)

	White Pine County		Nevada		United States	
	2010 Census	Percent	2010 Census	Percent	2010 Census	Percent
OCCUPATION (16+ Years)						
Employed	4,122		1,254,163		141,833,331	
Management, Bus., Science and Arts	1,105	26.8%	343,316	27.4%	50,034,578	35.3%
Services	1,112	27.0%	324,844	25.9%	24,281,015	17.1%
Sales and Office	771	18.7%	327,123	26.1%	36,000,118	25.4%
Natural Resources, Construction & Maintenance	742	18.0%	136,811	10.9%	13,940,273	9.8%
Production, Transportation, & Material Moving	392	9.5%	122,069	9.7%	17,577,347	12.4%
CLASS OF WORKER						
Employed	4,122		1,254,163		141,833,331	
Private Wage & Salary	2,636	63.9%	1,035,934	82.6%	111,303,933	78.5%
Government	1,191	28.9%	155,498	12.4%	21,024,265	14.8%
Self-Employed	295	7.2%	60,935	4.9%	9,250,789	6.5%
HOUSEHOLD INCOME						
Total Households	3,480		979,621		114,235,996	
Less than $10,000	225	6.5%	55,595	5.7%	8,274,388	7.2%
$10,000 to $14,999	169	4.9%	38,868	4.0%	6,294,748	5.5%
$15,000 to $24,999	618	17.8%	93,880	9.6%	12,340,738	10.8%
$25,000 to $34,999	370	10.6%	103,404	10.6%	12,043,840	10.5%
$35,000 to $49,999	475	13.6%	142,975	14.6%	16,132,902	14.1%
$50,000 to $74,999	741	21.3%	204,802	20.9%	21,201,711	18.6%
$75,000 to $99,999	503	14.5%	135,345	13.8%	14,097,295	12.3%
$100,000 to $149,999	308	8.9%	129,777	13.2%	14,065,756	12.3%
$150,000 to $199,999	24	0.7%	41,141	4.2%	4,993,775	4.4%
$200,000 or More	47	1.4%	33,834	3.5%	4,790,843	4.2%
Median HH Income	$48,545		$55,726		$51,914	
HOUSEHOLD EARNINGS						
Total Households	3,480		979,621		114,235,996	
Earnings	2,479	71.2%	811,791	82.9%	91,045,812	79.7%
Social Security	1,192	34.3%	243,526	24.9%	31,387,932	27.5%
Supplemental Social Security Income	126	3.6%	28,249	2.9%	4,626,547	4.0%
Public Assistance	83	2.4%	22,351	2.3%	2,816,127	2.5%
Retirement	1,049	30.1%	163,057	16.6%	19,998,762	17.5%

Table 3. Economic Characteristics – White Pine County, Nevada, & United States (cont.…)

	White Pine County		Nevada		United States	
	2010 Census	Percent	2010 Census	Percent	2010 Census	Percent
INDUSTRY EMPLOYMENT						
Employed	4,122		1,254,163		141,833,331	
Agriculture, Forestry, Fishing & Hunting, & Mining	873	21.2%	18,242	1.5%	2,634,188	1.9%
Construction	221	5.4%	115,602	9.2%	10,115,885	7.1%
Manufacturing	38	0.9%	54,763	4.4%	15,581,149	11.0%
Wholesale Trade	49	1.2%	29,700	2.4%	4,344,743	3.1%
Retail Trade	422	10.2%	142,339	11.3%	16,293,522	11.5%
Transportation and Warehousing, and Utilities	106	2.6%	62,482	5.0%	7,183,907	5.1%
Information	44	1.1%	21,043	1.7%	3,368,676	2.4%
Finance, Insurance, and Real Estate and Rental and Leasing	99	2.4%	81,155	6.5%	9,931,900	7.0%
Professional, Scientific, and Management, and Administrative and Waste Management Services	136	3.3%	129,611	10.3%	14,772,322	10.4%
Educational Services, and Health Care and Social Services	699	17.0%	182,042	14.5%	31,277,542	22.1%
Arts, Entertainment, and Recreation, and Accommodation and Food Service	579	14.0%	307,792	24.5%	12,566,228	8.9%
Other Services, except Public Administration	97	2.4%	51,230	4.1%	6,899,223	4.9%
Public Administration	759	18.4%	58,162	4.6%	6,864,046	4.8%

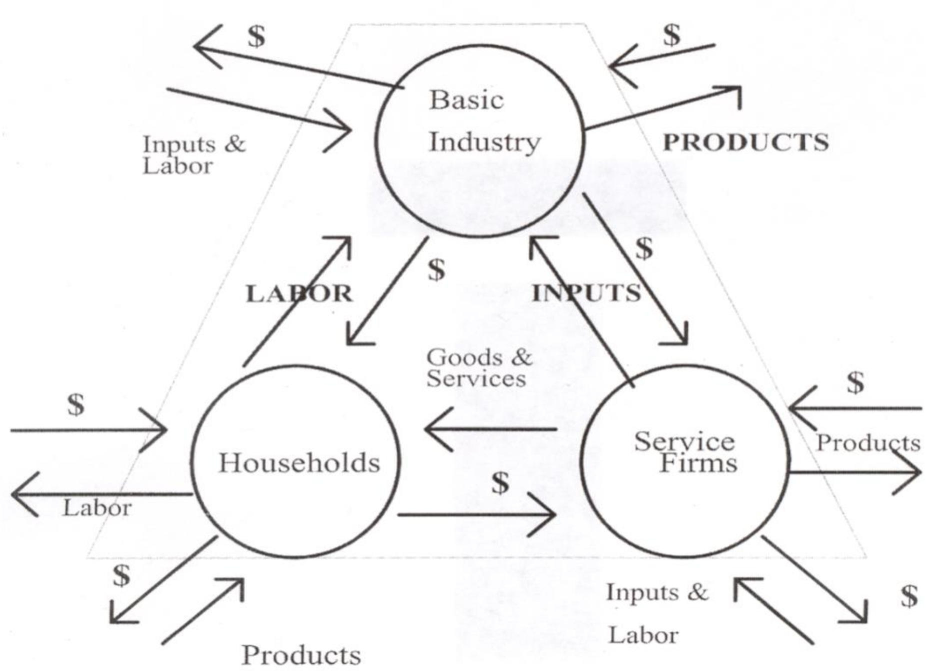
Source: The Rural Data Portal, Housing Assistance Council (HAC).

CONCEPTUAL ECONOMIC MODEL

Figure 1 illustrates the major dollar flows of goods and services in any economy. The foundation of a county's economy is those businesses which sell some or all of their goods and services to buyers outside of the county. Such a business is a basic industry. The flow of products out of, and dollars into, a county is represented by the two arrows in the upper right portion of Figure 1. To produce these goods and services for "export" outside the county, the basic industry purchases inputs from outside of the county (upper left portion of Figure 1), labor from the residents or "households" of the county (left side of Figure 1), and inputs from service industries located within the county (right side of Figure 1). The flow of labor, goods and services in the county is completed by households using their earnings to purchased goods and services from the county's service industries and from outside the county (bottom of Figure 1). It is evident from the interrelationships illustrated in Figure 1 that a change in any one segment of a county's economy will have reverberations throughout the entire economic system of the county.

Consider, for instance, theconstruction and operation activities of renewable energy facilities on White Pine County economy.The construction and operation of Renewable Energy activities in White Pine Countycan be considered a basic industry since funding will more than likely come from outside sources. During the construction and operation phase of renewable energy facilities, people will be hired from local households to build and maintain operations. Also renewable energy facilities will purchase goods and services from the local economic sectors. Transactions described above will cause earnings of local businesses to increase which will yield further local economic growth. Thus the changes in economic base such as construction and operation activities will work its way through the entire local economy.

Figure 1: Overview of Community Economic System



WHITE PINE COUNTY ECONOMIC IMPACT MODEL

Economic impacts for alternative renewable energy development were estimated using a White Pine County IMPLAN economic impact model. IMPLAN stands for "Impact Analysis for Planning" and is a commonly used analytical software tool to estimate economic impacts originally developed by researchers at the U.S. Forest Service. The model is owned and administered by IMPLAN Group LLC. The IMPLAN software is an input-output based model that describes the inter-industry relationships between industries and commodity purchases within a local economy. The model relies on county and state-level data sets that are continually updated by the U.S. government and by IMPLAN Group LLC. IMPLAN is used to measure the multiplier impacts or total economic impacts associated with a given project's spending relationships or linkages to a region's vendors, suppliers, households, and government entities. A multiplier describes the response of the regional economy to a stimulus (e.g. construction period spending associated with a project's local capital expenditures and payroll) that is a change in final demand. The multiplier process represents the predictive part of the model.

Economic impacts are defined as total expenditures, personal income, and employment. Totalimpacts are estimated using the following components

Direct Impacts – Represents the impacts for the expenditures and/or production values specifiedas direct final demand changes.

Indirect Effects – Represents the impacts caused by the iteration of industries purchasing from industries and local businesses resulting from direct final demand changes.

Induced Effects - Represents the impacts caused by the iteration of households purchasing from industries and local businesses resulting from direct final demand changes.

Total Impact – The total impact is the sum of the direct, indirect and induced effects.

Two phases of impacts are considered that have different levels of impacts on White Pine County. Phase One is the construction of alternative renewable energy facilities, projected to last between 12-15 months, which is considered a short-term impact that does not have any long-term economic sustainability. Phase Two consists of annual operations of the project that will provide ongoing economic sustainability and have positive economic impacts on White Pine County for several years. Description of each alternative renewable energy facility and economic impact will be discussed in the following sections.

WHITE PINE COUNTYAND STATE OF NEVADA
ECONOMIC IMPACT ESTIMATES
PHASE ONE – CONSTRUCTION ACTIVITY

Phase one of the White Pine County alternative renewable energy development includes the construction of a power facility. Based on this analysis the following assumptions were made in terms of facility size; 10MW Solar (PVSP & CSP), 10MW wind, 50 MW hydroelectric, and 10MW biomass. Also considered in phase one is the construction of 5 miles of transmission lines to support either a 10MW or 50MW facility. It is estimated that each alternative renewable energy facility would require a construction period between 12-15 months. During the construction period communities in White Pine County will experience temporary increases in the levels of overall economic activity through the purchases of goods and services, employment, and personal income. Table 4 summarizes the estimated direct expenditures, employment and personal income required for the construction of a power facility for each alternative energy resource. Direct activity is reported for White Pine County and State of Nevada.

Purchases - Construction costs for renewable energy facilities ranged from $19.5 million for wind to $139.2 million for pumped storage hydro. The main components of construction costs include labor, materials, equipment, supplies and taxes. Due to the confidentiality of detailed component construction cost estimates, only total estimated construction costs were reported. However, the detailed construction cost estimates by type and place of purchases is integrated in the White Pine County IMPLAN economic model. In addition, it is assumed that during the construction phase all attempts will be made to purchase local labor and supplies when available. The only components that will be difficult to purchase locally is specialized equipment that is only available in other markets.

Employment – White Pine County has a relatively small workforce which under certain circumstance will require seeking specialized employees from other areas in the State of Nevada or at times outside the state. Average employment requirement during the construction phase for each renewable energy source is estimated to range from 29 average employees for wind construction to 736 for pumped storage hydro.

Personal Income – Personal income, wages and benefits, range from an average annual rate of $43,322 for pumped storage hydro to $126,998 for CSP. The variation in wages could be the result of specialized trade and expertise. In the instances that employees are being imported, the personal income earned while working in White Pine County will still have a positive economic impact through purchasing lodging, goods and services.

Table 4. Direct Expenditures, Employment, and Personal Income for Construction of Alternative Renewable Energy Facilities in White Pine County & Nevada.

	PVSP	CSP	Wind	Hydro	Biomass	Transmission	Transmission
Facility Size	10MW	10MW	10MW	50MW	10MW	10MW	50MW
Direct Investment	$26,840,930	$69,672,738	$19,479,010	$139,235,415	$47,547,000	$10,191,037	$12,670,650
Direct Income (Wages & Benefits)	$3,381,957	$10,032,874	$3,214,037	$31,884,910	$2,852,820	$3,331,797	$4,323,839
Direct Employment (Jobs)	35	79	29	736	37.5	35.7	46.4
White Pine County Investment	$492,638	$2,673,200	$162,650	$3,971,969	$4,279,230	$489,170	$709,556
White Pine County Income	$338,195	$1,003,284	$110,829	$3,188,499	$1,369,350	$785,573	$1,038,657
White Pine County Employment	3.5	7.9	1	73.6	19	8.9	11.7
Nevada Investment (include WPC)	$6,662,348	$12,822,571	$3,757,209	$59,686,881	$8,558,520	$4,310,808	$5,853,840
Nevada Income (include WPC)	$3,381,957	$10,032,874	$238,238	$31,884,910	$2,548,520	$2,014,289	$2,663,223
Nevada Employment (include WPC)	35	79	22	736	34	22.7	30
Average Wages	$96,627	$126,998	$110,828	$43,322	$76,075	$93,328	$93,186

Tables 5 through 8 summarize the economic impacts on White Pine County from the construction of alternative renewable energy facilities and 5 miles of transmission lines. White Pine County total economic impacts are greatly influenced by the lack of available goods and services, thus requiring importing significant levels of goods and services from outside the county. This can be thought of as import substitution where White Pine County is importing goods and exporting dollars. In all instances, less than 15 percent of total expenditures are with White Pine County businesses, mainly because support businesses do not exist. This minimizes the overall impact on White Pine County. However, significant employment and income impacts are realized by hiring and providing wages to White Pine County residents. This is can be seen through the induced impacts generated in White Pine County. When local employees, directly working on a construction crew earns wages they then spend those earning on local goods and services that support additional levels of employment. This is why in Table 5 several of the top impacted sectors by employment can be consideredcommunity support sectors. This is referred to as the multiplier effect.

Key Points:

- Pumped storage hydro facility construction is estimated to contribute over $7.1 million directly to White County's economy. Each $1 invested in the construction of pumped storage hydro in White Pine County generates an additional $0.27 of economic activity. All other renewable resources also have a positive impact on White Pine County.
- Biomass facility construction is estimated to have significant income and employment impacts on White Pine County by generating and additional $0.22 for each direct dollar of income and 0.53 additional jobs for each construction job.
- CSP has the largest employment impact generating an additional 0.72 jobs per one direct construction jobs.
- Income impacts on White Pine County appear somewhat low, which is influenced by relatively low business incomes for support and service industries (induced impacts).

Table 5. Top 10 Impacted Sectors by Employment for Alternative Energy Construction Activity in White Pine County.

Nonresidential construction
Food service & drinking places
Architectural, engineering & related services
Retail stores – food & beverage
Automotive repair & maintenance
Accounting, tax preparation & bookkeeping
Nursing & residential care facilities
Real estate establishments
Legal services
Securities, commodity contracts & investments

Table 6. Expenditure Impacts on White Pine County for the Construction of Alternative Energy Facilities and 5 Miles of Transmission Lines.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$830,833	$85,571	$125,026	$1,041,430	1.25
CSP	10MW	$2,673,200	$275,324	$373,057	$3,321,581	1.24
Wind	10MW	$273,479	$28,167	$40,984	$342,630	1.25
Hydro	50MW	$7,160,195	$737,459	$1,171,784	$9,069,438	1.27
Biomass	10MW	$5,648,580	$581,772	$529,862	$6,760,214	1.20
Transmission	10MW	$1,274,743	$131,291	$283,638	$1,689,673	1.33
Transmission	50MW	$1,748,213	$180,056	$375,666	$2,303,935	1.32

Table 7. Income Impacts on White Pine County for the Construction of Alternative Energy Facilities and 5 Miles of Transmission Lines.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$338,195	$24,731	$30,056	$392,981	1.16
CSP	10MW	$1,003,284	$79,571	$89,680	$1,172,535	1.16
Wind	10MW	$110,829	$8,140	$9,852	$128,822	1.16
Hydro	50MW	$3,188,499	$213,131	$281,696	$3,683,327	1.16
Biomass	10MW	$1,369,350	$168,136	$127,363	$1,664,849	1.22
Transmission	10MW	$785,573	$37,944	$68,190	$891,707	1.14
Transmission	50MW	$1,038,657	$52,038	$90,314	$1,181,008	1.14

Table 8. Employment Impacts on White Pine County for the Construction of Alternative Energy Facilities and 5 Miles of Transmission Lines.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	3.5	0.5	1.0	5.0	1.43
CSP	10MW	7.9	2.7	3.0	13.6	1.72
Wind	10MW	1.1	0.3	0.3	1.7	1.55
Hydro	50MW	73.6	7.4	9.4	90.3	1.23
Biomass	10MW	19.0	5.8	4.2	29.0	1.53
Transmission	10MW	8.9	1.3	2.3	12.5	1.40
Transmission	50MW	11.7	1.8	3.0	16.5	1.41

Tables 9 through 12 summarize the estimated economic impacts on the State of Nevada from the construction of alternative renewable energy facilities and 5 miles of transmission lines. Conversely to White Pine County economic impact results, when estimating the economic impacts on the State of Nevada, including White Pine County, the impacts increase significantly because more goods and services are available at the state level. This can be seen by the total expenditure impact ranging from $10.4 million for wind power facility construction to $151 million for pumped storage hydro. Although these impacts are significant, there are still large direct business and service purchase from outside the state to meet facility construction needs. When considering the income and employment impacts, the multiplier effect is very positive because of the well above average wages that help increase the secondary induced impacts.

Key Points:

- Economic activity generated for each construction dollar invested in Nevada for renewable energy facilities generates between $0.62 and $0.99 of additional economic activity for Nevada's economy.
- Pumped storage hydro has the largest income and employment impact of the State of Nevada generating over $54 million and supporting $1,200 jobs for an average annual income of $45,000.

Table 9. Top 10 Impacted Sectors by Employment for Alternative Energy Construction Activity in Nevada.

Nonresidential construction
Architectural, engineering & related services
Food service & drinking places
Real estate establishments
Securities, commodity contracts & investments
Office of physicians, dentists & other medical
Wholesale trade businesses
Retail stores – General merchandise
Retail stores – food & beverage
Employment services

Table 10. Expenditure Impacts on the State of Nevada for the Construction of Alternative Energy Facilities and 5 Miles of Transmission Lines.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$10,044,305	$2,848,754	$3,613,413	$16,506,472	1.64
CSP	10MW	$22,855,445	$6,482,234	$10,079,372	$39,417,052	1.72
Wind	10MW	$6,195,447	$1,757,145	$2,508,648	$10,461,240	1.69
Hydro	50MW	$91,571,791	$25,971,483	$33,778,866	$151,322,140	1.65
Biomass	10MW	$11,107,040	$3,150,165	$3,049,192	$17,306,397	1.56
Transmission	10MW	$6,325,097	$1,793,917	$2,183,748	$10,302,761	1.63
Transmission	50MW	$8,517,063	$2,415,599	$2,901,499	$13,834,161	1.62

Table 11. Income Impacts on the State of Nevada for the Construction of Alternative Energy Facilities and 5 Miles of Transmission Lines.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$3,381,957	$1,164,484	$1,237,423	$5,783,864	1.71
CSP	10MW	$10,032,874	$2,649,740	$3,451,706	$16,134,321	1.61
Wind	10MW	$2,438,238	$718,268	$859,093	$4,015,598	1.65
Hydro	50MW	$31,884,910	$10,616,353	$11,567,659	$54,068,922	1.70
Biomass	10MW	$2,548,520	$1,287,692	$1,044,204	$4,880,416	1.92
Transmission	10MW	$2,014,289	$733,299	$747,830	$3,495,418	1.74
Transmission	50MW	$2,663,223	$987,424	$993,626	$4,644,272	1.74

Table 12. Employment Impacts on the State of Nevada for the Construction of Alternative Energy Facilities and 5 Miles of Transmission Lines.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	35.0	21.0	29.2	85.2	2.43
CSP	10MW	79.0	47.8	81.5	208.3	2.64
Wind	10MW	22.0	13.0	20.3	55.2	2.51
Hydro	50MW	736.0	191.6	273.1	1,200.7	1.63
Biomass	10MW	34.0	23.2	24.7	81.9	2.41
Transmission	10MW	22.7	13.2	17.7	53.6	2.36
Transmission	50MW	30.0	17.8	23.5	71.3	2.38

WHITE PINE COUNTYAND STATE OF NEVADA
ECONOMIC IMPACT ESTIMATES
PHASE TWO – ANNUAL OPERATIONS

At the conclusion of the renewable energy facility construction phase, White Pine County will realize a new level of sustainable economic impacts through annual operations. Annual operations for each renewable resource will require purchases of labor, supplies, materials and services. Table 13 summarizes the direct annual expenditures, employment and personal income for each alternative energy resource.

Purchases **-** Annually it is projected that alternative energy resource operators will spend annually between $230,000 (PVSP & Wind) to $18.2 million for biomass. Similar to the construction phase, there is a strong commitment to purchase labor, supplies, materials, and services from local sources and businesses. Additionally it is not unusual for new supportive businesses and industries to be created to support sustainable renewable energy operations demands as the industry matures.

Employment – Annual total permanent employment to sustain alternative energy resource facilities range between one employee for PVSP and wind to 21 employees for CSP operations. All employees will be residents of White Pine County.

Personal Income **–** Annual total personal income used to support the levels of permanent employment ranges from $83,260 for wind operations to $884,101 for CSP operations. At this level the average wages are well above the overall average wages in White Pine County.

Tables 14 through 17 summarize the economic impacts on White on County from the annual operations of alternative energy facilities. Similar to construction impacts, White Pine County annual estimated economic impacts are influenced by the lack of available goods and service supplied locally.

Key points:

- Direct annual expenditures, including labor income, is relatively low for PVSP, wind and pumped storage hydro. Biomass operations does support over $6 million of direct economic activity that then supports an additional $536 thousand through indirect and induced spending.
- Biomass operations has the greatest annual income and employment impacts on White Pine County generating over $936 thousand of income that supports 15.6 jobs.
- CSP also reports a strong income and employment sustainable impact on White Pine County by realizing over $962 thousand of personal income and 23.6 jobs or an average payroll of $40,763.

Table 13. Direct Expenditures, Employment, and Personal Income for Annual Operations of Renewable Energy Facilities.

	PVSP	CSP	Wind	Hydro	Biomass
Facility Size	10MW	10MW	10MW	50MW	10MW
Direct Investment	$230,000	1,078,172	$230,000	$2,605,143	$18,282,521
Direct Income (Wages & Benefits)	$95,308	$884,101	$83,260	$562,711	$869,400
Direct Employment (Jobs)	1	21	1	6.5	12
White Pine County Investment	$18,260	$6,016	$38,180	$78,155	$5,223,936
White Pine County Income	$95,308	$884,101	$83,260	$562,711	$869,400
White Pine County Employment	1	21	1	6.5	12
Nevada Investment (include WPC)	$37,302	$22,512	$48,760	$1,601,267	$10,447,873
Nevada Income (include WPC)	$95,308	$884,101	$83,260	$562,711	$869,400
Nevada Employment (include WPC)	1	21	1	6.5	12
Average Wages	$95,308	$42,100	$83,260	$86,571	$72,450

Table 14. Top 10 Impacted Employment Sectors for Alternative Energy Annual Operations in White Pine County

Electric power generation & transmission
Food service & drinking places
Business support services
Retail stores – food & beverage
Maintenance and repair construction
Accounting, tax preparation & bookkeeping
Nursing & residential care facilities
Real estate establishments
Legal services
Securities, commodity contracts & investments

Table 15. Expenditure Impacts on White Pine County from Annual Operations of Alternative Energy Facilities.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$113,568	$2,472	$33,022	$149,062	1.31
CSP	10MW	$890,117	$19,375	$306,020	$1,215,512	1.36
Wind	10MW	$121,440	$2,643	$28,889	$152,972	1.26
Hydro	50MW	$640,866	$13,950	$194,913	$849,729	1.33
Biomass	10MW	$6,093,336	$132,633	$310,591	$6,536,560	1.07

Table 16. Income Impacts on White Pine County from Annual Operations of Alternative Energy Facilities.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$95,308	$607	$7,940	$103,854	1.09
CSP	10MW	$884,101	$4,755	$73,579	$962,434	1.09
Wind	10MW	$83,260	$649	$6,946	$90,855	1.09
Hydro	50MW	$562,711	$3,423	$46,864	$612,988	1.09
Biomass	10MW	$869,400	$32,547	$74,673	$976,621	1.12

Table 17. Employment Impacts on White Pine County from Annual Operations of Alternative Energy Facilities.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	1.0	0.1	0.3	1.4	1.40
CSP	10MW	21.0	0.2	2.4	23.6	1.12
Wind	10MW	1.0	0.1	0.2	1.3	1.30
Hydro	50MW	6.5	0.1	1.6	8.2	1.26
Biomass	10MW	12.0	1.2	2.5	15.6	1.30

Tables 18 through 21 summarize the estimated economic impacts on the State of Nevada from the annual operations of alternative renewable energy facilities. Similar to White Pine County the annual operating expenditures, income, and employment are relatively low. With the exception of annual operations for a biomass facility, direct expenditures range from approximately $132 thousand for wind and PVSP to $2.1 million for pumped storage hydro. Biomass facility annual operations areestimated to contribute over $11.3 million of direct economic activity to the state's economy. The total annual economic impact for a 10MW biomass facility operation on the State of Nevada include $12.8 million of economic activity that includes over $1.4 million of personal income and supporting 23.8 jobs.

Table 18. Top 10 Impacted Employment Sectors for Alternative Energy Annual Operation in Nevada.

Electric power generation & transmission
Food services and drinking places
Maintenance and repair construction
Legal services
Real estate establishments
All other misc. professional services
Transport by rail
Securities, commodity contract & investments
Services to building and dwellings
Scenic and sightseeing transportation

Table 19. Expenditure Impacts on State of Nevada from Annual Operations of Alternative Energy Facilities.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$132,610	$7,894	$67,728	$208,232	1.57
CSP	10MW	$906,613	$53,970	$318,398	$1,278,981	1.41
Wind	10MW	$132,020	$7,859	$68,474	$208,353	1.58
Hydro	50MW	$2,163,978	$128,820	$485,113	$2,777,912	1.28
Biomass	10MW	$11,317,273	$673,711	$889,543	$12,880,527	1.14

Table 20. Income Impacts on State of Nevada from Annual Operations of Alternative Energy Facilities.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	$82,308	$2,928	$23,194	$108,430	1.32
CSP	10MW	$884,101	$20,019	$246,017	$1,150,137	1.30
Wind	10MW	$83,260	$2,915	$23,449	$109,624	1.32
Hydro	50MW	$562,711	$47,783	$166,128	$776,622	1.38
Biomass	10MW	$869,400	$249,899	$304,626	$1,423,925	1.64

Table 21. Employment Impacts on State of Nevada from Annual Operations of Alternative Energy Facilities.

	Size	Direct	Indirect	Induced	Total	Multiplier
PVSP	10MW	1.0	0.1	0.5	1.6	1.60
CSP	10MW	21.0	0.4	5.8	27.2	1.30
Wind	10MW	1.0	0.1	0.6	1.7	1.70
Hydro	50MW	6.5	0.9	3.9	11.3	1.74
Biomass	10MW	12.0	4.6	7.2	23.8	1.98

CONCLUSIONS & DISCUSSION

White Pine County economic development efforts are considering alternative renewable energy development to achieve economic diversification that provides job stability and growing community services. Demographic, social and economic characteristics of White Pine County have been relatively stable with very modest population change. It might be safe to conclude that the development of a 10MW or 50WM alternative renewable energy facility in White Pine County will have minimal impacts on demographic, social and economic characteristics. Each of these renewable energy resources require relatively modest levels of sustainable employment that White Pine County could absorb.

The following study examined the economic contributions on White Pine County and the State of Nevada from the construction and annual operations of five renewable energy resources: PVSP, CSP, wind, pumped storage hydro, and biomass. During the construction phase, 12-15 months, pumped storage hydro is estimated to have the greatest economic impact on White Pine County generating over $9 million in economic activity, including $3.6 million in personal income that supports over 90 jobs. In addition, the construction of 5 miles of transmission lines supports additional significant level of short-term impacts on White Pine County. Similar impacts are also reported for the State of Nevada but at much larger levels because of the availability of more goods, services and employment. When considering long-term sustainability impacts on White Pine County, biomass operations have the greatest impacts generating over $6.5 million of economic activity, including over $976 thousand of personal income and supporting 15.6 jobs.

Finally, this study provides the basic framework for White Pine County to evaluate the economic impacts of alternative renewable energy facility construction and annual operations. This is just one component that White Pine County needs to consider when deciding if one or more of the renewable energy resources makes sense for full scale development.

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