US Department of the Interior

Bureau of Land Management
Carson City District, Nevada

May 2013

Carson City District
Resource Management Plan Revision

Reasonably Foreseeable Development Scenario for Solar, Wind and Biomass

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
BLM	United States Department of the Interior, Bureau of Land Management
CCD	Carson City District
CSP	concentrating solar power
EIS	Environmental Impact Statement
GIS	geographical information systems
MWh	megawatt hour
PV	photovoltaic
RFD	Reasonably Foreseeable Development Scenario
RPS	Renewable Portfolio Standard
US	United States

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CHAPTER 1
INTRODUCTION

The following Reasonably Foreseeable Development Scenario (RFD) has been prepared in support of the United States (US) Department of the Interior, Bureau of Land Management (BLM) Carson City District (CCD) Resource Management Plan (RMP) and Environmental Impact Statement (EIS). The RFD identifies the lands that are likely most suitable for the development of solar, wind, and biomass energy resources, and estimates the electrical energy generating capacity of those lands should they be developed.

Developing an RFD requires a series of assumptions about future development; these assumptions include evolution of technologies, energy policy, economic growth, and the cost of energy in the future, among others. Uncertainties due to assumptions are amplified when dealing with unproven and yet-to-be commercialized technologies. For the purpose of this RFD, only known, proven, and currently used commercial-scale renewable energy types were considered in the estimations provided. Those technologies meeting these criteria are solar thermal electric (both concentrating solar power [CSP] and photovoltaic [PV] technologies), wind and biomass. Further, the scope of this analysis is limited to on-the-ground, commercial-scale renewable energy projects.

Other forms of renewable energy include but are not limited to, geothermal, hydropower and ocean power, and emerging technologies in carbon neutral fuels, artificial photosynthesis, anaerobic digestion, and algae-based fuels. Nevada does not have potential for ocean-harvested power. As for hydropower, although some hydroelectric projects have been brought forward informally, no utility-scale hydroelectric projects have been formally proposed through application or otherwise. Simply securing the necessary water rights for this form of renewable energy would most likely make such a proposition financially unfeasible, although not impossible. There are two withdrawals in the planning area for hydropower facilities, but the withdrawals transferred jurisdiction from

the BLM to Federal Energy Regulatory Commission for the public lands affected by the projects.

No interest has been expressed in and no applications have been received for projects involving forms of emerging renewable energy technologies. These other technologies do have the potential to be deployed at a commercial scale on public land in the future; however, it is difficult to forecast which of these technologies will reach commercial-scale deployment and what proportion of the future energy landscape they will represent. Therefore, in-depth discussions of these technologies are excluded from this document.

The planning area does have historical, existing, and potential for geothermal utility-scale energy production. However, the RFD for geothermal energy is discussed in the separate mineral potential report for the RMP and is therefore excluded from further discussion in this document.

This document provides an overview of the purpose of the RFD, an overview of wind and solar technologies assumed to be used under this RFD, the methodology used for preparing the RFD, the results of the analysis, and conclusions. Maps and acreages are provided along with descriptions identifying patterns and trends observed in the results.

1.1 PURPOSE OF THIS REPORT

The purpose of this report is to identify the potential for development and potential location of renewable energy projects on lands administered by the BLM within the CCD planning area. The planning area encompasses 4.8 million acres of BLM-administered land in 11 counties within two states (Washoe, Storey, Carson City, Douglas, Lyon, Churchill, Mineral, and Nye counties within Nevada, and Alpine, Plumas, and Lassen counties within California). Potential renewable energies addressed in this report are utility-scale solar, biomass, and wind energy testing and development projects on public land within the planning area.

This RFD was prepared for the RMP with the following purposes in mind:

- To inform policy makers: Policy makers, including land management agencies such as the BLM, develop landscape-level approaches to determine the allowable uses of lands. The RFD informs these parties of which areas are most suitable for energy projects from both technical and environmental standpoints so they are better prepared for land use planning efforts.
- To inform decision makers: Decision makers are involved at all levels of development, from large-scale planning processes all the way through site-specific project approvals. An RFD allows a decision maker to see how an individual proposed project might fit into the energy and environmental landscape, and allows him or her

to make a decision that takes into account big-picture, planning-level considerations.

- To inform the general public: The general public is a major force in creating political pressure that can directly affect the approval or denial of a local project proposal. An RFD allows the public to understand their local resources in the context of the state as a whole. Having this context can help local residents to submit informed opinions to political representatives or decision makers during an environmental review process or other public hearing for future projects that may be proposed in their community.
- To inform developers: Energy developers are typically looking to site a project for the maximum energy production at the lowest possible cost. An RFD shows developers a range of options for siting their projects in technically suitable locations with minimal environmental constraints. While local issues are not identified in the RFD, this document is intended to provide an initial screening of major environmental constraints. Informed developers save time, money, and are able to launch smarter outreach to communities and stakeholders.

An RFD is a forecast or estimate of activity that is likely to occur. The goal is to give scope or scale to the potential consequences of new activities and their associated impacts on the environment. The RFD is not meant to predict actual activities but to be a basis for quantifying environmental effects from a range of development scenarios.

The RFD projection is based on knowledge of past use, the capability of the resource for additional development, local and regional economic trends, and the needs of the public. The data presented in an RFD is deliberately general for ease in assessment. Specific locations of surface-disturbing activities, such as roads or well developments, are not indicated. The period covered by this RFD is 20 years.

1.2 Renewable Energy-Related BLM Policies and Regulations

The policies and procedures cited in this report are applicable at the time of writing but are expected to evolve over the timeframe of the RMP, a planning timeframe of 20 years. As of 2013, the BLM's renewable energy policy is directed by the following regulations and executive orders:

- The Energy Policy Act of 2005 (Title II, Sec. 211), which requires the US Department of the Interior to approve at least 10,000 megawatts of renewable energy on public lands by 2015
- Executive Order 13212, Actions to Expedite Energy-Related Projects, which requires federal agencies to expedite review of energy project applications

- Secretarial Order 3285, which requires the US Department of the Interior to identify and prioritize specific locations best suited for large-scale renewable energy production

Additionally, two Programmatic EISs on Wind and Solar Energy Development have been completed:

- The Record of Decision for the Programmatic EIS on Solar Energy Development (BLM and DOE 2012) and processing right-of way (ROW) applications for solar energy projects on BLM-administered lands
- The Record of Decision for the Wind Energy Development Programmatic EIS and Associated Land Use Plan Amendments (BLM and DOE 2005)

Finally, the BLM has specific policy and guidance for certain types of renewable energy promultaged through Instructional Memoranda (IM). The main solar- and wind energy-related IMs are summarized here:

- IM 2002-196 establishes Land Use Planning requirements for wind projects on public land.
- IM 2003-020 establishes interim wind development policy, mostly updated or replaced by subsequent IMs.
- IM 2005-069 establishes policy on off-site mitigation and compensation for energy-related ROW impacts.
- IMs 2005-006, 2007-097, and 2011-003 establish policy for the processing of ROW applications for solar energy development projects on public land.
- IM 2006-216 provides guidance on implementing the Record of Decision for the Programmatic EIS on Wind Energy Development (BLM and DOE 2005).
- IM 2009-043 establishes the main BLM Wind Energy Development policies, including land use planning, environmental review, best management practices and Plan of Development requirements, due diligence, rent, types of testing and development projects, and renewal policy.
- IM 2010-156 provides guidance on Eagle Act compliance for renewable projects including wind projects on BLM-administered lands.
- IM 2010-141 establishes policy on collection of rent for solar development projects on BLM-administered lands.
- IM 2011-059 discusses the NEPA document requirements for processing utility-scale wind applications.

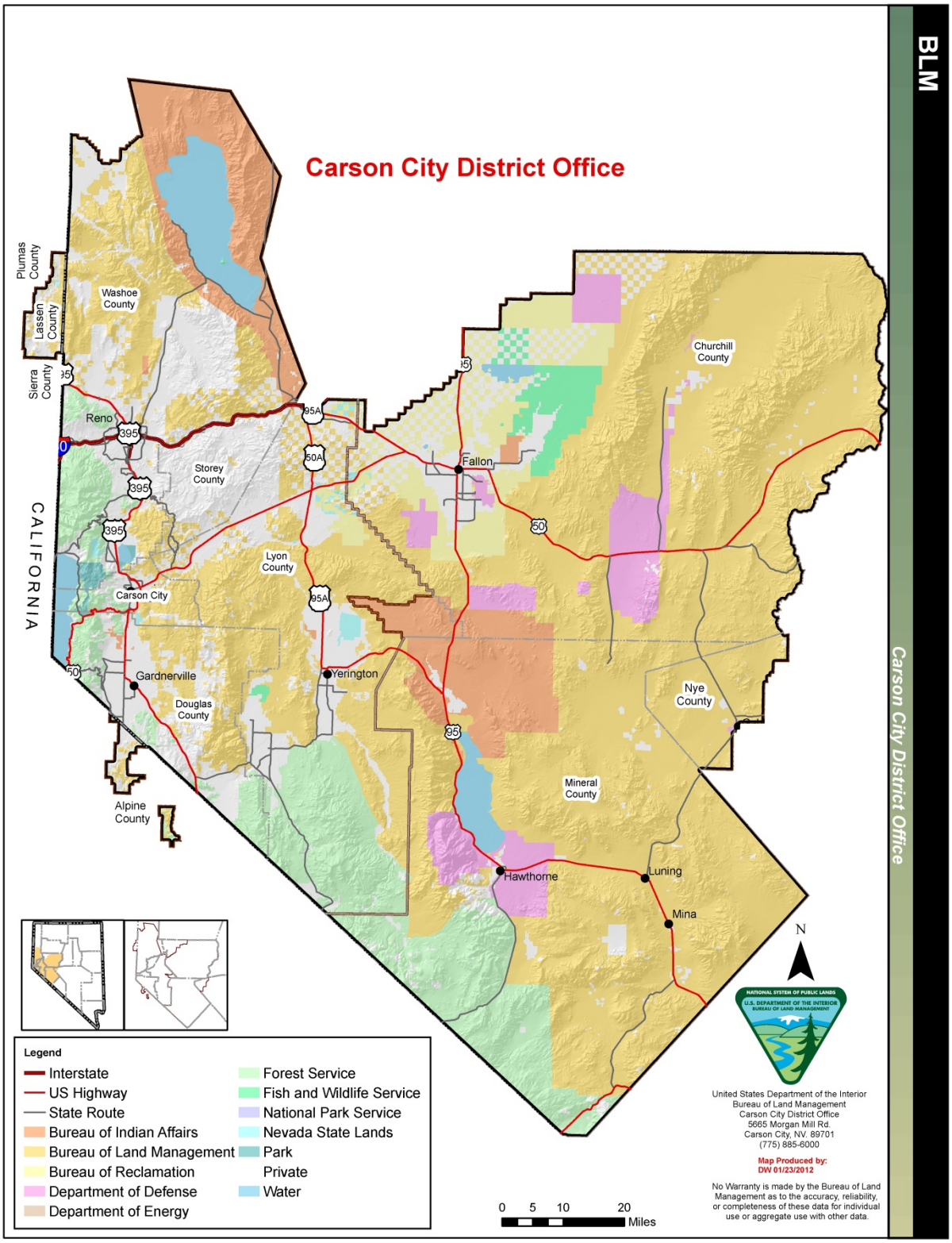
- IM 2011-060 establishes policy on the due diligence requirements of the proponents to facilitate environmentally responsible development for solar and wind projects on BLM-administered lands.
- IM 2011-061 provides guidance on wind project pre-application meetings and project screening.
- IM 2011-096 establishes policy for the collection of reclamation bonds on all wind projects on public land prior to ground disturbing activities.
- IM 2011-181establishes policy for involvement of grazing permittees and lessees on solar and wind projects on public land.
- IM 2011-183 provides procedures for two-year segregation of wind energy development areas entry through the Federal Register process.
- IM 2012-032 provides guidance on ongoing tribal consultation for implementation of the Solar PEIS and introduces a draft Programmatic Agreement for National Historic Preservation Act Section 106 requirements for solar projects on public land.
- IM 2013-015 implements the Programmatic Agreement for National Historic Preservation Act section 106 requirements for solar projects on public land.

Solar and wind testing and development projects are authorized via the ROW process under the regulations at 43 Code of Federal Regulations 2800. After an initial review of ROW applications (submitted on Form SF-299) for projects on public lands, the BLM notifies the applicant of the processing category into which their application fits as set forth in 43 Code of Federal Regulations 2804.14. ROW applications are generally accepted and processed on a first-come, first-served basis, although energy-related applications are treated as a priority. The ROW regulations at 43 Code of Federal Regulations 2804.23 (c) provide authority for offering public lands under competitive bidding procedures for ROW authorizations if two or more competing applications are for the same facility or system. The ROW process is discretionary, and, if successful, results in a ROW grant authorization for the use of public lands after conducting the necessary environmental analysis. Once the grant is executed, annual rent payments are made on the authorization to the US Treasury based on fair market value. Biomass facilities would also be authorized under the appropriate Lands and Realty program regulations depending on the proposed action. Removal of the feed-stock itself from public land is typically addressed with vegetative removal permits through the State Forester at the Field Office level.

The ROW authorization process is expected to change over the timeframe of the RMP. Recent discussions have revolved around a leasing arrangement and

possible royalties to the federal, state, and local government entities, as seen with oil and gas and geothermal public resource use, as opposed to a ROW process, for renewable energy such as solar and wind. However, no official guidance has been drafted as of the time of this writing.

Figure 1-1 CCD RMP Planning Area



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CHAPTER 2
SOLAR ENERGY

2.1 SOLAR ENERGY

Solar energy is the energy produced in the sun's core through nuclear fusion. This energy reaches the earth in form of electromagnetic radiation, mostly in visible and near-visible (ultraviolet and near-infrared) bands. The intensity of radiation striking the top of earth's atmosphere is 1,367 watts per square meter. This value varies by plus or minus three percent as the earth orbits the sun on an elliptical orbit (University of Oregon 2002). The amount of solar radiation that reaches earth's surface is known as insolation or "incident solar radiation." Insolation values are affected by location (latitude and elevation), season, time of day, local landscape, and local weather.

As solar radiation passes through the atmosphere, some of it is scattered, absorbed, and reflected by air molecules, water vapor, clouds, ozone, and other agents in the atmosphere. On a clear day at noon, only about 25 percent or 1,000 watts per square meter of the incident direct radiation reaches the earth's surface. The solar radiation that reaches earth's surface directly without being scattered is called direct normal irradiance. The radiation that has been scattered before reaching the earth's surface is called diffuse solar radiation. The total solar radiation (sum of direct normal irradiance and diffuse solar radiation) projected onto a horizontal surface is called global radiation, which is sometimes referred to as global horizontal irradiance.

Solar radiation may be harnessed through various technologies and transformed to usable energy such as heat and electricity. It has small-scale applications such as powering solar vehicles and generating electricity or heating water for residences. It may also be used for large-scale commercial applications such as generating electricity in solar power plants. Two basic solar energy technologies that produce electrical power are PV systems and concentrating solar power systems.

2.1.1 Photovoltaic Systems

Photovoltaic (PV) systems use solar cells, which are semiconductor materials similar to those used in computer chips, to capture the energy in sunlight and convert it directly into electricity. PV systems must be scaled over a very large area in order to be effective for utility-scale applications. Due to the high cost of PV cell productions, large PV electrical generating systems are less likely to be used in commercial utility application. PV systems are generally used to provide power to individual homes and small buildings. They are also found in rural areas on communication towers, water pumps, and road and traffic signs.

The process by which a PV cell converts sunlight into electricity is called the photoelectric effect. Through this process, the sunlight absorbed by the semiconductor material knocks electrons loose from their atoms, allowing them to flow through the material and generate electric current.

PV cells can be connected into units to form PV modules, which in turn are combined to make PV arrays. The size of an array depends on the amount of sunlight and the needs of the customer. For utility-scale electricity generation, hundreds of arrays are interconnected to form a single large system. Modules and arrays are often combined with other components, such as those that convert the current within the cell material to usable electricity, batteries to store some of the electricity, and mounting structures that point them toward the sun. These components, referred to as the balance-of-system components, combined with modules and arrays create a complete PV system.

Water requirements for PV systems are approximately 20 gallons per megawatt-hour (MWh) for the purpose of cleaning solar panels (Solar Energy Industries Association 2010). In some operations where water availability is especially limited, a PV operator may choose not to wash the panels at all, eliminating water consumption altogether.

There are two types of PV systems in use today: flat-plate systems and concentrated PV systems.

Flat-plate Photovoltaic Systems

The most common PV system is flat-plate PV panels, which can either be fixed in place or programmed to track the sun. These panels respond to both diffuse and direct solar radiation, making them useful even on cloudy days when the diffuse radiation accounts for nearly 100 percent of the total radiation. On a sunny day, an estimated 10 to 20 percent of the total solar radiation comes from the diffuse component of sunlight.

Generally, flat-plate PV panels are mounted on stationary structures with a tilt at a fixed angle determined by the latitude of the site, the requirement of the load, and the availability of sunlight. The fixed arrays are advantageous in that they are simple, inexpensive, and lightweight. However, because their orientation to the sun is fixed, often at a less than optimal angle, they receive

less energy per unit area compared with a tracking array. The flat-plate tracking arrays are primarily mounted on one-axis tracking structures, which are designed to track the sun from east to west.

Concentrated Photovoltaic Systems

Concentrated PV systems use lenses or mirrors to concentrate sunlight on solar cells. The concentration of sunlight allows for greater efficiency and reduction in size and number of cells. These systems must track the sun to keep light focused on the PV cells. They are primarily mounted on two-axis tracking structures, which are designed to track the sun's daily and seasonal course. One-axis tracking systems are also sometimes used.

Both reflectors and lenses have been used to concentrate light for PV systems. The most promising lens for concentrated PV application is the Fresnel lens, which uses a miniature sawtooth design to focus incoming light. The best lenses, however, can transmit only 90 to 95 percent, and in practice even less, of incident light. In addition, lenses cannot focus diffuse sunlight, which makes up nearly 10 to 20 percent of the radiation on a clear day.

While concentrated PV systems lower costs by reducing PV material needs, they require sophisticated tracking devices and expensive concentrating optics. High concentration ratios also introduce an excessive heat, which can decrease cell efficiencies and damage solar cells.

2.1.2 Concentrating Solar Power Systems

Concentrating solar power (CSP) technologies use mirrors to concentrate sunlight onto receivers that convert it to heat. The thermal energy is then used to drive a generator via a steam turbine or heat engine to produce electricity. CSP technologies are the most suitable solar technologies for large utility-scale applications. The three main types of CSP technologies are linear concentrator, dish/engine, and power tower systems. CSP technologies require cooling of the exhaust steam so that it condenses back into water before being heated again into steam. Wet cooling is many times more efficient than dry cooling and uses 500 to 800 gallons of water per MWh (Solar Energy Industries Association 2010).

Linear Concentrator Systems

Linear CSP systems use a large field of long, rectangular, U-shaped mirrors tilted toward the sun that capture and focus solar energy onto linear receiver tubes that run along the length of the mirrors. The receiver contains a fluid (oil or water/steam) that is heated by the sunlight and used to boil water in a steam-turbine generator to produce electricity.

The two major types of linear CSP systems are parabolic trough systems and linear Fresnel reflector systems. Parabolic trough systems are the predominant CSP systems currently in operation in the US. They use collectors in which the receiver tube is positioned along the focal line of each parabolic mirror.

Currently the largest individual trough systems generate 80 megawatts of electricity.

In linear Fresnel reflector systems, the receiver tube is positioned above several flat or slightly curved mirrors that are mounted on tracking structures. Sometimes a small parabolic mirror may be added atop the receiver to further focus the sun's rays.

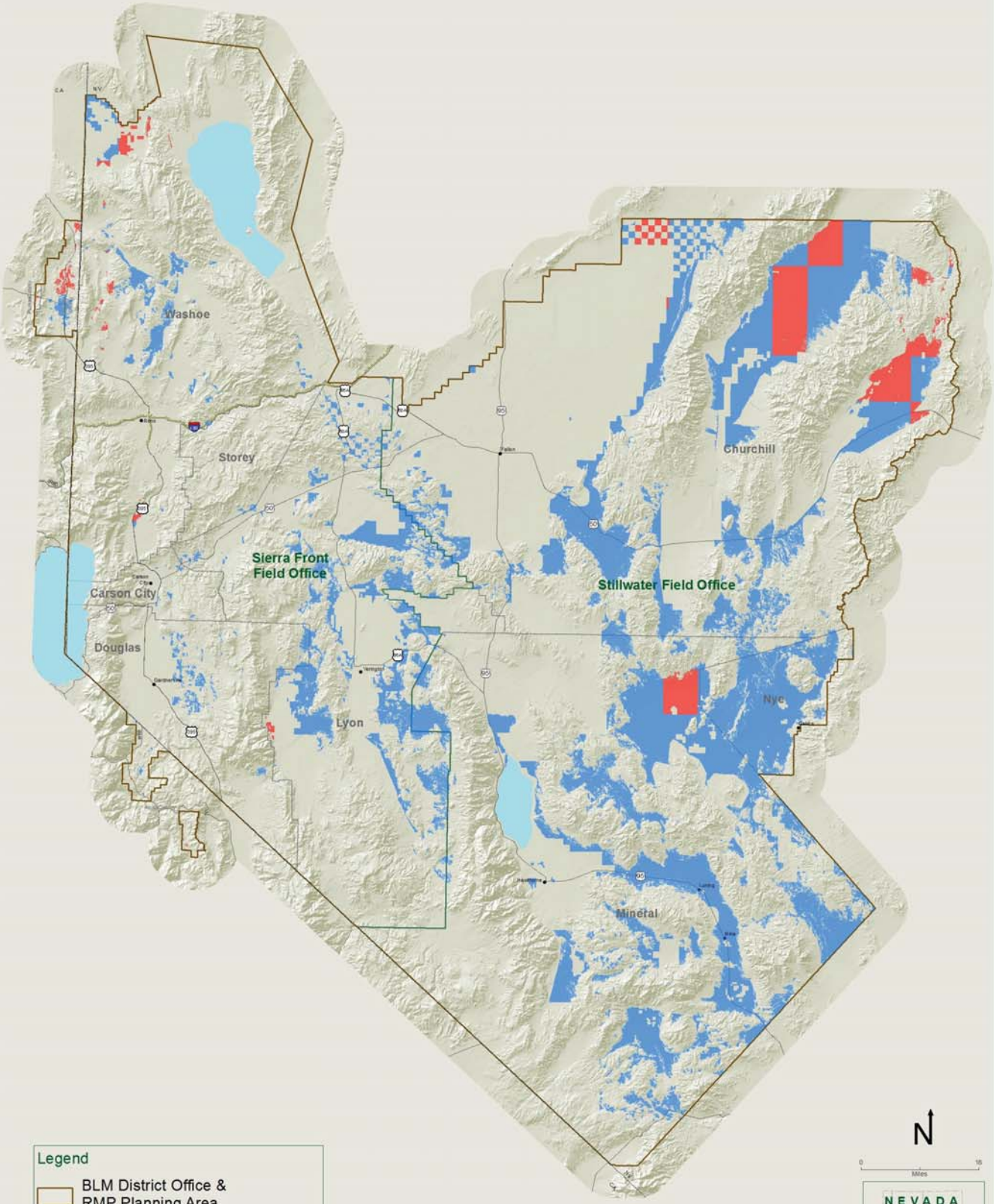
Dish/Engine Systems

The dish/engine system produces relatively small amounts of electricity (3 to 25 kilowatts) compared to other types of CSP technologies. It uses a parabolic mirrored dish similar to a large satellite to concentrate sunlight onto a thermal receiver. The thermal receiver, mounted at the focal point of the dish, absorbs and transfers the heat to an engine or generator. The most common type of heat engine used today in dish/engine systems is the Stirling engine. A Stirling engine uses the fluid heated by the receiver to move pistons and create mechanical power. Mechanical work turns a crankshaft, which drives a generator and produces electricity. To maximize the amount of solar energy captured by the dish/engine collectors, the dish assembly is mounted on a tracking structure that follows the sun across the sky.

Power Tower Systems

Power tower systems use a large field of flat sun-tracking mirrors, known as heliostats, to focus sunlight onto a receiver, which is located atop a tower. A fluid in the receiver, either water/steam or molten nitrate salt, is heated and used to generate steam, which, in turn, is used in a conventional turbine generator to produce electricity. The molten nitrate salt has heat-transfer and energy-storage capabilities, which allows for production of electricity during cloudy weather and at night.

Bureau of Land Management
Solar Potential



Legend

- BLM District Office & RMP Planning Area
- BLM Field Office
- County Boundaries
- 5.51-5.99 kWh/m2/day (Moderate)
- 6.00-7.00 kWh/m2/day (Good)

(kWh/m2/day = kilowatt-hours per square meter per day)

Bureau of Land Management
Carson City District Office
5665 Morgan Mill Rd.
Carson City, NV. 89701

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Figure 2-1

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Carson City District Office

April 2013

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CHAPTER 3
WIND ENERGY

3.1 WHAT IS WIND ENERGY AND HOW IS WIND ENERGY DEVELOPED?

Wind is a form of solar energy. Solar radiation causes uneven heating of the atmosphere, producing regions of high and low pressure. This pressure gradient results in movement of air from high-pressure to low-pressure regions, creating wind. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow when harvested by modern wind turbines can be used to generate electricity.

The terms wind energy and wind power describe the process by which the wind is used to generate mechanical power or electricity. Because air has mass, moving air carries with it kinetic energy. Wind turbines convert the wind's kinetic energy into mechanical power. This mechanical power can be used for specific tasks such as grinding grain, pumping water, or producing electricity.

A wind turbine consists of a blade or rotor, a drive train (usually including a gearbox and a generator), a tower, and other equipment, including controls, electrical cables, ground support equipment, and interconnection equipment. The blades turn in the moving air and power an electric generator that supplies an electric current. The blades act much like an airplane wing. Blowing wind causes a pocket of low-pressure air to form on the downwind side of the blade, which in turn causes the blade to be pulled toward that pocket. This force causes the rotor to spin like a propeller and turn a shaft. The rotational energy of the shaft turns the generator to produce electricity.

Wind turbines are mounted on a tower to enable them to capture the most energy. Tower height affects the amount of power that can be extracted by a given wind turbine. At 98 feet above ground or higher, wind turbines can take advantage of faster and less-turbulent wind.

Wind turbines fall into two basic groups: the horizontal-axis variety (propeller-style), such as traditional farm windmills, and the vertical-axis design, such as the

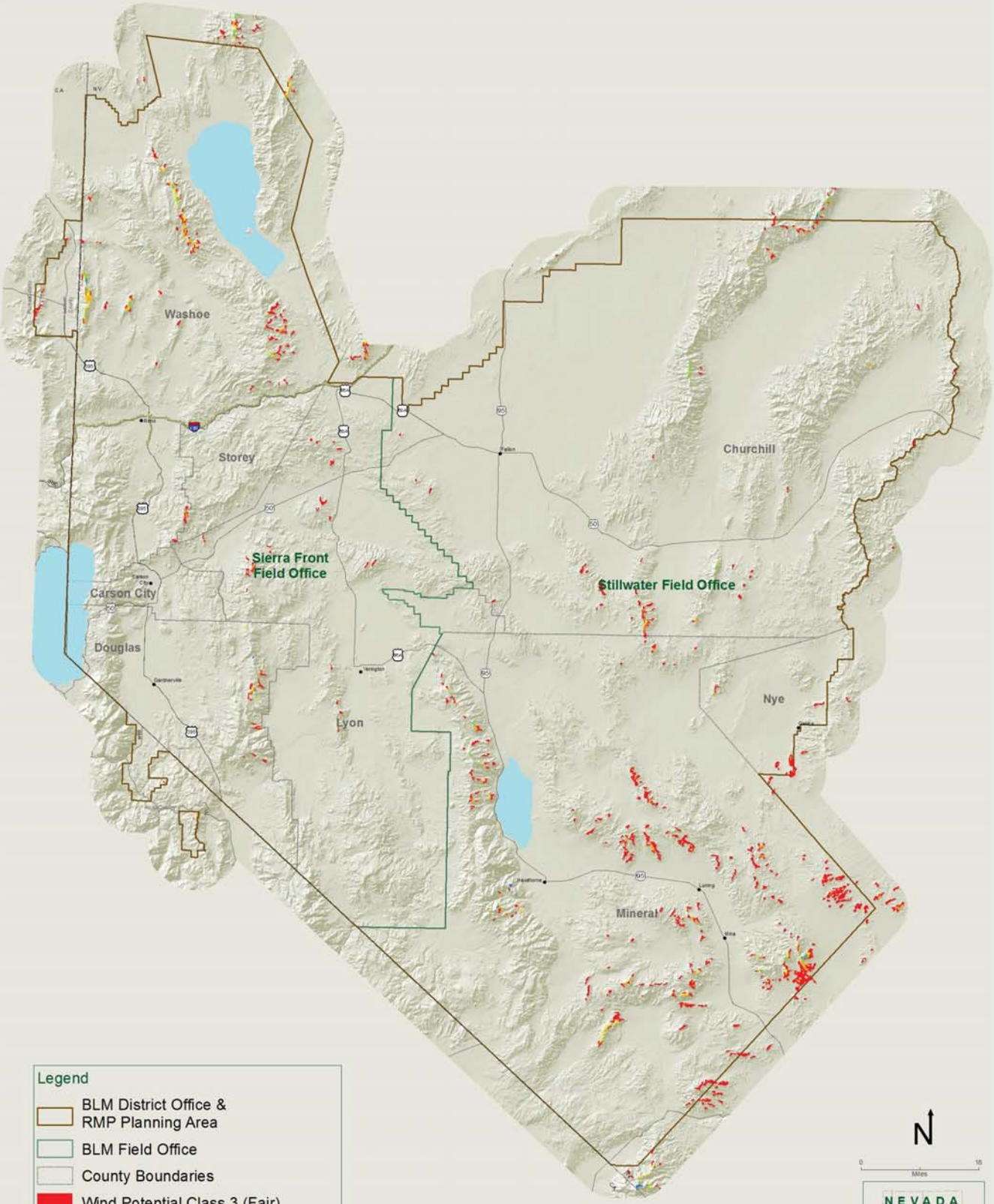
eggbeater-style Darrieus model. The horizontal-axis type turbines are the most common, constituting nearly all the utility-scale turbines. These typically have either two or three blades. The three-blade turbines are operated upwind with their blades facing into the wind.

Wind turbines are available in a variety of sizes, and, subsequently, a variety of power ratings. Utility-scale wind turbines for land-based wind farms have rotor diameters ranging from 130 to about 395 feet and towers that reach 130 to 425 feet high.

Utility-scale turbines range in power rating from 100 kilowatts to as many as several megawatts. Larger turbines are grouped together into wind farms, which provide bulk power to a utility power grid. Wind power plants are modular, which means they consist of small individual modules (turbines), and, depending on electricity demand, can easily modify production capacity.

Single small turbines below 100 kilowatts are used for homes, telecommunications, or water pumping. Small wind systems also have potential as distributed energy resources. These systems, called hybrid wind systems, operate in connection with diesel generators, batteries, and PV systems in remote, off-grid locations where a connection to the utility grid is not available.

Bureau of Land Management
Wind Potential



Legend

- BLM District Office & RMP Planning Area
- BLM Field Office
- County Boundaries
- Wind Potential Class 3 (Fair)
- Wind Potential Class 4 (Good)
- Wind Potential Class 5 (Excellent)
- Wind Potential Class 6 (Outstanding)
- Wind Potential Class 7 (Superb)

(kWh/m2/day = kilowatt-hours per square meter per day)

Bureau of Land Management
Carson City District Office
5665 Morgan Mill Rd.
Carson City, NV. 89701

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Figure 3-1

April 2013

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CHAPTER 4
BIOMASS

4.1 WHAT IS BIOMASS AND HOW IS BIOMASS DEVELOPED?

Biomass is an important source of energy and the most important fuel worldwide after coal, oil, and natural gas. Biomass is also a form of solar radiation because the power it generates is from the solar energy stored in plants and plant-derived materials such as food crops, grassy and woody plants; residues from agriculture or forestry; and the organic component of municipal and industrial wastes of various human and natural activities. Biomass energy can be derived from fuels, also called biofuels. The term biomass excludes organic material that has been transformed by geological processes into substances such as coal or petroleum.

Biomass can be used for direct heating, such as burning wood in a fireplace or wood stove, for generating electricity, or can be converted directly into liquid fuels to meet transportation energy needs. Wood has been used for energy longer than any other biomass source and today is still the largest biomass energy resource. Waste energy is the second-largest source of biomass energy. The main contributors of waste energy are municipal solid waste, manufacturing waste, and landfill gas. Biomass power provides two valuable services: it is the second most-utilized source of renewable energy in the United States (hydropower being the primary source), and it is an important part of waste management infrastructure.

Electricity generated from biomass is also called biopower. Biopower facilities use many different technologies; the most common is burning of wood or other biomass feedstocks to produce steam which then is used to drive turbines and produce electricity. Some generators use a mix of biomass and fossil fuels to generate electricity, while others burn methane, a product of the natural decay of organic materials. Dry plant tissue can produce as much as 1,890 kilocalorie of heat per 0.5 kilogram (about 1.1 pounds), which is equivalent to the heat available from 0.25 kilogram of coal.

Biofuels are liquid fuels produced from plants and other organic materials. The two most common types of biofuels are ethanol and biodiesel. Ethanol is an alcohol made by fermenting any biomass high in carbohydrates through a process similar to brewing beer. The majority of ethanol produced in the United States is made from corn. Current research is exploring ways to efficiently convert cellulose (agricultural waste, forest residue, municipal solid waste, and energy crops) to ethanol. Ethanol is mostly used as a fuel additive for vehicles to increase octane and cut down carbon monoxide and other smog-causing emissions. Biodiesel is made by processing vegetable oil, animal fat, or recycled cooking grease with alcohol or other chemicals. Biofuels can be used to run generators or heat substances like water to turn turbines, similar to other energy sources like fossil fuel, in the production of electricity.

While biomass is a renewable energy resource, it can have both negative and positive environmental impacts. It may reduce emissions and pollutants, but utility-scale farming of biomass crops can reduce biodiversity and negatively impact wildlife habitat. Municipal solid waste may contain toxins which could cause pollution and the release of hazardous materials if it is used as a biomass feedstock. As with other renewable resources, use of appropriate technology and prior analysis will promote the most positive environmental impacts. Through replanting or natural regrowth/regeneration, biomass has the capability of being a zero-carbon emission energy source, as the same carbon released by burning the fuel can be fixed in the growth cycle of the new plants.

Because biomass power is produced from plant sources, it can potentially be produced almost anywhere in the United States.

CHAPTER 5
BACKGROUND

5.1 BACKGROUND

5.1.1 Statewide Portfolio Standard

Nevada established a renewable portfolio standard as part of its 1997 restructuring legislation. Under the standard, NV Energy (formerly Nevada Power and Sierra Pacific Power) must use eligible renewable energy resources to supply a minimum percentage of the total electricity it sells. In 2001, the state increased the minimum requirement by 2 percent every 2 years, culminating in a 15 percent requirement by 2013. The portfolio requirement has been subsequently revised, most significantly by Nevada State Bill 358 of 2009, which increased the requirement to 25 percent by 2025. The 2009 amendments also raised the solar carve-out, requiring utilities to meet 6 percent of their portfolio requirement through solar energy beginning in calendar year 2016. The solar carve-out remains at 5 percent through the end of calendar year 2015.

Nevada Assembly Bill (AB) 3 of 2005 allowed efficiency measures to be used to satisfy a portion of the requirement. To qualify as portfolio energy credits, efficiency measures must be implemented after January 1, 2005; sited or implemented at a retail customer's location; and partially or fully subsidized by the electric utility. The measure must also reduce the customer's energy demand (as opposed to shifting demand to off-peak hours). The contribution from energy efficiency measures to meet the portfolio standard is capped at one-quarter of the total standard in any particular year.

The following schedule is currently in effect:

Table 5-1
Nevada Statewide Energy Portfolio

Minimum Percentage	Time Frame
6% renewables/efficiency	2005 and 2006
9% renewables/efficiency	2007 and 2008
12% renewables/efficiency	2009 and 2010
15% renewables/efficiency	2011 and 2012
18% renewables/efficiency	2013 and 2014
20% renewables/efficiency	2015 through 2019
22% renewables/efficiency	2020 through 2024
25% renewables/efficiency	2025 and thereafter

Source: DSIRE 2012

In addition to solar, qualifying renewable energy resources include biomass, geothermal energy, wind, certain hydropower, energy recovery processes, and waste tires (using microwave reduction).

5.2 Historic and Existing Activity on the Carson City District

5.2.1 Solar

In the time period between 2002 and 2013, the CCD received two applications for solar development. One, authorizied in 2010 for Luning Solar, was for a 500-acre phased development of either PV or CSP, depending on investments gained through having a viable ROW grant authorization. The project also included a transmission line corridor of approximately 0.75 mile. The Plan of Development was to specify which technology was to be used. However, in late 2012, the ROW grant was relinquished. The project was to be located northwest of the town of Luning, east on Highway 95 from the town of Hawthorne near Walker Lake.

The other application received on the CCD was made by the Department of the Navy for Naval Air Station Fallon in 2008. The proposal was for a flat-plate PV system to supplement power needs of Navy personnel housing and the airbase itself, similar to the use of the output of the array for Nellis Air Force Base in Las Vegas, Nevada. This proposal, was not for a traditional utility-scale use, although it was similar in size and impacts. However, due to land status concerns and other issues, the application was withdrawn before reaching an authorization and the case was closed in 2013.

Solar projects in conjunction with geothermal power plants (hybrid plants) have been discussed, but no applications have been submitted. The world's first solar-geothermal hybrid power plant, Enel's Stillwater facility, is located within the planning area boundary but not on public land.

Solar power generated in conjunction with geothermal, such as with the Stillwater facility, can take the form of self-sufficient utiltity-scale production. Geothermal plants take electricity to run, and solar facilities married with the

plant can provide this energy, reducing parasitic load. Solar in conjunction with geothermal can also be used to reheat water after interface with the turbines or turbine medium to allow for recirculation to the turbines prior to reinjection, increasing the efficiency of use for geothermal resources.

5.2.2 Wind

In the same 2002 to 2013 timeframe, wind testing and development has experienced much greater activity on the CCD. The CCD has received 39 applications for wind energy projects. Of the 39 applications received, 35 have been for Type 2 Testing and Monitoring projects. These are three-year authorizations to use a specific public land area and possibly erect meteorological towers, sonic detection and ranging facilities, and other testing sensors to gather data in an effort to make a determination if a wind energy development project would be viable. The physical area does not preclude other land uses, only other wind applicants. These three-year authorizations can only be renewed if a corresponding application for development is submitted and a Plan of Development for the utility-scale production is also submitted. Of the 39 applications received, all but 1 have resulted in grant issuance for testing. Of these testing projects, 35 are now closed due to expiration without accompanied development, leaving 3 Type 2 Testing and Monitoring projects active at the time of this report.

Four applications have been received for full utility-scale wind energy development projects. However, only one development project remains pending; the other three applications have been withdrawn. It should be noted that two of the applications for development projects experienced funding issues, and the testing side of the two sites are still active through new applications for the same project areas.

The CCD also began processing a ROW request for facilities tied to wind development on private land. The Virginia Peak Wind Co, LLC, Project involved aerial power line and road crossings of public land. However, the project has not progressed, and no grant has been issued.

5.2.3 Biomass

The Nevada Division of Forestry, through woody biomass grants from the US Forest Service, has several bins in which to collect biomass. This biomass was then delivered to the co-generation plant at the Northern Nevada Correction Center in Carson City, which produced over 5 million kilowatts of power annually.

A BLM fuels reduction project at Indian Creek Reservoir, demonstrated the potential of a closed loop biomass delivery system. Utilizing the bins, Nevada Division of Forestry was able to divert 75 tons of woody biomass from burn piles in the field to the boiler at Northern Nevada Correction Center. The biomass was delivered at a cost of approximately $5 per ton, a significant savings

over the $39 per ton Northern Nevada Correction Center was paying through contract suppliers.

Although the Northern Nevada Correction Center plant is no longer in operation, was not located on public land, was not utility-scale, and, due to shipping costs, was poorly constructed (Atkins 2012), it demonstrates the potential for future development of biomass resources for utility-scale energy production within the planning area. There are ongoing efforts to find another facility that could reconstruct the biomass generator and utilize biomass in the future.

There are numerous state and national efforts to utilize woody biomass in meeting forest health objectives and renewable energy goals. For example, a Statewide Natural Resource Assessment was issued in 2010 by the Nevada Division of Forestry, which identified BLM-administered lands in the CCD as priority landscapes for addressing catastrophic wildfire, forest health declines, and invasive weeds (Nevada Division of Forestry 1990). This assessment identified the lack of product utilization opportunities (e.g. mills, biomass plants, and pellet plants) as a limiting factor in successful restoration of forest and woodland stands in the priority landscapes located within the CCD.

CHAPTER 6
RESOURCE POTENTIAL

6.1 INTRODUCTION AND METHODOLOGY

Potentially developable lands are those lands that have no known regulatory or technical restrictions on which energy projects could potentially be sited. These lands were identified to give an idea of the maximum electrical generation capacity of public lands in the planning area that are free from such known restrictions for solar and wind potentail. Methodologies to identify such lands were reviewed from the following sources:

- Department of Energy's National Renewable Energy Laboratory geographic information systems (GIS) data for wind potential (Nevada Wind 50-meter Resolution, May 18, 2012)
- National Renewable Energy Laboratory GIS data for solar potential, 10 Kilometer (Lower 48 and Hawaii PV 10-kilometer Resolution 1998 to 2009, September 12, 2012)
- BLM Coporate GIS data for potential technical or regulatory restrictions

The solar radiation potenial development considers slopes of 5 degrees or less and direct normal radiation of at least 5 kilowatt-hours per square meter per day in 10-meter cells. The wind potential shows data at 50-meter height (about average for utility-scale production, the higher the better to reduce turbulence) with a 1,000-meter cell size, considering slope of 20 degrees or less with low surface roughness. The development for both wind and solar resources considered the following regulatory restrictions:

- Areas of Critical Enviromental Concern
- Greater and Bi-State Sage Grouse Habitat
- Proximity to Known Raptor Nests

- Herd Management Areas
- Wilderness Study Areas

Potential for biomass was based on previous and potential wood removal either through personal wood tags, commercial thinning and removal, and hazardous fuels removal for wildfire management. As stated above, there are emerging technologies also encompassed in the term "biomass," however, emerging technologies are difficult to predict, especially for a utility-scale development.

All three major sources of renewable energy are addressed in detail in the following sections.

6.2 How is Solar Potential Defined in this Report?

Solar energy potential is determined using solar insolation values measured in kilowatt-hours per square meter per day. Good solar potential is 6 to 7 kilowatt-hours per square meter per day, while 5 to 6 is defined as moderate. PV data was used because CSP needs large quantities of water for development and maintenance of power production facilities. Solar developers within the CCD are more likely to use PV technologies due to the lack of water resources. Therefore, the insolation values represent the resource available to a flat-plate collector, oriented due south, at an angle from horizontal equal to the latitude of the collector location.

Other technical characteristics of siting decisions for solar projects would include proximity to major highways and transmission corridors. A location far removed from the power transmission grid might be uneconomic, as new transmission lines would be required to connect the wind farm to the grid. A 5-degree slope(about 10-percent slope) was selected for the raster data in this report which exceeds the 5 percent used in the PEIS for Solar. This was used because PV technologies are not as dependent on slope as CSP technologies, and, as previously stated, the foreseeable development in the planning area would most likely be PV in nature. See Figure 2-1 for solar potential acre locations. Only parcels 40 acres or larger were considered in this analysis.

Table 6-1
Solar Potential by Acres, CCD

Kilowatt-hours per Square Meter per Day	Acres
5.51 - 5.74 (moderate)	26,490
5.75 - 5.99 (moderate)	122,243
6.00 - 6.25 (good)	489,663
6.26 - 6.59 (good)	722,483
6.60 - 7.00 (good)	5,002

Source: BLM 2010

Thus, there are over 1.2 million acres of good solar potential in the planning area.

6.3 How is Wind Potential Defined in this Report?

Wind speed is a crucial element in projecting turbine performance, and a site's wind speed is measured through wind resource assessment prior to a wind system's construction. The power available in the wind is proportional to the cube of its speed, which means that slightly higher wind speeds will produce a significantly higher power. Wind resources are characterized by wind power density classes, which range from Class 1 (the lowest) to Class 7 (the highest). See Figure 3-1 for wind potential within the CCD.

While the resource characteristics of the wind in a specific location are very important, many other factors also contribute to siting decisions. A location far removed from the power transmission grid might be uneconomic as new transmission lines would be required to connect the wind farm to the grid. Soil conditions and the terrain must be suitable for the construction of tower foundations. Surface roughness is another determining factor because it determines the amount of turbulence a turbine will experience. Turbulent winds put greater stresses on the rotor and tower, reducing the turbine's lifespan.

The majority of the acreage identified as having wind potential occurs in the lowest commercially viable wind class, Class 3. The acreage breakdown for CCD is as follows:

Table 6-2
Wind Potential by Class and Acres, CCD

Class	Acres
Class 3 (Fair)	668,980 acres
Class 4 (Good)	121,521 acres
Class 5 (Excellent)	28,153 acres
Class 6 (Outstanding)	27,275 acres
Class 7 (Superb)	20,106 acres

Source: BLM 2010

There are approximately 197,000 acres of better than fair wind potential in the planning area.

5.4 How is Biomass Potential Defined in this Report?

Other than fire wood permits, only 13 green tons of biomass have been sold on the CCD in the last five years.

There have been 64 fuels treatment projects in the CCD between 2002 and 2012. Fuels treaments can include any one or a combination of the following: lopping and scattering, piling and burning, controlled burning with or without removal of biomass, downing trees and conducting a wood sale, and chipping

with either scattering or removing the masticated product. These treatments can address sage-grouse habitat objectives as well as fuels reduction.

Total acres affected by these 64 fuels treatments are approximately 12,720. Given an average wood tonnage of 5 tons per acre, and assuming that on average 30 percent of the acres can be accessed by equipment for removal, 19,080 tons of biomass in fuels reduction treatments could have been removed from public land in the planning area since 2002. This would be an average to 1,900 tons per year. Personal wood tags are sold on a cordage basis and the district has sold approximately 1,800 tons of personal firewood per year in the last 5 years. Through programs that are already taking place within the planning area, an average of approximately 3,700 tons of biomass is being produced annually. One ton of seasoned wood produces 15 million BTUs, so 3,700 tons of biomass would yield 55.5 billion BTUs. Because 1 million BTUs produce 0.293 MWh, 3,700 tons of material historically removed annually from the district represents approximately 16,262 MWh of biomass energy potential.

Until 2002, very little active vegetation management occurred within the planning area. There are approximately 900,000 acres of pinyon-juniper woodlands on the CCD and another 20,000 acres of other forest and woodlands types. Many of these stands contain high tree densities which leads to insect, disease, drought-related mortality, and high fuel loads that threaten the health and diversity of these stands. Assuming that 30 percent of these acres are located on gentle slope areas near existing roads, approximately 276,000 acres of forest and woodlands could be treated to meet resource objectives and facilitate use of the biomass. The majority of these acres are in the pinyon-juniper woodland type, which is a fairly slow growing species. Using a conservative estimate of 80 years for these species to grow to a size large enough to warrant utilization, approximately 3,500 acres could be removed on an annual basis while also meeting sustained yield goals. An average yield of 5 green tons per acre on 3,500 acres has the potential to produce 17,000 green tons of biomass on an annual basis. Given green wood at 50 percent moisture content produces 5.74 million BTUs per ton: 17,000 green tons would produce 97,580 million BTUs. Because 1 million BTUs produce 0.293 MWh, 17,000 green tons would generate 28,591 MWh of potential energy annually for future biomass energy projects.

If these green tons were seasoned, assuming a weight loss of 25 percent, the potential MWh of biomass energy on the district annually would be 12,750 tons. Because dry biomass yields 15 million BTUs per ton, 12,750 tons would produce 191,250 million BTUs. Because million BTUs yields 0.293 MWh, the potential for future biomass energy projects could be as high as 56,036 MWh annually on the district if the green tons are seasoned prior to utilization.

CHAPTER 7
REASONABLE FORESEEABLE DEVELOPMENT

7.1 SOLAR

It is foreseeable that 2 utility-scale PV solar power plants could be permitted within the next 20 years within the planning area. The best location is in the southern Stewart Valley area, near the Esmeralda County border; however, this area has no major transmission line in close proximity. The most likely utility-scale PV technology will be used on public land in hybrid concert with an existing geothermal power plant, such as the one located in the Carson Sink east of Fallon. The largest obstacles for utility-scale solar production are access to water, access to the power grid, and cost of technology.

7.2 WIND

It is reasonably foreseeable that 2 utility-scale wind development projects could be developed in the CCD in the next 20 years. Among the obstacles to previous development projects are visual resource impacts, pending sage-grouse regulation, and impacts on eagles. Wind has garnered the most interest of all technologies within the CCD and still appears to be viable at a utility-scale. However, funding, sage-grouse, and eagle issues will have to be resolved before any companies will move forward on full-scale development proposals.

7.3 BIOMASS

The largest obstacles for utility-scale biomass production using woody fuels in Nevada are removal costs, transportation costs, and for the power plant to have a consistant feedstock supply. Due to ongoing fuels reduction projects funded with wildfire management dollars, utilization of fire hazard reduction materials removes one of the major obstacles.

Small-scale technologies such as a small modular biomass power system that have the potential to off-set transportation costs have been developed (Nicholls 2008). Small modular biomass systems are trailer-mounted gasification generators that can use a three-step process to produce gas, followed by

cleaner gas, followed by engine combustion to generate electricity. Utilization of a small-scale application such as this could significantly reduce transportation costs, and due to mobility, would increase the likelihood of steady feedstock supply.

If biomass were to be utilized effectively in the next 20 years, small-scale mobile biomass power production would be the most reasonable way to develop the potential in the planning area, especially in concert with numerous BLM planning areas as well as local government and private land, to maximize utilization of similar fuels treatments within Northern Nevada. It is reasonably foreseeable that 2 small mobile biomass utilization devices that could tie directly into the grid in relatively close proximity to fuels treatment projects could be developed in the future within the planning area, combining the BLM programs of forestry, realty, and fuels management.

CHAPTER 8
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