A Renewable America

POWERING UP NEVADA

A REPORT ON THE ECONOMIC BENEFITS OF RENEWABLE ELECTRICITY DEVELOPMENT

A Renewable America
Wind Energy Foundation
1501 M Street NW, Suite 900
Washington, DC 20005
202-552-8105
http://arenewableamerica.org/
info@ARenewableAmerica.org

A Renewable America

POWERING UP NEVADA

A REPORT ON THE ECONOMIC BENEFITS OF RENEWABLE ELECTRICITY DEVELOPMENT

JANUARY 2015

EXECUTIVE SUMMARY

Economic growth, energy independence, and new job creation are just a few of the many reasons that a significant majority of Americans consistently support developing renewable electricity.[1] Technological innovations continue to lower costs, and in recent years, several of the renewable electricity sectors have experienced significant growth, attracting billions in new private investment.

Solar, wind, hydroelectric power, biomass, geothermal and waste-to-energy already provide more than 13 percent of U.S. electricity, and renewables are capturing an increasing share of the power grid every year.[2] In 2013, the major renewable electricity technologies provided well over 527 million megawatt hours of electricity to the utility grid – enough to supply the equivalent of over 43 million average American homes.[3] The renewable electricity industries also represent an important source of American jobs, directly employing over half a million people.

This report examines the current and potential economic benefits from developing renewable electricity in Nevada. The Silver State's existing deployment of renewable energy is already delivering significant economic benefits, as the sector attracted $5.5 billion in new investment to bring projects online between 2010 and 2014.[4] The state will receive over $820 million in employment and property benefits from these projects, according to the Nevada Office of Energy.[5]

The state also has considerable untapped renewable electricity potential, and this analysis finds that developing these resources can deliver significant economic gains.

Renewable electricity is **driving economic growth** and creating jobs in communities across Nevada. The state is already home to more than an estimated 21,800 jobs in renewable power industries, energy efficiency and other conservation services.[6]

Renewable electricity offers an **affordable source of power**, as the cost of renewable electricity has declined dramatically in recent years. Renewable power purchase agreements are typically long-term, fixed cost agreements, helping protect ratepayers from price spikes associated with other energy sources. Wind power costs have fallen over 50 percent in the last five years.[7] Solar installation costs have fallen nearly 40 percent since 2010.[8]

A **reliable source of power**, renewable electricity can displace the most expensive, least efficient power sources on the utility grid.

While there are many examples of successful Nevada renewable electricity projects, this report features four case studies that are representative of the current and future potential for the state's renewable power industries. Utility-scale projects including the McGinness Hills geothermal project, the Copper Mountain Solar complex, and the Dixie Valley geothermal facility, as well as projects by large institutions, including Nellis Air Force Base, are featured in greater detail below. The case studies demonstrate that renewable energy is delivering low cost, reliable electricity, and creating jobs, while also saving businesses and other institutions money.

This report also builds on a scenario from the U.S. Department of Energy's (DOE) 2012 *Renewable Electricity Futures* study, which demonstrates that the U.S. is able to reliably and affordably meet 80 percent of its electricity use by 2050.

In a **"High Renewables" scenario**, Nevada has the potential to deploy as much as 3,638 megawatts (MW) of additional installed renewable electricity capacity by 2030 (enough to supply over 77 percent of overall state electricity use). Our report finds that this deployment would:

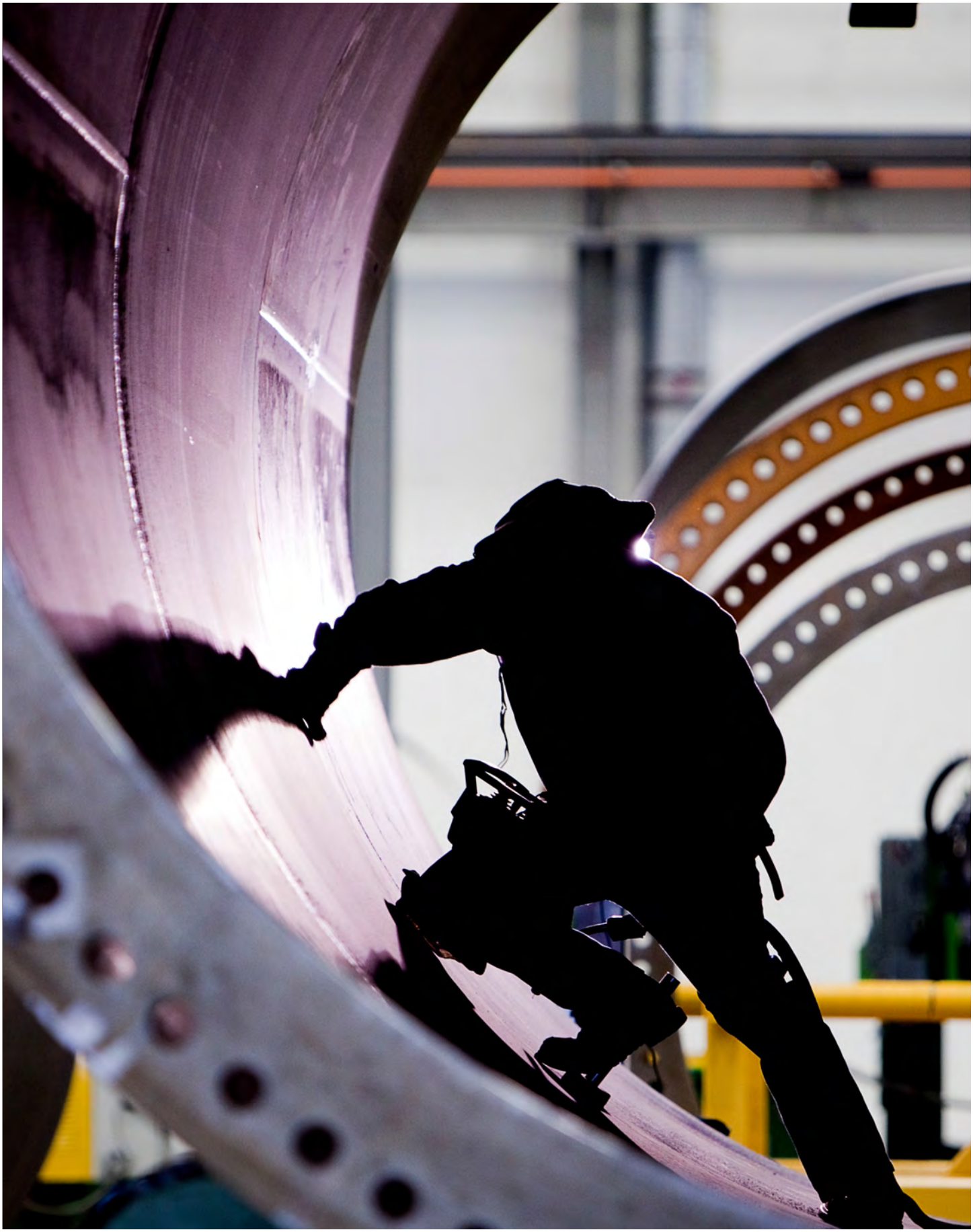
- Create over 92,000 additional local jobs and over $5 billion more in wages and benefits during construction.
- After construction and during its operation, these new renewable energy projects would create nearly 1,100 additional annual jobs and nearly $63 million in annual wages and benefits. The projects would generate $337 million in annual tax revenue and $5 million in annual land leasing revenue.

Even in a **"Low Renewables" scenario**, characterized by low growth in electricity demand and 'Business-As-Usual' with no new policies, about 1,472 MW of additional renewable electricity capacity would be added by 2030. These additions would be driven by Nevada's Renewable Portfolio Standard (RPS) and the increasing competitiveness of renewable energy technologies. Our report finds that this deployment would:

- Create nearly 18,600 additional local jobs and $1.1 billion more in wages and benefits during construction.
- After construction and during operation, these new renewable electricity facilities would create nearly 300 annual jobs and $20 million in annual wages and benefits. The projects would generate $84 million in annual tax revenue and $3 million in annual land leasing revenue.

Finally, in June 2014, the U.S. Environmental Protection Agency (EPA) proposed a rule, known as the Clean Power Plan, to reduce carbon dioxide emissions from existing power plants. The rule aims to cut national emissions 30 percent from 2005 emissions by 2030, with an interim target of 25 percent on average between 2020 and 2029.[9] In developing emission reduction targets for each state, EPA assumed a certain level of renewable energy development, energy efficiency improvement, and increased natural gas use in each state.

EPA's proposed rule calls for Nevada to reduce carbon dioxide emissions by 35 percent by 2030.[10] Based on our "High Renewables" case, Nevada could produce nearly seven times as much renewable energy as projected by EPA.[11] Even in the "Low Renewables" case, Nevada would exceed the EPA assumption of renewable energy development thanks largely to the Nevada RPS. As demonstrated in greater detail below, these results imply that the state should be able to easily meet or exceed its emission reduction target.



NEVADA RENEWABLE ENERGY SUCCESS STORIES

Nevada is home to hundreds of companies that either produce renewable electricity or supply the components to build and maintain new projects. These companies employ thousands of workers and contribute billions to the state's economy.

The Silver State's existing deployment of renewable energy is already delivering significant economic benefits, as the sector attracted $5.5 billion in new investment to bring projects online between 2010 and 2014.[12]

This section features an overview of current renewable electricity generation in Nevada and includes four examples that illustrate the benefits of renewable power development. Utility-scale projects including the McGinness Hills geothermal project, the Copper Mountain Solar complex, and the Dixie Valley geothermal facility, as well as projects by large institutions, including Nellis Air Force Base, are featured in greater detail below.

More than 23 percent of Nevada's electricity generation currently comes from renewable sources:[13]

- 152 MW of Wind Power
- 480 MW of Solar Power
- 517 MW of Geothermal
- 1,052 MW of Hydropower
- 3 MW of Biomass Power

DRIVING ECONOMIC GROWTH

Renewable electricity is helping fuel Nevada's economy.

- The state is home to more than an estimated 21,800 jobs in renewable power industries, energy efficiency and other conservation services.[14]
- There are more than 160 in-state solar companies and suppliers, employing 3,100 people.[15]
- Nevada's investment of $500 million in renewable energy tax abatements has attracted $5.5 billion of capital investment in renewable electricity projects – a 10 to 1 return on investment.[16]
- At least $44 million has been generated from Bureau of Land Management geothermal leasing activities between 2005 and 2009, with $33 million distributed to the State of Nevada and specific counties.[17]

AFFORDABLE SOURCE OF POWER

The cost of renewable electricity has declined dramatically in recent years. Renewable power purchase agreements are typically long-term, fixed cost agreements, helping to protect ratepayers from price spikes associated with other energy sources. In many cases, renewable electricity is now cost competitive with traditional electricity sources. For example:

- Wind power costs have fallen over 50 percent in the last five years[18]
- Solar installation costs have fallen nearly 40 percent since 2010[19]

RELIABLE SOURCE OF POWER

Renewable electricity can displace the most expensive, least efficient power sources on the utility grid.

- The U.S. Geological Survey estimates that there is on average 1,300 MW of identified and 4,300 MW of unidentified geothermal resources in Nevada that could provide reliable renewable electricity in the state.[20]

> "Geothermal resources like those found at the McGinness Hills plant provide everything that the grid wants: affordability, grid stability, and dispatchability. It's consistent and renewable. In Nevada, geothermal is a very cost competitive resource compared to conventional fuels such as coal or natural gas. The McGinness Hills geothermal facility has been a huge boost to the local economy. We estimate that Ormat's investment in the local and regional economy is around $5 million a year."
>
> ***JOSH NORDQUIST***
> *DIRECTOR, ORMAT TECHNOLOGIES*

MCGINNESS HILLS GEOTHERMAL PROJECT INVESTS IN LOCAL ECONOMY

EXECUTIVE SUMMARY:

Ormat Technologies completed Phase I of the McGinness Hills geothermal project near Austin, Nevada in Lander County in 2012 and plans to finalize construction on Phase II in 2015. Once complete, this 68 megawatt (MW) facility will provide an estimated $5 million a year to the local economy through direct and indirect spending, as well as taxes and investments.

BACKGROUND AND CONTEXT

Developed by Ormat Technologies, a global leader in geothermal development, Phase I construction of the McGinness Hills geothermal facility was completed in 2012. In 2013, Ormat announced plans to expand the facility by 30 megawatts (MW), to bring its total generation capacity to 68 MW of clean, reliable energy production when construction is complete in early 2015.

McGinness Hills is a binary cycle power plant that pumps geothermal brine, heated to 330 degrees Farhenheight from the core of the earth, from 3,500 feet below the surface. The Ormat power plant produces consistent and reliable electrcity that is sold to NV Energy through a long-term, fixed rate power purchase agreement (PPA). After the brine has cycled through the power plant it is all reinjected into the basin. This ensures that the geothermal resource is truly renewable. In a water scarce region like Nevada, this makes geothermal an especially appealing renewable energy technology.

Geothermal power generation continues to meet a majority of Nevada's Renewable Portfolio Standard, which requires state utilites to generate 25 percent of their electricity from renewable sources by 2025.

INCREASING LOCAL REVENUE

The facility will require $60 million in total investment, and will generate an additional $5 million a year for the local economy.

JOB CREATION

The development of this facility has created 500 construction jobs.

The McGinness Hills geothermal facility will provide an estimated $5 million a year to the local economy. Photo courtesy of Ormat Technologies, Inc.

MAKING THE INVESTMENT

Geothermal is a site specific renewable energy resource. After a geothermal resource is located and appropriate permitting and planning is completed, the plant can be up and running in under 18 months. Phase I of the McGinness Hills geothermal facility received favorable financing terms through the Department of Energy's loan guarantee program. The strength of the geothermal resource allowed the plant to consistently produce more energy than what was contracted in the original PPA. The 30 MW expansion will allow the site to take advantage of the additional resource potential starting in 2015.

The total local economic impact by Ormat Technologies is estimated at $60 million. In a rural community like Austin, Nevada with a population of around 250, this means that the McGinness Hills facility has a huge positive economic impact on the local community. The project has created over 500 local construction jobs in the area and upon completion, will invest $5 million a year to the local economy in direct and indirect spending.

TECHNOLOGY SPOTLIGHT: GEOTHERMAL POWER IN NEVADA

Nevada has an estimated 1,500 MW in geothermal power capacity, totaling $22.5 billion in local economic impact. The geothermal employment potential in Nevada is approximately 6,375 in direct, indirect and induced jobs.[21] Geothermal offers Nevada a competitive resource for improving grid reliability and providing affordable, reliable and long-term power.

COPPER MOUNTAIN SOLAR SHINES AS A BRIGHT INVESTMENT

> "The Copper Mountain Solar complex represents what the right technology at the right place can achieve. Panel prices have been coming down significantly while the efficiency of the panels has been increasing. Each expansion of Copper Mountain Solar has benefited from what we learned from the previous project. The cost per kilowatt hour for solar is on track to be cost competitive with natural gas in the very near future."
>
> ***LISA BRIGGS***
> *GOVERNMENT AFFAIRS MANAGER, SEMPRA U.S. GAS & POWER*

EXECUTIVE SUMMARY:

Copper Mountain Solar is one of the nation's largest photovoltaic solar installations. The project has expanded to four phases since 2010, taking advantage of the declining costs of solar power technology. The Copper Mountain Solar complex accounts for 150 megawatts (MW) of operational solar generating capacity, with an additional 300 MW under construction. By the end of 2015, the projects will have collectively created more than 1,300 construction jobs with an additional 350 local construction jobs expected when the 94 MW Copper Mountain Solar 4 breaks ground in 2015.

BACKGROUND AND CONTEXT

In 1936, Boulder City, Nevada completed construction on the largest renewable electricity project in the country – the Hoover Dam. Today, the community boasts an equally impressive addition to its renewable legacy – it is now home to one of the largest photovoltaic solar installations in the country. The Copper Mountain Solar complex accounts for 150 MW of operational solar generating capacity, enough to power more than 45,000 homes. By the end of 2015, the projects are expected to collectively power more than 140,000 homes, and will be responsible for the creation of more than 1,300 construction jobs and over $200 million in local tax revenue.

MAKING THE INVESTMENT

The development of the Copper Mountain Solar complex has created hundreds of local jobs, increased capital investment and local tax revenue, and helped secure long-term power at a fixed rate for customers across the region.

- **Copper Mountain 1**: Completed in 2010, the project uses nearly one million solar PV panels spread across more than 450 acres to generate 58 MW of renewable electricity, enough to power 17,000 homes. The installation created 350 local construction jobs and is expected to generate $135 million in new revenue for local, state and federal governments over the life of the project. In 2011, the solar plant was named "Solar Project of the Year" by Renewable Energy World.
- **Copper Mountain 2**: The 92 MW first phase was completed in 2012, with a 58 MW second

phase scheduled for completion in 2015. When both phases are complete, the project will have created about 650 construction jobs and five full-time positions, and generate enough renewable electricity to power about 45,000 homes.

- **Copper Mountain 3**: Construction on the 250 MW solar array will be complete in 2015. The project is anticipated to create 500 construction jobs and three full-time positions. When complete, the solar plant will generate enough electricity to power 80,000 homes. The project will result in $75 million in combined property taxes, school support taxes and employee payroll.[22]
- **Copper Mountain 4**: Construction on the 94 MW expansion project will begin in 2015, creating 350 local construction jobs, with completion expected by 2016. The project will produce enough electricity to power about 41,000 homes.

TECHNOLOGY SPOTLIGHT: SOLAR IN NEVADA

According to the Solar Energy Industries Association, there are currently more than 161 solar companies at work throughout the value chain in Nevada, employing 3,100 people. The 656 MW of solar energy currently installed in the state ranks it 6th in the country in installed solar capacity. The average installed price of solar in Nevada has fallen by 24 percent between 2012 and 2013, enabling solar to compete as an affordable source of power.[23]

NEW JOBS AND TAX REVENUE

By the end of 2015, the Copper Mountain Solar complex will have created more than 1,300 construction jobs and generated over $200 million in local tax revenue.

POWERING NEVADA

When complete, the project will provide 450 MW of solar generating capacity, enough to power 140,000 average homes.

The Copper Mountain Solar complex accounts for 150 MW of operational solar generating capacity, with an additional 300 MW under construction. Photo courtesy of Sempra U.S. Gas & Power.

SOLAR DELIVERING SECURE POWER AND MISSION READINESS AT NELLIS AIR FORCE BASE

> "The Air Force is very interested in renewable energy - we have an ambitious target of 25 percent renewable energy by 2025. Our bases need to ensure energy reliability, resiliency, and supply continuity. We see solar and other renewable power sources as a way to enhance our security and deliver mission readiness. Every renewable energy project we consider must be cost competitive. Renewable electricity offers a great way to improve reliability, save tax-payer dollars, and enhance security."
>
> ***DAVID BEK***
> *DIRECTOR OF THE ENERGY DIRECTORATE, AIR FORCE FACILITY ENERGY CENTER*

EXECUTIVE SUMMARY:

Nellis Air Force Base is on track to generate 42 percent of its total electricity needs from solar power. Located just outside of Las Vegas, the base already saves more than $1 million a year in operating expenses, as the result of a 14-megawatt (MW) solar PV array completed in 2007. Based on this success, Nellis Air Force Base announced a 19 MW solar array expansion to be completed by mid-2015. The Air Force has set a goal to increase facility consumption of renewable energy to 25 percent of total electricity use by 2025. Renewable electricity deployment enables the Air Force to achieve a reliable, secure, and affordable supply of power.

BACKGROUND AND CONTEXT

In 2007, Nellis Air Force Base (AFB) partnered with SunPower Corporation to install a 14 MW solar power array to provide 25 percent of all power on base. The solar array saves Nellis AFB $1 million a year in operating expenses. At the time, it was the largest solar photovoltaic system in the United States. The primary driver for a project of this scale is to enhance energy supply continuity and deliver mission readiness with reliable power.

COST SAVINGS

The 14 MW solar array currently saves Nellis Air Force Base $1 million a year in operating expenses.

RELIABLE POWER

Starting in 2015, the base is expected to meet 42 percent of its electricity from on-site solar power.

Nellis Air Force Base is expanding its current 14 MW solar array by adding 19 more MW of power. Photo courtesy of U.S. Air Force.

MAKING THE INVESTMENT

In partnership with SunPower Corporation and NV Energy, the Nellis AFB solar array uses innovative solar tracking panels that maximize solar electrical generation by following the path of the sun. Phase I is spread over 140 acres and totals more than 5,800 solar trackers with 72,000 panels. The project created an approximately 200 construction jobs during the 26 week construction.[24]

In June 2014, the Air Force announced Phase II of the Nellis Solar array project. Sun Power will construct the 19 MW facility and NV Energy will own and operate the project, selling the power to Nellis AFB through a long-term, fixed-rate power purchase agreement. Phase II is expected to represent an investment of up to $54.5 million by NV Energy.[25] In addition to the solar PV system, NV Energy will build a secondary substation and improved transmissions lines on the base, as an in-kind consideration to the government for the lease.[26] By providing a redundant primary electric feed to the base, this project will enhance energy security and mission assurance at Nellis AFB.

Construction of the expansion is underway and the project will be complete in mid 2015. This expansion will allow Nellis AFB to meet 42 percent of its electricity demand from solar power. By partnering with the private sector and the local utility, Nellis AFB is able secure long-term, reliable, and affordable power with on-site renewable energy generation.

DIXIE VALLEY GEOTHERMAL FACILITY PROVIDES CLEAN AND RELIABLE POWER AROUND THE CLOCK

> "Nevada is fortunate to be home to some of the nation's best geothermal resources and has a long successful history of proven technology deployment. Since the commissioning of the Dixie Valley facility in 1998, it has and will continue to supply steady and reliable renewable electricity to the grid while being a good neighbor and providing economic support to the local community."
>
> ***JOE GRECO***
> *SENIOR VICE PRESIDENT, TERRA-GEN POWER*

EXECUTIVE SUMMARY:

The 67 megawatt (MW) geothermal facility near the city of Fallon in central Nevada has generated clean and reliable power since 1988. Owned and operated by Terra-Gen Power, Dixie Valley underwent a 5.2 MW expansion in 2012 making Dixie Valley the largest geothermal plant in the state. Dixie Valley employs 14 full-time workers. The facility has an average availability factor of 98 percent, offering a reliable and steady renewable electricity resource.

BACKGROUND AND CONTEXT

When the Dixie Valley facility came online in July of 1988 it earned the title of the largest individual geothermal facility in the United States. Terra-Gen Power, a national renewable energy developer, owns and operates the facility. It is located near Fallon, Nevada in the center of the state in an unpopulated area. The facility consisits of 19 wells between 6,000 to 12,000 feet deep.

A water-based brine solution is circulated and heated by the 480-degree Fahrenheit geothermal resource. The brine is transformed into steam which spins a turbine and generates electricity. A majority of the brine is then reinjected into eleven injection wells and recirculated and reheated through the geothermal system below ground, ensuring a constant reliable renewable electricity resource. Prior to reinjection some of the brine is diverted to the recently installed binary bottoming cycle which extracts additional heat to generate even more renewable electricity. This is especially important in a water scare region such as Nevada.

The 67 megawatts (MW) of generated electricity is sold through a long-term power purchase agreement to Southern California Edison and transported over a 220-mile 230 kilovolt transmission line that was specifically built for the Dixie Valley geothermal facility.

MAKING THE INVESTMENT

In 2011, Terra-Gen Power received $2 million in funding from the U.S. Department of Energy's Geothermal Technologies Program to increase the generating capacity of Dixie Valley by 5.2 MW. Terra-Gen Power invested $12 million of its own funds into the expansion project. The project attempts to prove the technical and economic feasibility of power generation expansion at the existing Dixie Valley Power Plant by utilizing the wastewater from the present power generation in a binary plant. The addition of the 5.2 MW binary system improves the energy efficiency of the geothermal resource by taking advantage of cooler brine. The brine is passed through a heat exchanger where it is turned into steam and directed through turbines.

The facility currently employs 14 full-time workers in positions ranging from geological engineers to well-head technicians, along with staff in accounting, asset management, engineering, and purchasing.

Dixie Valley has been able to maintain an incredibly high availability factor of more than 98 percent, ensuring that Dixie Valley is able to provide 24/7, base-load power requirements.

RELIABLE POWER

The Dixie Valley facility has an average availability factor of 98 percent, offering a reliable and steady renewable electricity resource.

NEW INVESTMENT

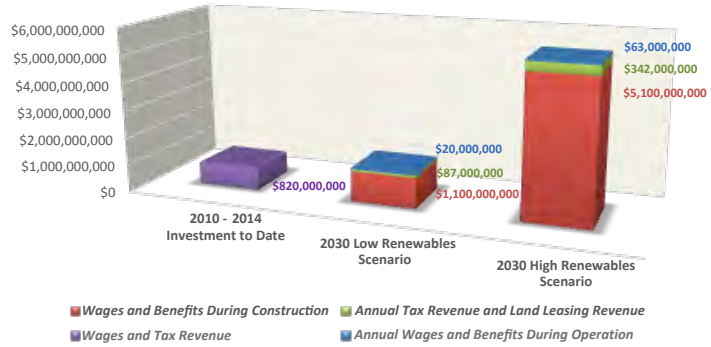
The recent expansion at the facility required $12 million in new investment, making it the largest geothermal plant in the state.

At 67 MW, the Dixie Valley geothermal facility is the largest individual geothermal plant in Nevada. Photo courtesy of Terra-Gen power.

NEVADA'S RENEWABLE FUTURE

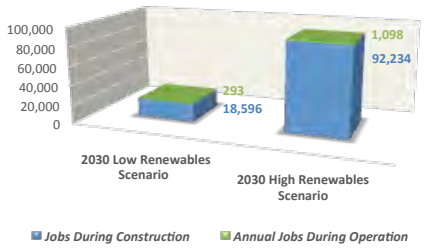
Our key findings are listed in the summary tables below (see Methodology section for data sources and methods used).

Current Investment and Potential Future Opportunities for Renewable Electricity in Nevada



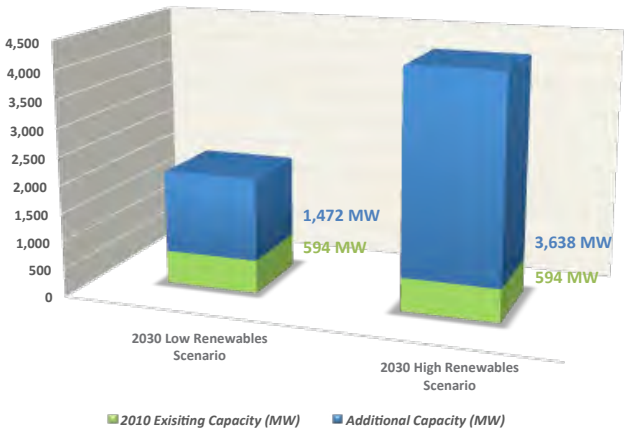
In a "High Renewables" scenario, Nevada has the potential to attract over $5 billion more in wages and benefits during construction in addition to annual land leasing and tax revenue.

Jobs During Construction and Operation



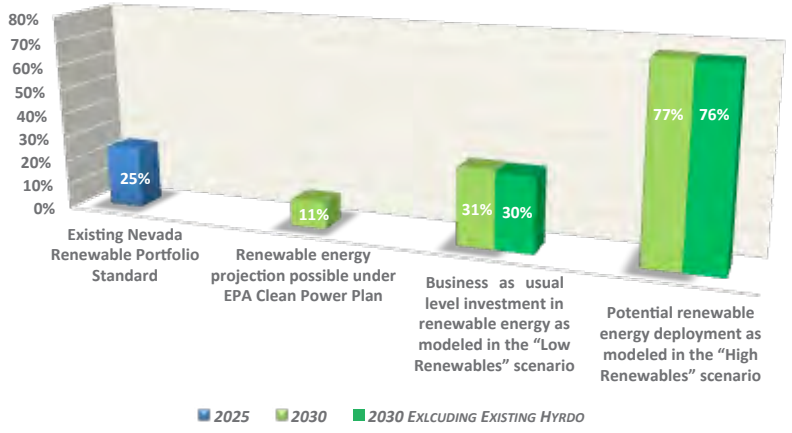
In a "High Renewables" scenario, Nevada has the potential to create over 92,000 additional local jobs during construction and over 1,000 additional annual jobs committed to operations and maintenance.

Additional Installed Capacity (MW)



In a "High Renewables" scenario, Nevada has the potential to supply 77 percent of overall state electricity use from renewable electricity.

Potential Renewable Electricity Capacity



In our "High Renewables" case, renewable energy development (excluding existing hydroelectric power) would produce nearly seven times as much renewable energy as EPA projected.

NEVADA'S RENEWABLE ELECTRICITY DEVELOPMENT POTENTIAL FAR EXCEEDS THE PROPOSED CLEAN POWER PLAN

The EPA Clean Power Plan calls for Nevada to reduce carbon dioxide emissions by 35 percent by 2030.[27] EPA based Nevada's target on cuts through the following measures:

- A 1.8 percent reduction through increased efficiency of coal plants
- A 17.3 percent reduction through increased use of low-emitting natural gas combined cycle plants where excess capacity is available
- An 8 percent reduction through the use of more zero-emitting power sources such as renewable energy and nuclear power, and
- A 7.4 percent reduction through energy efficiency improvements to reduce electricity demand.[28]

Nevada has a great deal of flexibility in developing its compliance plan, and may choose these or other carbon reduction strategies. A state could select a different balance among the approaches than EPA used to set the proposed emission reduction target.

Analysis from the Union of Concerned Scientists (UCS) demonstrates that even under a conservative growth scenario, states can achieve twice the renewable energy proposed by the EPA. According to UCS analysis, the Clean Power Plan does not sufficiently consider existing renewable energy deployment rates or the falling costs of renewable energy.[29]

Another recent analysis based on modeling by ICF International, a business management consulting firm, concludes that the EPA utilized outdated renewable energy cost considerations, including "levelized costs for both wind and solar energy that are 46 percent above current average costs".[30] The recent price drops in renewable energy will likely make the proposed rule less expensive to meet, and provide even greater opportunity for renewable energy development.

Our analysis shows that Nevada could meet the entire EPA emissions reduction target through the increased use of renewable energy.

Indeed, Nevada also has the potential for significant renewable electricity development far beyond what is likely under the proposed standards. Developing those resources would attract substantial investment to the state and create thousands of new jobs.

Renewable energy projection possible under EPA Clean Power Plan[31]	**11% by 2030**
Existing Nevada Renewable Portfolio Standard	**25% by 2025**
Business-as-usual level investment in renewable energy (excluding existing hydroelectric power) as modeled in the "Low Renewables" scenario	**30% by 2030**
Business-as-usual level investment in renewable energy as modeled in the "Low Renewables" scenario	**31% by 2030**
Potential renewable energy deployment (excluding existing hydroelectric power) as modeled in the "High Renewables" scenario	**76% by 2030**
Potential renewable energy deployment as modeled in the "High Renewables" scenario	**77% by 2030**

In the proposed Clean Power Plan, the EPA proposed a 2030 target emissions rate for each state. This target is based on EPA estimates of how each state could leverage a mix of measures, including adding new renewable electricity generation. States are not required to achieve EPA's renewable projections in order to comply with the proposed Clean Power Plan, or they may exceed them if cost-effective for the state. For Nevada, EPA projects 11 percent renewable energy generation under the proposed rule by 2030. The "High Renewables" scenario modeled here and in the NREL *Renewable Electricity Futures* study would exceed the EPA proposed target seven-times over.[32]

Nevada already meets the EPA proposed target and is on track to significantly exceed it before 2030, due to a robust state Renewable Portfolio Standard of 25 percent by 2025.

RESEARCH METHODOLOGY

PURPOSE OF STUDY

David Gardiner and Associates (DGA) conducted this study for the Wind Energy Foundation and the A Renewable America campaign to assess the overall opportunity for renewable energy-based economic development in Nevada.

METHODOLOGY

DGA modeled the economic effects of a renewable electricity future in 2030 for Nevada based on two trajectories from the 2012 National Renewable Energy Laboratory (NREL) Renewable Electricity Futures (REF) study, the most comprehensive analysis of high-penetration renewable electricity in the United States to date.[33] That study involved a collaboration of more than 100 experts from 35 institutions representing national energy labs, academia, utilities, grid operators, industry, financial institutions, environmental groups and renewable energy businesses. It found that the United States could reliably meet at least 80 percent of its electricity needs from renewable energy resources by 2050, at a cost comparable with other scenarios for reducing harmful carbon dioxide (CO_2) and other power plant pollutants.

DGA features a "Low Renewables" and a "High Renewables" scenario based on updated 2014 results of the NREL Regional Energy Deployment System (ReEDS) model, completed by authors of the original REF study.[34]

- The "Low Renewables" scenario in this study is based on the "Low Demand Baseline" in the REF study. It assumes that electricity demand grows very slowly, and that no new renewable energy policies are enacted. Existing federal policies are assumed to expire as scheduled.
- The "High Renewables" scenario in this study is based on the REF "Core 80% RE scenario '80% RE-ITI'". It assumes that policies are enacted to achieve 49 percent of total contiguous U.S. electricity generation from renewable sources in 2030 and 80 percent in 2050, without specifying which of many policies could enable achieving that goal. It also assumes low electricity demand growth, and only incremental technology improvement (ITI) that reflects partial achievement of the future technical advancements that may be possible for each technology.

DGA did not utilize the scenario from REF that assumed a higher rate of "Evolutionary Technology Improvement", or scenarios that assumed "No Technology Improvement" or that assumed various potential constraints on renewable energy development, such as inadequate available renewable resources, inadequate transmission, or inadequate flexibility technologies, such as energy storage, needed to balance electricity demand with supply.[35] DGA also did not utilize REF scenarios with high energy demand, which would have produced higher levels of renewable energy development.

ReEDS calculates the mix of renewable energy and other technologies in each state that could meet the national renewable energy goals at the lowest total system cost.

DGA then calculated the economic development impacts of the five major renewable electricity technologies (biomass, geothermal, hydroelectric power, solar, and wind) using the NREL Jobs and Economic Development Impact (JEDI) model, with its generic default cost assumptions. JEDI was initially designed to estimate economic impacts of renewable energy to state economies, and later refined to focus on specific renewable energy projects. It includes both direct employment in the projects and their supply chains, and indirect and induced employment including wages and benefits spent in the state or local region.

The JEDI model is not a macroeconomic model, and does not calculate any offsetting reduction in employment in other parts of the economy, such as extracting fossil fuels. Many previous studies have found, however, that renewable energy technologies yield more employment per dollar or per megawatt than fossil fuel technologies, and thus lead to net increases in employment.[36]

DGA has also not calculated the economic benefits of other investments needed to enable the "High Renewables" scenario, such as upgrades to transmission and distribution systems, or the development of energy storage or other flexibility resources. ReEDS calculates that the "High Renewables" scenario would also be accompanied by 2,165 MW of electricity storage technologies by 2030.

While distributed generation solar photovoltaics are exogenous to the ReEDS model, which focuses primarily on utility-scale solar opportunities, the REF study utilized a separate model to represent rooftop solar PV deployment.

The REF study and JEDI model do not include specific estimates for waste-to-energy technology. We include an estimate of the technical potential for waste-to-energy expansion in the key findings section of the report, based on a recent study from Columbia University.[37] The growth assumptions for waste-to-energy in this report are based on the percent of municipal solid waste (MSW) used at waste-to-energy facilities in Europe (which process 25 percent of MSW using waste-to-energy facilities, as opposed to 7.6 percent in the United States). Unlike the ReEDS modeling for other technologies, that estimate is not based on any assessment of the economic competitiveness of waste-to-energy relative to other electricity generation technologies. Other studies, such as the U.S. Energy Information Administration Annual Energy Outlook, have found that significant expansion of waste to energy is unlikely under business-as-usual or with modest renewable energy or greenhouse gas reduction policies. Expanded use of waste-to-energy is possible under policies favorable to that technology, however.

APPENDIX

Total Renewable Electricity (Biomass, Geothermal, Hydroelectric, Solar, and Wind)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	3,638 MW	1,472 MW
Local Jobs During Construction	92,234	18,596
Wages and Benefits During Construction	$5.1 billion	$1.1 billion
Annual Jobs During Operation	1,098	293
Annual Wages and Benefits During Operation	$63 million	$20 million
Annual Tax Revenue	$337 million	$84 million
Annual Land Leasing Revenue	$5 million	$3 million
Solar (154 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario*
Additional Installed Capacity	1,782 MW	424 MW
Local Jobs During Construction	84,111	13,952
Wages and Benefits During Construction	$4.6 billion	$779 million
Annual Jobs During Operation	800	116
Annual Wages and Benefits During Operation	$43 million	$7 million
Annual Tax Revenue	$323 million	$76 million
Wind (0 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	1,720 MW	969 MW
Local Jobs During Construction	6,230	3,510
Wages and Benefits During Construction	$390 million	$220 million
Annual Jobs During Operation	251	141
Annual Wages and Benefits During Operation	$15 million	$8.5 million
Annual Tax Revenue	$14 million	$8 million
Annual Land Leasing Revenue	$5 million	$3 million
Geothermal Power (410 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	103 MW	64 MW
Local Jobs During Construction	1,680	1,050
Wages and Benefits During Construction	$96 million	$60 million
Annual Jobs During Operation	20	16
Annual Wages and Benefits During Operation	$4 million	$3.4 million
Biomass (14 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	14 MW	14 MW
Local Jobs During Construction	62	62
Wages and Benefits During Construction	$5.3 million	$5.3 million
Annual Jobs During Operation	18	18
Annual Wages and Benefits During Operation	$1.1 million	$1.1 million
Hydroelectric Power (17 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	18 MW	1 MW
Local Jobs During Construction	152	25
Wages and Benefits During Construction	$11 million	$2 million
Annual Jobs During Operation	8	3
Annual Wages and Benefits During Operation	$0.5 million	$0.1 million

***NREL assumed no growth for distributed generation solar PV in the Low Renewables scenario.**

Separately, this report also reviewed the technical potential for waste-to-energy in Nevada.

Waste-to-Energy (0 MW in 2014)	2030 Additional Capacity Potential
	69 MW

ACKNOWLEDGEMENTS

LEAD AUTHORS:

David Gardiner and Associates – David Gardiner, Michael Grubert, Ryan Hodum, and Stefan Koester

LEAD CONTRIBUTORS:

David Gardiner and Associates – Alan Nogee

Wind Energy Foundation – John Kostyack, Robin Pressman, Todd Keller, and Kevin O'Rourke

PHOTO ATTRIBUTIONS:

Page 4: Black Rock Solar photovoltaic array at Pyramid Lake High School on Flickr
License: https://creativecommons.org/licenses/by/2.0/legalcode

REPORT DESIGN:

Cater Communications, Inc. – Sarah Golden and Cristen Farley

ABOUT THE ORGANIZATIONS

A RENEWABLE AMERICA

A project of the Wind Energy Foundation, a 501c3 nonprofit organization, *A Renewable America* provides education about the many benefits of American-made renewable electricity. A Renewable America raises public awareness of how each of the six major U.S. renewable electric technologies – biomass, geothermal, hydro, solar, waste-to-energy, and wind power – are already providing a substantial amount of clean, affordable, and reliable electricity.

For more information, visit www.arenewableamerica.org.

WIND ENERGY FOUNDATION

The Wind Energy Foundation is a 501c3 nonprofit organization dedicated to raising public awareness of wind as a clean, domestic energy source through communication, research, and education. The Foundation is also committed to supporting ongoing research that furthers the continued growth of wind energy.

For more information, visit www.windenergyfoundation.org.

DAVID GARDINER AND ASSOCIATES

David Gardiner and Associates is a strategic advisor to organizations seeking a sustainable future. We are focused on climate change, clean energy, and sustainability. Our clients are non-profits, corporations, and trade associations. Our non-profit clients include advocacy organizations and foundations, while our corporate clients include clean energy companies and companies committed to sustainability. We help our clients develop their strategies, conduct research and analysis, and improve their communications through our writing expertise, partnership building, and advocacy. Our team integrates decades of practical experience across business sectors with diverse subject expertise resulting in highly-tailored products or deliverables meeting the specific needs of each client.

For more information, visit www.dgardiner.com.

ENDNOTES

1 Gallup, *Americans Look to Conservation and Renewable Energy for Solutions*, April 2, 2014, http://www.gallup.com/poll/168176/americans-favor-energy-conservation-production.aspx.

2 U.S. Energy Information Agency, *What is U.S. Electricity Generation by Source?* http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3; see also, U.S. Federal Energy Regulatory Commission, *Office of Energy Projects Energy Infrastructure Update for September 2014,* https://www.ferc.gov/legal/staff-reports/2014/sep-infrastructure.pdf (New renewable projects represent 41 percent of generation capacity added in 2014).

3 U.S. Energy Information Agency, *Frequently Asked Questions: What is U.S. Electricity generation by source?* June 13, 2014, http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3 (noting that in 2013, the United States generated about 4,058 billion kilowatthours of electricity, 13 percent of which was from renewables); see also U.S. Environmental Protection Agency, *Clean Energy: Calculations and References,* September 9, 2014, http://www.epa.gov/cleanenergy/energy-resources/refs.html (noting that, "on average, each home consumed 12,069 kWh of delivered electricity (EIA 2013a).").

4 Clean Energy Project, *Renewable Energy Powers Silver State as a Clean Energy Industry Hub*, March 2014, http://cleanenergyprojectnv.org/projects/nv-clean-energy-hub

5 Nevada Governor's Energy Office, Renewable Energy Tax Abatement Projects, http://energy.nv.gov/Programs/Renewable_Energy_Tax_Abatement_Projects/

6 Bureau of Labor and Statistics, *Green Goods & Services*, 2010, http://www.bls.gov/ggs/home.htm

7 U.S. Department of Energy, 2013 Wind Technologies Market Report

8 Solar Energy Industries Association (SEIA) *State Solar Policy: Nevada*, 2014 http://www.seia.org/state-solar-policy/nevada

9 U.S. EPA, *Clean Power Plan Overview,* June 13, 2014, http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan-overview (To account for regional differences in power generation and electricity consumption, EPA proposed different emission reduction targets for each state).

10 U.S. EPA, *Clean Power Plan Toolbox for States,* November 24, 2014, http://www2.epa.gov/cleanpowerplantoolbox (This level may change in the final rule).

11 In crafting its proposed rule, EPA elected not to allow states to count existing hydroelectric power toward their emission reduction targets in their state implementation plans. Thus, in applying the "High Renewables" scenario to determine how much renewable energy is likely to be available in any state to comply with EPA's proposed rule, it is necessary to remove NREL's data on existing hydropower. Whereas the full set of NREL data show that Nevada can supply 77 percent of its electric power needs in 2030 from renewable sources, we apply a subset of these data (all data except existing hydropower) to conclude that EPA would allow 76 percent of Nevada's potential renewable energy to count toward Clean Air Act section 111d compliance. This would be nearly seven times the amount of renewable energy that EPA estimates will be needed to comply with its proposed rule.

12 Clean Energy Project, supra note 4.

13 Energy Information Administration, *State Renewable Electricity Profiles*, 2012, http://www.eia.gov/renewable/state/pdf/srp2010.pdf; American Council on Renewable Energy (ACORE), *Renewable Energy in Nevada*, 2013 http://www.acore.org/files/pdfs/states/Nevada.pdf; American Wind Energy Association (AWEA) *State Wind Energy Statistics: Nevada*, 2014 http://awea.files.cms-plus.com/FileDownloads/pdfs/Nevada.pdf; SEIA supra note 8.

14 Bureau of Labor and Statistics, supra note 6.

15 SEIA, supra note 8.

16 Clean Energy Project, supra note 4.

17 Geothermal Resources Council (GRC), "Geothermal Energy in Nevada", March 2014, http://geothermalresourcescouncil.blogspot.com/2014/03/usa-nevada_20.html

18 U.S. DOE, *2013 Wind Technologies Market Report,* 2014.

19 SEIA, supra note 8.

20 GRC, supra note 17.

21 Geothermal Energy Association (GEA), *Geothermal Basics – Employment,* 2014, http://geo-energy.org/geo_basics_employement.aspx

22 Nevada Governor's Office of Energy, "GOE Approves Tax Incentive for Copper Mountain Solar 3", February 4, 2014, http://energy.nv.gov/Media/Press_Releases/2014/Copper_Mountain_Solar_3/

23 SEIA, supra note 8.

24 Nellis Air Force Base, "Nellis Air Force Base Solar System", http://www.nellis.af.mil/shared/media/document/AFD-080117-043.pdf

25 Eli Segall, "Company Announces Plan for 2nd Solar Plant at Nellis AFB", *Vegas Inc.* June 4, 2014, http://www.vegasinc.com/news/2014/jun/04/company-announces-plan-2nd-solar-plant-nellis-afb/

26 U.S. Air Force, "Nellis AFB to Add Second Large Solar Plant", July 15, 2014, http://www.af.mil/News/ArticleDisplay/tabid/223/Article/486227/nellis-afb-to-add-second-large-solar-plant.aspx

27 U.S. EPA, supra note 8.

28 Center for Climate and Energy Solutions, *Proposed State Emission Rate Targets,* http://www.c2es.org/federal/executive/epa/carbon-pollution-standards-map.

29 Union of Concerned Scientists, *Strengthening the EPA's Clean Power Plan*, October 2014, http://www.ucsusa.org/sites/default/files/attach/2014/10/Strengthening-the-EPA-Clean-Power-Plan.pdf

30 Natural Resources Defense Council, *The EPA's Clean Power Plan Could Save Up to $9 Billion in 2030*, November 2014, http://www.nrdc.org/air/pollution-standards/files/clean-power-plan-energy-savings-IB.pdf

31 Center for Climate and Energy Solutions, *Renewable Generation in the Clean Power Plan*, http://www.c2es.org/federal/executive/epa/carbon-pollution-standards-renewable-energy-map.

32 See supra note 11 and accompanying text.

33 National Renewable Energy Labs, *Renewable Electricity Futures,* http://www.nrel.gov/analysis/re_futures/.

34 Trieu Mai, David Mulcahy, M. Maureen Hand, Samuel F. Baldwin, "Envisioning a Renewable Electricity Future for the United States", *Energy*, Volume 65, February 1, 2014, Pages 374-386, http://www.sciencedirect.com/science/article/pii/S0360544213009912.

35 REF found that none of these constraints examined precluded achieving 80 percent renewable energy by 2050, but that adding constraints or assuming no technology improvement increased the cost of achieving the goal.

36 Max Wei, et al., *Putting Renewables and Energy Efficiency To Work: How Many Jobs Can The Clean Energy Industry Generate in the U.S ?,* August 13, 2009, http://rael.berkeley.edu/sites/default/files/green_jobs_paper_Oct1809_0.pdf.

37 Nickolas J. Themelis and Charles Mussche, *2014 Energy and Economic Value of Municipal Solid Waste, Including Non-Recycled Plastics, Currently Landfilled in the Fifty* States, July 9, 2014, http://www.americanchemistry.com/Policy/Energy/Energy-Recovery/2014-Update-of-Potential-for-Energy-Recovery-from-Municipal-Solid-Waste-and-Non-Recycled-Plastics.pdf.

A Renewable America